

National Climate Change Health Adaptation Strategy and Action Plan of Jordan

Ministry of Health

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List of Abbreviations

BF	Breast Feeding
BFHI	Baby Friendly Hospital Initiative
BMI	Body Mass Index
CDD	Civil Defence Directorate
CEHA	Regional Centre for Environmental Health Activities, WHO
DCD	Directorate of Communicable Diseases
DDCP	Diarrheal Disease Control Program
DES	Dietary Energy Supply
DHS	Demographic and Health Survey
DNCD	Directorate of Non-Communicable Diseases
DOS	Department of Statistics, Amman, Jordan
EHD	Environmental Health Directorate
FAO	Food and Agriculture Organization
FBD	Food borne Disease
FDA	Food and Drug Administration
GAM	Greater Amman Municipality
GCMs	General Circulation Models
GNP	Gross National Product
GSHS	Global School-based Student Health Survey
HD	Health Directorates in the governorates
HIES	Household Income and Expenditure Survey
ICD	International Classification of Diseases
IDD	Iodine Deficiency Disorder
IDDNC	Iodine Deficiency Disorder-National Committee
IMR	Infant Mortality Rate
IR	Incidence Rate
JAFS	Jordan Annual Fertility Survey
JISM	Jordan Institute for Standards and Metrology
JPFHS	Jordan Population and Family Health Survey
JFDA	Jordan Food and Drug Administration
JUH	Jordan University Hospital
MCH	Mother and Child Health Centres
MD	Meteorological Department
MIT	Ministry of Industry and Trade
MND	Micronutrient Deficiency

MOA	Ministry of Agriculture
MOL	Ministry of Labor
MEMR	Ministry of Energy and Mineral Resources
MoEnv	Ministry of Environment
MoEdu	Ministry of Education
MOH	Ministry of Health
MWI	Ministry of Water and Irrigation
Mt	Metric Tons
NCHS	National Centre for Health Statistics
NCDD	Non-Communicable Diseases Directorate
NCIDD	National Committee on Iodine Deficiency Disorders
NPITS	National Programme for the Iodization of Table Salt
NSCP	National Society for Consumer Protection
NSI	National Salt Iodization
OHD	Occupational Health Directorate
PEM	Protein Energy Malnutrition
PHCA	Primary Health Care Administration
PZDD	Parasitic and Zoonotic Diseases Department
RMS	Royal Medical Services
RSS	Royal Scientific Society
SNC	Second National Communications
SRC	Serum Retinol Concentration
SSC	Social Security Corporation
STC	Serum Tocopherol Concentration
UJ	University of Jordan
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
UNRWA	United Nations Relief and Works Agency for Palestine Refugees
USFDA	United States Food and Drug Administration
WAJ	Water Authority of Jordan
WHO	World Health Organization
WTO	World Trade Organization

Executive Summary

It is widely accepted that climate change is occurring because of the accumulation of greenhouse gases in the atmosphere arising from the combustion of fossil fuels. Over the past 100 years, average global surface temperatures have increased by about 0.74°C; most of this increase has occurred in the past 50 years. Despite the mitigation policies that are now being implemented in the world, some degree of global climate change is unavoidable.

Climate change may affect health through a range of pathways, for example as a result of increased frequency and intensity of heat waves, reduction in cold related deaths, increased floods and droughts, changes in the distribution of vector-borne diseases and effects on the risk of disasters and malnutrition. Overall, the effects of climate change on health are likely to be negative, with populations in low-income countries being mostly vulnerable.

The sixty-first session of the World Health Assembly (WHA) held in May 2008 identified climate change as a fundamental threat to public health and adopted a resolution urging Member States to take decisive action to address health impacts from climate change. Later in October 2008, the World Health Organization (WHO) Eastern Mediterranean Regional Committee issued at its fifty-fifth session a Regional Committee Resolution (EM/RC55/R.8). The resolution on Climate Change and Health aims at protecting health from the effects of climate change. It also urges Member States to implement the endorsed Regional Framework for Health Sector Action to Protect Health from the Effects of Climate Change. Significant focus of the resolution is on capacity building of the health sector in the Member States encouraging the health systems to undertake assessment of health vulnerability to climate change to proactively prepare and address the health impacts of climate change.

The Jordanian government represented by the Ministry of Health (MOH) is a member of the Regional Committee and is committed to implementing the WHA resolution of May 2008 and the Regional Committee Resolution of October 2008 on protecting health from climate change. In fulfilling its commitment to implementing these resolutions, the MOH developed the National Climate Change Health Adaptation Strategy and Plan of Action, with WHO/CEHA technical and financial assistance, under the *Joint Program of Adaptation to Climate Change to Sustain Jordan's MDG Achievements, Output 2.3: Adaptation Measures by the Health Sector to Protect Health from Climate Change are Institutionalized*.

The current health related vulnerabilities were assessed, as well as coping capacities. Vulnerable populations and regions were also identified. The impact of climate change on six climate-sensitive health issues, namely, air-borne and respiratory diseases (Chapter 2), water and food-borne diseases (Chapter 3), vector-borne diseases (Chapter 4), nutrition (Chapter 5), heat waves (Chapter 6), and occupational health (Chapter 7) were selected. Health vulnerability and adaptation assessment to climate change over the next 25-30 years was carried out by six MOH specialized teams and national experts for the six health issues.

Several consultative meetings and workshops were held during the course of implementing the project to obtain stakeholders' feedback. The assessments were guided by the WHO Document on "Framework for Vulnerability, Impact and Adaptation Assessment". A National strategy for health sector's preparedness for the impacts of climate change and adaptation plans of action were developed (Chapter 8). In addition, 24 adaptation project proposals were prepared (Chapter 9). Each team developed an Early Warning System to monitor and assess the impacts of climate change on each of the 6 climate-sensitive health issues.

The Adaptation Strategy, Plan of Action, and EWS would have long-term potential for delivering improved health outcomes. The multiple levels of health promotion and prevention within the public health system are important in minimizing the adverse health impacts of climate change. A particular challenge would be to support the groups most vulnerable to climate change in rural, desert, remote areas, and poverty pockets.

The National Climate Change Health Adaptation Strategy and Plan of Action will be carried out by the MOH in collaboration with the other relevant sectors in the country. The general goal is to plan climate-change adaptation measures for the health system to prevent existing and future risks, respond punctually, and increase resilience and preparedness.

The various GCM and statistical models projected higher temperature and lower precipitation as a result of climate change with projected increase in rainfall intensity during December-February of the rainy season. The assessment of climate change burden on respiratory diseases reveals that the most visible effect would be on chronic respiratory diseases including bronchial asthma and COPD. There are no effects on acute infectious respiratory diseases; on the contrary, the assessment illustrates a positive effect of the predicted increase in temperature and decrease in humidity.

The increase in temperature due to climate change is likely to be associated with increased survival and abundance of microorganisms; thus, increased water and food-borne diseases. The expected decrease in precipitation will lead to decreased availability of water, which may lead to the consumption and use of unsafe (contaminated) water for drinking and other uses, causing many water and food-borne diseases. Flooding will cause epidemics of water and food-borne diseases. The spread of these diseases after floods results primarily from contamination of water caused by disruption of water purification and sewage disposal systems. However, the secondary effects of flooding, including crowding and subsequent focal-oral spread of gastrointestinal pathogens, may also contribute to spreading of water and food-borne diseases.

VBDs risk is expected to increase by increasing temperature. Areas with scarce water like the Eastern Desert will become an area of higher risk due to water harvesting projects. Water projects will certainly have impacts on the intermediate hosts or vectors responsible for the transmission of malaria, schistosomiasis and leishmaniasis.

Access to nutritious food is expected to be reduced; dietary quality and eventually quantity declined, and micronutrient malnutrition (or hidden hunger) increased as indirect impacts of climate change. The expected increase of heat waves due to climate change will cause an increase in a spectrum of disorders such as sunburn and fatigue, heat rash, heat cramps, heat syncope, heat exhaustion, and heat stroke. The most serious of these are heat exhaustion and heat stroke, which can lead to death. In addition, exposure to hot weather may exacerbate existing chronic conditions.

Climate change is expected to alter outdoor workers' exposure to solar ultraviolet radiation (UVR) to cause a range of health impacts. The greatest burdens result from UVR-induced cortical cataracts, cutaneous malignant melanoma, and sunburn. Heat stress due to high temperature and humidity can lead to an increase in deaths or chronic ill health after heat strokes. Both outdoor and indoor workers are at risk of heatstroke. Indoor (chemical industries) workers and farmers may be exposed to higher levels of air pollutants due to increased temperatures.

The health sector can respond to the adverse impacts of climate change with regard to the above-mentioned health issues in a number of ways by preparing for extreme events (e.g. heat waves), surveillance, monitoring, responding to infectious disease, increasing awareness, and by providing extra support for the communities. The adaptation actions/measures/ interventions for each of these climate-sensitive health issues can be classified into 7 major categories: Regulatory/ legislative; Capacity building; Public education and communication; Surveillance and monitoring; Medical intervention; Infrastructure development; Research and further information.

It was recognized that the lack of detailed time-series data on certain health issues and data on influencing factors other than climate change did not allow for a comprehensive and quantitative assessment of health impacts. Nevertheless, good understanding of current activities and programs, their adequacy with respect to health under climate change scenarios, and a range of adaptation measures, early warning systems, and required supporting research emerged. The outcomes provide a proactive approach to protect the health of communities in Jordan from adverse impacts associated with climate change, and form the basis for future planning and decision-making.

A resilient health sector with adequate infrastructure and widespread access to primary healthcare services is fundamental to reduce the population's vulnerability to the impacts of the changing patterns of diseases due to climate change. Health professionals must be trained to better understand the potential impacts of climate change on health. Improving health systems is a clear "no-regrets" option for adaptation.

The Guiding Principles

- Climate change is first and foremost a public health issue;
- The goals of the public health system are to promote health, prevent illness, and protect the health of the population;
- Encourage mitigation and adaptation strategies that maximize health co-benefits, and minimize unintended consequences (adverse health impacts);
- Prioritize adaptation actions; adopting multiple-benefits and no-regret adaptation options;
- Provide and maintain the required resources to implement adaptation activities to minimize the impacts of climate change on human health and well-being;
- Promote healthy, sustainable, and resilient populations to increase preparedness for unavoidable climate change impacts;
- Reduce health inequities and ensure health promotion and protection for vulnerable populations and communities;
- Build knowledge, awareness and understanding of climate change impacts on human health and the need to prepare for these changes;
- Enable dialogue between decision-makers, researchers, businesses, NGOs, local communities, etc to implement appropriate and accepted actions for achieving sustainable population health;
- Cooperate with identified stakeholders;

Policy Recommendations

Climate change poses a threat to human health; generally, it does not create new health problems, but it may make them worse and change the severity and geographic patterns of disease occurrence. Public health programs already target the health issues that are directly linked to climate change. Therefore, policy recommendations related to climate change and health would reflect the need to maintain, strengthen, and refine current measures to enhance their resilience and sensitivity to climate change. Policy recommendations related to climate change and health should:

- Ensure the participation of the health sector when planning climate change adaptation in other sectors;
- Ensure health risks are considered when planning adaptation measures;

- Ensure that existing public health surveillance systems are adequately comprehensive and sensitive and are easily linked to environmental and meteorological data to be able to detect potential effects of climate change on health;
- Focus surveillance efforts at areas predicted to be at particularly high risk for changing patterns of disease.
- Establish and implement heat warning system;
- Increase public awareness of consequences of heat exposure;

Challenges

- Sustained collaboration and coordination among the relevant sectors;
- Adopting more effective and rapid electronic exchange of surveillance data;
- Availability and access to real-time air quality monitoring data;
- Introducing new indicators that are useful for protecting health, such as Air Quality Index, UV index;
- Utilizing available effective tools (e.g. GIS or Health Mapper) to link environmental and climatic factors to health outcomes;
- Establishing consistent and continual resources to maintain the public health adaptation efforts (infrastructure, research, surveillance, awareness and education);
- Ensuring that limited research funds are targeted toward better understanding of the links between climate change and health impacts.

CHAPTER I CLIMATE CHANGE AND VARIABILITY IN JORDAN

Jordan's Location and Climate

The Hashemite Kingdom of Jordan stretches over an area of over 89,318 km² in the hot and dry region of West Asia (DoS, 2010). The country, located in the eastern Mediterranean region between 29° 11' to 33° 22' N latitudes and 34° 19' to 39° 18' E longitudes, has three distinguished ecological zones (Al-Bakri et al., 2008). The Jordan Valley, which forms a narrow strip located below the mean sea level, and has warm winters and hot summers with irrigation being mainly practiced in this area. The Western Highlands, where rainfall is relatively high, and climate is typical to the Mediterranean areas. The arid and semi-arid inland to the east, known as the “Badia”, where the annual rainfall is below 200 mm (Map shows the climatological regions of Jordan).

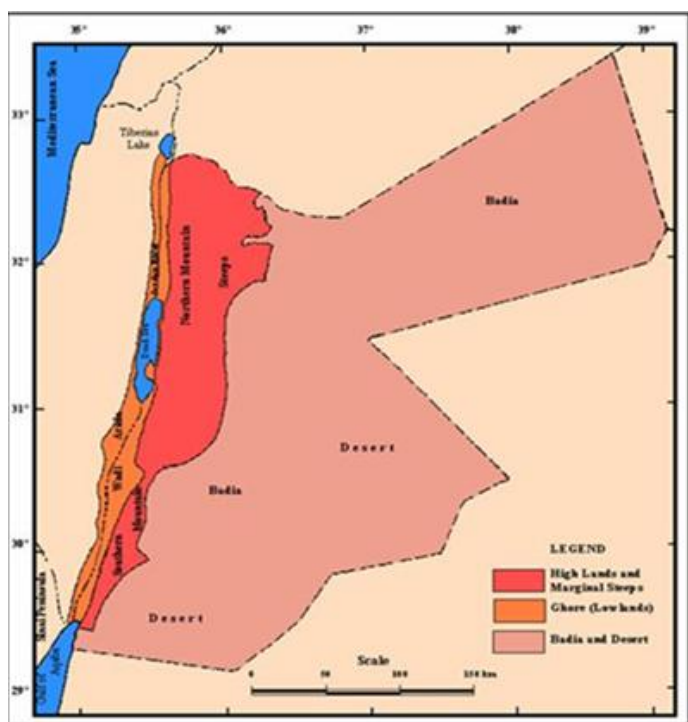
The annual average rainfall ranges between 600 mm in the northern uplands and less than 50 mm in the southern and eastern desert areas. About 90 % of the country receives less than 150 mm/season. Most of the precipitation falls in the form of rain or drizzle, snow may fall on highlands, and hail is frequent during thunderstorms. Precipitation falls during rainy season (October-May), but about 75% of precipitation falls during winter season, which extends from December to March.

During summer, the Jordan valley is very hot, and the mean daily maximum is 39°C. During winter, the mean minimum temperature is about 9°C. In the mountainous region, it is rather cold during winter with mean daily minimum temperature of about 4°C, while in the summer, it is about 26°C-30°C.

Although the country has three major rivers (Jordan River and its two principal tributaries, the Yarmouk, and the Zarqa rivers), Jordan suffers from a severe water scarcity problem. Jordan's Water Strategy for the period of 2008-2022 states that Jordan is one of the four driest countries in the world. Due to salinity and other quality problems, surface water is used mainly for irrigation. Drinking water is taken from underground aquifers. The annual per capita water availability has declined from 3600 m³/year in 1946 to 145 m³/year in 2008; this is far below the international

water poverty line of 500 m³/year. This share is continuously decreasing and is forecasted to go down to 90 m³ by 2020 without the construction of strategic projects.

Jordan's demographic profile is also a major factor affecting development opportunities. Despite the Government efforts in managing the limited water resources and its relentless search for alternative supply, the available water resources per capita are falling as a result of population growth (MoEnv, 2006). It is projected that the population will continue to grow from about 6.1 million in 2010 to over 7.8 million by the year 2022. The current population density is about 69 inhabitants per km², with 83% of the population residing in urban areas. About 40% of Jordanians are less than 15 years old. Such a high percentage imposes heavy



economic burden on Jordanian families (DOS, 2010).

Jordan's remarkable development achievements are under threat due to the crippling water scarcity, which is expected to be aggravated by adverse trends of climate change; mainly decreased rainfall and increased air temperature (Al-Bakri et al., 2011). The scarcity of water in Jordan is the single most important constraint to the country's growth and development as water is not only considered a factor for food production but a very crucial factor of health protection and economical development. This is mainly attributed to the dependence on the limited and fluctuated precipitations. The trans-boundary water problems also increase the pressure on water resources, the main two rivers (Yarmouk and Jordan) are impacted by water use and development outside Jordan's borders.

In terms of water use, agriculture sector consumes more than 60% of the available water resources in Jordan. With time, the dependence on treated water resources will increase. It is anticipated that the amounts of treated wastewater currently used in agriculture sector will increase from 100 million cubic meters (MCM) to 220 MCM by year 2022 (MWI, 2009).

Trends of climate change in Jordan

Analysis of historical records showed that the Eastern Mediterranean countries, including Jordan, suffered from 30% reduction in rainfall during the last 100 years and an incremental increase in air temperature that reached 1°C during the last 50 years.

In Jordan, spatial and temporal characteristics of climatological variables in the different climatic regions were analyzed in the First and Second National Communication (SNC) to the UNFCCC in 1999 and 2009, respectively (GCEP, 1999; MoEnv, 2009). Both reports used historical air temperature and rainfall records to project future climate changes. Three General Circulation Models (GCMs) (CSIROMK3 (Australian), ECHAM5OM (German), HADGEM1 (British)) were used in the SNC to predict future changes in climate during the period of 2005-2050, on the basis of a fundamental climate data for 45 years from 1960- 2005. All of the models showed an increase in temperature of less than 2°C by the year 2050. Warming was found to be stronger during the warm months of the year while less warming is projected to occur in the cold months of the year. No consistency in predicting rainfall was observed among the three GCMs (MoEnv, 2009).

Climate change projections in the Middle East and Jordan are compared using simulation results from four different GCMs (ECHAM4, HadCM2, CGCM1, GFDL) for the same set of assumptions (IS92a scenario). Both greenhouse gases and sulfur aerosols are accounted for in the GCMs and the projections available are for the 2020s climate conditions in comparison to the period 1961-1990.

The temperature change during winter (January, February, March) and summer (June, July, August), and the rainfall change during the wet season (October to April) as calculated by the different models for the Middle East and Jordan are summarized in Table I.

Table I Calculated temperature changes and rainfall by different models (Values are for 2020s relative to the 1961-1990)

Climate change parameters (IPCC-DCC 1999)	HadCM2	GFDL-R15	CGCM	Echam4	ΔT_{max}	ΔP_{max}
January-March mean temperature increase (°C)	0.9	1.8	1.3	1.1	1.8	
June-August mean temperature increase (°C)	0.9	2.1	0.8	1.2	2.1	
October-April mean rainfall change (mm/day)	0	0	0	0		0

These results show minor changes in mean precipitation for the region, while temperatures are projected to increase in all seasons. Mean summer temperatures, already high, will rise significantly (0.8-2.1°C).

In order to assess climate change impacts on the six health issues, the experts from Jordan MD analyzed climatic data for the period 1981-2010. The analysis focused on predicting trends of change for air temperature, heat waves, rainfall, and dust storms for the northern, middle and southern parts of Jordan,. Results of the analysis were compared with results of the SNC.

Trends of air temperature and heat waves

Results indicate significant, increasing trends in the annual maximum of daily maximum air temperatures in the different parts of the country (Baqura, Wadi Dhulail, Ghor- Safi and Amman Airport). Increasing trends in the annual minimum of daily maximum and daily minimum are also evident. Significant negative trends have been found in the number of days when daily minimum temperature (cool days) is below its 10th percentile at all stations and also increase trend is found in daily temperature range (maximum minus minimum) at all stations except Mafraq and Wadi Dhulail.

Analysis of heat waves, periods of 3 consecutive days when maximum temperature exceeds its normal "long-term average" by 5°C or more, show a warming trend all over the country during 1981-2010, as confirmed by data for whole Jordan and the analysis of station-by-station data for the same period. The maximum number of heat waves occurs in May with 15.3 heat waves as monthly average number. This indicates the transition period from spring to summer and due to instability and khamasinic conditions. October is considered to be the second month when heat waves occur with 8.2 heat waves as monthly average number. The period 1981-2010 shows 5.1 heat waves events as yearly average. The maximum number of heat waves is 9 and occurred in year 2010 at Shoubak.

The range of temperature increase during these heat waves is 6.9 to 11.5 °C. Further analysis of air temperature data shows that the average number of monthly heat waves during the 1981-2010 period are 55 for mountainous region (Ras Muneef, Irbid, Amman, Er Rabbah, Shoubak, Tafleeh), 41 for the desert regions (Mafraq, Wadi Dhulail, Ruwaished, Ma'an, Al Jafer, Safawi) and 27 for Jordan Valley (Baqura, Aqaba, Deir Alla, Wadi El-rayyan, Ghor Safi). The highest absolute maximum air temperatures for the period (1981-2010) recorded are 48.8°C at Wadi El-Rayyan in August, 48.6°C at Ghor Safi in July and 47.7°C at Baqura in July. The highest absolute minimum air temperature during this period was -14.0°C at Shoubak in January. The highest number of monthly days with minimum temperature ≤ 0 °C for the period (1981-2010) is 80.6 days in Shoubak.

Extreme events of weather are also expected in the near future, as the data of 1981-2010 show a trend of increase in "Hot Days", annual count when (daily maximum) >35 °C. A slight increase in the trend of frost days, i.e. annual count when (daily minimum) <0 °C, during the period 1981-2010 is also observed.

Trends of rainfall

Almost all regions suffered from reduction in rainfall to some degrees but not all the regions experience that during the same periods. The longest dry spell is 15 seasons in Shoubak (1995-2010), 14 seasons in Amman (1995-2009), 15 seasons in Mafraq (1995-2010), 11 seasons in Wadi Dhulail (1998-2009), 7 seasons in Baqura 2003-2010, 5 seasons in Wadi El Rayyan (2005-2010).The maximum frequency of dry seasons found in the north desert region is 21 dry seasons. The mountainous region is the second region vulnerable to drought (19 dry seasons). The probability of rainy wet year (above average) is 9% and might occur once every 11 years. The probability of wet year (around average) is from 33-58% and might occur every 2 to 3 years. The probability of dry

year (below average) is 59% and might occur every one year. Rainfall data indicates shift in the beginning of rainfall season from September to October and November.

Trend of Dust storms

Records of the MD show that 56% (437 out of 783) of dust/sand storms was recorded with wind speed ranging from 20 to less than 30 knot. In terms of direction, more than half of the storms were through the direction from 90 to 270 degrees, i.e. from the east and south directions. Most of the dust storms with visibility of less than 1 km were recorded in the desert regions of Jafer and Ruwaished. The numbers of dusty days with visibility of less than 5 km were higher in Amman and Zarqa than in other areas.

These results indicate that most of the country's population will suffer from the direct impacts of climate change, particularly heat waves and increased air temperature. In summary, the highly populated areas of Amman and Irbid will suffer from increased heat waves relative to other locations. The southern parts of the country will suffer from increased droughts and reduced rainfall when compared to other parts. In addition, severe weather conditions of frost during winter and early spring, in addition to severe dust storms will become more frequent in the southern parts of the country.

CHAPTER 2 CLIMATE CHANGE AND AIR-BORNE AND RESPIRATORY DISEASES

Introduction

The link between climate change and human health has become even clearer over the last years. Rising temperatures and ground level ozone will lead to an increase in the burden of disease ranging from airway injury and inflammation to acutely decreased lung function. Worldwide hundreds of millions of people suffer every day from chronic respiratory diseases.

According to WHO global estimates, 300 million people suffer from asthma, 210 million people suffer from COPD, and millions have allergic rhinitis and other under diagnosed chronic respiratory conditions.

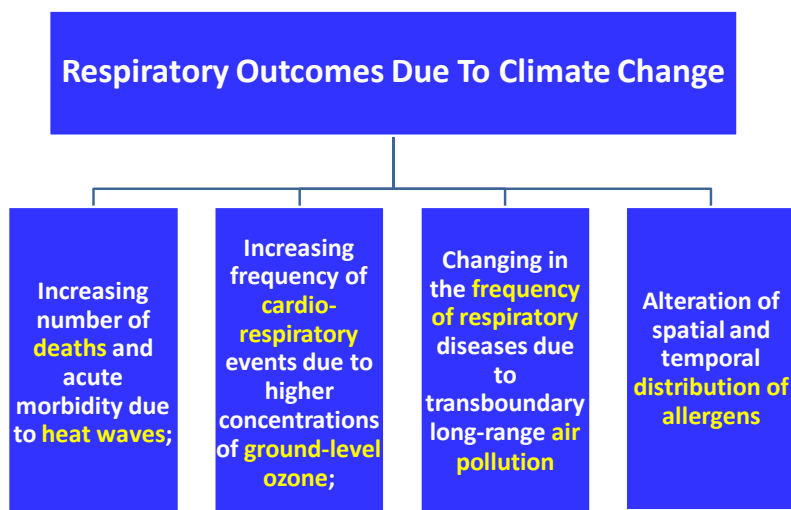
Climate change could have direct or indirect effects on respiratory related diseases. The key climatic change variables or events that could potentially influence respiratory disease are extreme temperature events, air pollution, drought with paradox flooding, damp housing, changes in allergen nature, forest fires, and dust storms.

The main diseases of concern that could be influenced by climate change are Asthma, Rhinosinusitis, Chronic Obstructive Pulmonary Disease (COPD), and respiratory tract infections.

Vulnerable areas that will suffer more are desert areas (sand storms), extended areas with olive trees (pollen), areas with new plants (new sensitizant), poverty areas, areas with less well-developed medical services, and areas with limited access to medical services.

With more hot days, fewer frost days, more periods of drought and dust storms, and paradoxically, more periods of heavy rain and consequent flooding, the projected respiratory outcomes due to climate change are summarized in Figure 1.

Figure 1 Respiratory outcomes due to climate change



Climate Change and AB&RDs

As the climate gets warmer, there is a growing danger of increased respiratory diseases. Higher temperatures in itself will not make people more likely to come down with asthma, allergies, or respiratory infections. The biggest concern is air quality (environmental air pollution). The formation, transport and dispersion of many air-pollutants is determined partly by climate and weather factors such as temperature, humidity, wind, storms, and droughts. These include increase in ground level ozone in urban areas, higher particulate matter in drought areas, more particulate matter from more wildfires, and the presence of airborne particles from dust storms due to desertification. Therefore, climate change may influence pollutant concentrations, which may affect respiratory health. However, the trend and magnitude of the effects of climate change on air pollution levels are highly uncertain with regional variations. Incidences of respiratory diseases may inflate during climate-change related events such as heat waves, bad air pollution days, or other extreme weather events, during which vulnerable populations will need the most support.

Extreme temperature events will contribute to increase the burden of disease and premature deaths, mainly among the elderly aged >65 years and patients with chronic obstructive pulmonary disease (COPD). Ozone is a powerful oxidant that has been associated with persistent structural airway and lung tissue damage; it contributes to more severe symptoms of asthma, increasing hospital admissions and deaths in patients suffering from respiratory diseases. Heat waves if accompanied with higher concentrations of ground-level ozone will lead to increasing frequency and severity of cardio-respiratory attacks.

Desertification and a higher frequency of forest fires increase particulates. Long-term exposure to air pollution is associated with increase in severity of symptoms, reduction of lung function in asthmatic children, and higher mortality in adults, including lung cancer. Short-term exposure to air pollution is associated with increase in cardiopulmonary hospital admissions and mortality. Compounding effects of air pollution and temperature will have significant public health consequences.

The spread of new plant species to new areas will lead to alteration of allergens distribution and will expose new populations to novel allergens. Combination of allergens with rising ozone will increase severity of symptoms in asthma and allergic rhinitis patients. In addition, increasing dust storms are associated with outbreaks of asthma caused by exposure to allergens.

Episodes of extreme precipitation potentially lead to severe flooding, which will have direct impact on population dislocation, poor living conditions, worsening water quality, poor nutrition, and inadequate access to medical care. This will affect respiratory infections, pneumonia in particular. Flooding will lead to damp houses that are recognized as a direct cause of respiratory diseases. This will be manifested by coughing and wheezing, asthma, and allergic sensitization associated with fungal exposure. Damp and mould exposure have been estimated to contribute to approximately 20% of all cases of asthma in the USA.

Respiratory diseases and climate change

- The overall effect of climate change on respiratory infections is modest and may even be beneficial
- The geographical occurrence could be modified
- The timing and duration of some respiratory virus seasons could change, there is shifting in season which could end earlier as temperatures increase
- Attacks could be more or less severe

- Tuberculosis may increase in some circumstances, especially with migrating populations
- Climate change might affect the ecology of avian influenza viruses through:
 - Alteration of bird migration,
 - Influence on virus transmission cycle
 - Virus survival

Figure 2 illustrates the key climatic change factors that potentially influence respiratory diseases.

Air-borne respiratory diseases

Acute respiratory infections (ARI) kill more than 4 million people per year and are the leading cause of death among children under age 5 years [1]. This range of infections, which includes pneumonia in its most serious form, accounts for more than 8% of the global burden of disease [2]. ARI's reach is global: it is the most frequent disease worldwide and a common cause of visits to pediatricians in the industrialized countries, although essentially all deaths from ARI occur in the developing world.

ARIs are among the leading causes of death in children under 5 years but diagnosis and attribution are difficult and uncertain, as they are often associated with other life-threatening diseases such as measles. The risk factors for ARI are numerous and difficult to sort out. Caused by different viruses or bacteria, ARI is closely associated with poverty. Overcrowding and unsanitary household conditions support the transmission of the disease, which is spread by droplets from a cough or a sneeze or unwashed hands. Death most often strikes those children who are already weakened by low birth weight, other infections, and malnutrition [4]. Several other factors seem to exacerbate the disease, such as exposure to tobacco, indoor and outdoor air pollution.

Other airborne diseases also thrive in conditions of poverty, exploiting enclosed spaces, crowding, and poor hygienic conditions such as Tuberculosis (TB), which killed an estimated 3 million people in 1996, and nearly 7.5 million others developed the disease. Measles and diphtheria (diseases of crowding and poverty) have been eliminated in the developed world since the advent of successful vaccines. In the developing world, however, measles still affects 42 million children per year who lack access to the vaccine; roughly, 1 million of these children die [6]. Since 1990, diphtheria has resurfaced in the former Soviet Union, triggered by social disruption and a drop in immunization rates [7].

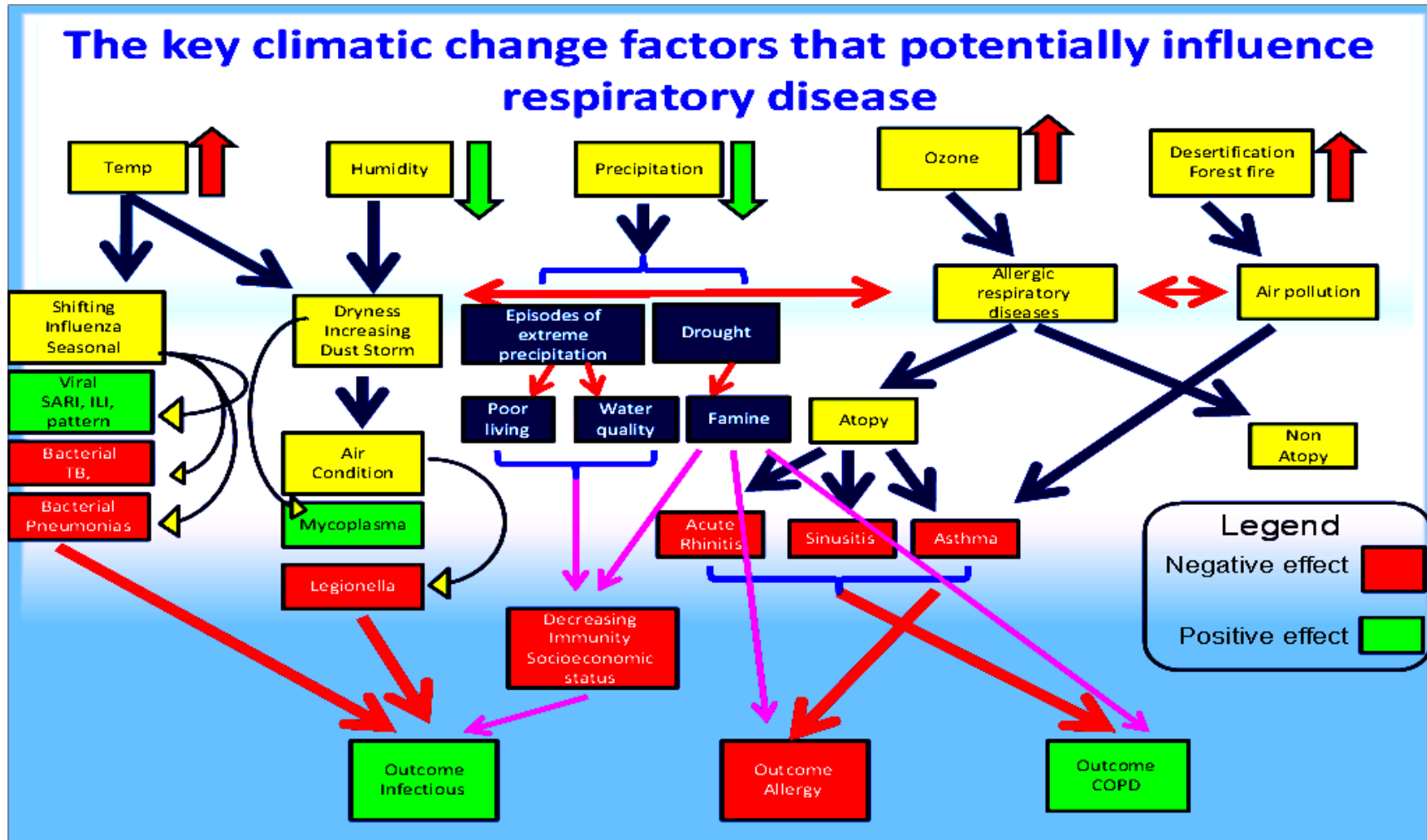
Climate change is likely to influence vegetation, with consequent changes in growth and reproductive cycles and in the production of allergenic pollen (seasonal period and intensity). In addition, weed species are expected to proliferate. These changes can vary from one region to another, since some areas receive greater amounts of UV radiation and/or rainfall [10]. In general, increased temperatures produce earlier flowering and longer pollen production [11].

The effects of climate change on allergic respiratory diseases are summarized as:

Known effects:

- Ambient air pollution increases the frequency and severity of asthma attacks and the number of symptomatic days.
- Pollen, air pollution, and weather interact and affect the clinical expression of allergic disease.
- Climate change is unequivocal, accelerating, and largely anthropogenic and will continue through at least the 21st century.
- Climate change is measurably affecting the timing, distribution, quantity, and quality of aeroallergens and changing the distribution and severity of allergic disease.

Figure 2 Key climatic change factors that potentially influence respiratory diseases



- Climate change alters local weather patterns, including minimum and maximum temperatures, precipitation, and storms, all of which affect the burden of allergic disease.
- Warming temperatures promote production of ground-level ozone, which worsens asthma.
- There are clinical interventions that can be used to minimize climate change–related increases in asthma and allergic disease (secondary prevention).
- Greenhouse gas mitigation is the current global recommendation for stabilizing the climate (primary prevention).

Unknown effects:

- Future air quality will be determined by energy and transportation choices, economic development, and population growth.
- The degree to which human intervention and planning can minimize changes in vegetation and aeroallergen exposure remains unexplored.
- The rate and magnitude of climate change in the future will depend on how rapidly and successfully global mitigation and adaptation strategies are deployed.
- New technologies addressing climate change and air pollution, as well as new medical treatments for asthma, allergic disease, or both could alter current predictions and trends.

A study on aeroallergens, allergic disease, and climate change concluded that the few epidemiological analyses of meteorological factors, aeroallergens, and allergic diseases demonstrate the pathways through which climate can exert its influence on aeroallergens and allergic diseases [12]. The effects of climate change on respiratory allergy are still lacking and current knowledge is provided by epidemiological and experimental studies on the relationship between asthma and environmental factors, such as meteorological variables, airborne allergens, and air pollution. However, there is also considerable evidence that subjects affected by asthma are at an increased risk of developing obstructive airway exacerbations with exposure to gaseous and particulate components of air pollution.

Pollen allergy is frequently used to study the interrelationship between air pollution, rhinitis, and bronchial asthma. Epidemiological studies have demonstrated that urbanization, high levels of vehicle emissions, and westernized lifestyle are correlated to an increase in the frequency of pollen-induced respiratory allergy prevalent in people who live in urban areas compared with those who live in rural areas. Meteorological factors (temperature, wind speed, humidity, etc.) along with their climatological regimes (warm or cold anomalies and dry or wet periods, etc.), can affect both biological and chemical components of this interaction. In addition, by inducing airway inflammation, air pollution overcomes the mucosal barrier priming allergen-induced responses. In conclusion, climate change might induce negative effects on respiratory allergic diseases. In particular, the increased length and severity of the pollen season, the higher occurrence of heavy precipitation events, and the increasing frequency of urban air pollution episodes suggest that environmental risk factors will have a stronger effect in the coming decades [13]. In addition, in the presence of high CO₂ concentrations and temperatures, plants increase their pollen output. [14]

A study found that a major responsible factor of respiratory allergy could be outdoor air pollution, derived from cars and other vehicles. Studies have demonstrated that urbanization and high levels of vehicle emissions and westernized lifestyle are correlated with the increasing frequency of pollen-induced respiratory allergy. There is evidence that air pollutants may promote airway sensitization by modulating the allergenicity of airborne allergens. Furthermore, airway mucosal damage and impaired mucociliary clearance induced by air pollution may facilitate the access of inhaled allergens to the cells of the immune system. In addition, vegetation reacts with air pollution and environmental conditions and influence the plant allergenicity. Several factors influence this

interaction, including type of air pollutants, plant species, nutrient balance, climatic factors, degree of airway sensitization, and hyperresponsiveness of exposed subjects [15].

Studies also link elevated exposure to ground-level ozone, PM_{2.5}, coarse thoracic PM, and aeroallergens to decreased lung function, aggravation of asthma, rhinitis, exacerbations of chronic obstructive pulmonary disease, hospitalizations for respiratory and cardiovascular diseases, and premature mortality. In addition, air pollutants such as PM_{2.5} and ozone may alter the allergenicity of aeroallergens like pollen, thereby promoting further airway sensitization. The triggers for such adverse respiratory responses vary and include climatic factors (meteorological events, rainfall patterns, and temperature anomalies), high levels of vehicle emissions, land-use patterns, variables in the built environment, geography, and distance from roadways. Physiology also plays a significant role, as individuals with existing respiratory conditions are most vulnerable to disease exacerbations triggered by the environment.

Other airborne exposures are also likely to worsen with climate variability and change. Changes in the hydrologic cycle with increasingly variable precipitation and more frequent drought may also lead to a global increase of airborne dust, which, when coupled with anticipated stagnant air masses and increasingly strong inversion layers, will trap ozone and other airborne pollutants near the ground causing exacerbations of respiratory disease.

A study in Jordan, among schoolchildren aged 6-12 years in Irbid City showed that the prevalence of physician-diagnosed asthma was 4.1%. Wheezing was reported by 8.3% of children. The male:female ratio was 2:1. In order of frequency, the triggering factors were respiratory tract infections, cold environment, exercise, and dust. Statistically significant associations were found between wheezing and family history of asthma, recurrent chest infections, eczema, allergic rhinitis and parental smoking; but no significant associations were found with mode of delivery, breastfeeding, and the presence of pets at home. The prevalence of childhood asthma in Northern Jordan is similar to that in some countries of the developed world [22].

A study conducted to test total and specific serum IgE to olive pollen in 400 allergic patients in Jordan before, during, and after the peak pollen season using Immunoblot Allergy Screen-Respiratory panel found that out of the 400 patients serum specimens 30% had allergy to IgE olive pollens. Ninety-four percent of the allergic patients had elevated total serum IgE >100 IU/ml. Ten samples from healthy subjects were used as negative controls [23].

Mycoplasma pneumoniae is rare in Jordan. A prospective study using both polymerase chain reaction (PCR) and culture demonstrated the absence of *Mycoplasma pneumoniae* in the throats of 100 Jordanian adult patients with respiratory tract infections and 100 healthy controls over a period of 8 months (2003-2004). However, a retrospective study covering a period of 24 months (2003-2005) suggested that *M. pneumoniae* infection occurs rarely in Jordanian adults and may be attributed to the prevalence of dry weather for most of the year in Jordan [16].

Assessment of Current Vulnerability of AB&RD in Jordan

Data collected on current status of respiratory related diseases in Jordan included morbidity, mortality, trends, seasonality, higher risk groups, geographical distribution to estimate the burden of air-borne and respiratory related diseases. Vulnerable geographic areas and populations, irrespective of climate change, were identified to study trends and patterns in the burden of air-borne and respiratory related diseases.

Vulnerable Population and Regions in Jordan

Vulnerable Population

Susceptibility is subdivided into innate and acquired susceptibility. Innate susceptibility may be due to genetic predisposition as broncho-constrictor effects of ozone or to transient incomplete development of normal physiological functions as detoxification processes among young children. Acquired susceptibility may be due to socioeconomic status or age.

Vulnerability is due to increased exposure to innate or acquired susceptibility. Some individuals are vulnerable to the effects of air pollutants as a result of their "greater than average" exposure to these substances, as living near busy roads. Maternal exposure to air pollutants had effects on fetal growth, prematurity, and the incidence of stillbirths. Children and elderly are the most vulnerable groups to climate change, as children lungs are not completely developed, thus, have greater exposure. Children spend more time outside, where concentrations of air pollution are generally higher. Their higher baseline ventilation rates and physical activity exposes their lungs to more air pollution. The immune systems in children are immature; this plays a significant role in asthma. The observed consequences of early life exposure to adverse levels of air pollutants include diminished lung function and increased susceptibility to acute respiratory illness and asthma [30]. Air-borne diseases are the primary cause of child morbidity and mortality seen to be aggravated by climate change. Adults with chronic respiratory disease, people with asthma, are at increased risk during episodes of poor air quality

Vulnerable Regions

Jordan is divided into three main areas with climate variation:

1. Badia area in the eastern part of the country where there is exposure to sand storms and dust storms leading to increase in the prevalence and attacks of bronchial asthma and other allergic diseases
2. Hilly Regions where there is exposure to relatively low temperature; this is the most populated areas with high density population which could increase the infectious respiratory borne diseases and COPD
3. Jordan Valley where there is exposure high temperature [31].

Although there is a small distance between these regions, there is a significant difference in the climate variation. The vulnerability study included the three main areas:

Deir Alla: Administratively belongs to Balka Governorate. It is a small town situated in the middle of Jordan Valley. Balka constitutes 1.2% of the total area of Jordan; the population is about 411,000, with a density of 365 / km². It is located at -314 m below sea level. Deir Alla has year-round cultivation due to warmer temperature, fertile soils, and extended summer. Irrigation water is obtained from Eastern Irrigation Canal. Annual rain in Jordan Valley ranges 120-300 mm.

Amman: It is situated in a hilly area northwestern Jordan, with an area of 1,680 km². The population is about 2,125,000, with a density of 1264/ km². The elevation ranges between 777–1,400 m. It has a semi-arid climate with long, hot and dry summers and wet cool winters.

Mafrak: It is a small city in Mafrak Governorate located in northeast Jordan; its area is 26541 km². The population is about 287,300 with a density of 10.8 people/km². It is divided into four administrative areas, Mafrak Al-Qasaba, North East Badia, North West Badia, and Rweished. 77% of the population lives in Alqasaba and North West Badia. Table 1 summarizes climate parameters in the three vulnerable regions.

Table 2 Summary table of climate elements in the Vulnerable Regions

Region	Temperature °C	Precipitation mm	Relative Humidity %
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	Summer	Winter	Winter	Summer	Winter
	June -August	Dec - March	Dec -March	June-August	Dec - March
Hilly Regions	23	8	376	48	71
Jordan Valley	31	15	259	53	68
Badia	26	9	101	45	69

Burden of COPD

According to WHO estimates, 65 million people have moderate to severe chronic obstructive pulmonary disease (COPD). More than 3 million people died of COPD in 2005, which corresponds to 5% of all deaths globally. At one time, COPD was more common in men, but because of increased tobacco use among women in high-income countries and the higher risk of exposure to indoor air pollution (such as biomass fuel used for cooking and heating) in low-income countries, the disease now affects men and women almost equally.

In 2002, COPD was the fifth leading cause of death. Estimates show that COPD will become the third leading cause of death worldwide in 2030 [35].

Prevalence of COPD and asthma in MENA and risk factors

In 2001, the prevalence of COPD in Africa was estimated at 179/100,000 and 301/100,000 in Eastern Mediterranean countries [37]. This prevalence is low compared with America and Europe. In Tunisia, prevalence of COPD is estimated at 3.8% [38]. In Algeria prevalence of COPD (> 40 years) was 125/100,000 people in 1990 [39].

COPD affects men more than it does women. Smoking among men can be the reason for that.

Burden of Asthma

The prevalence of asthma increases as communities adopt modern life styles and become urbanized. The European Community Respiratory Health Survey (ECRHS) estimated the prevalence of asthma in adults in Mediterranean countries between 1 and 4%. According to the International Study of Asthma and Allergies in Childhood (ISAAC) in 1998, asthma prevalence was evaluated at 16.5% and 10.7% in North Africa and East Mediterranean, respectively.

In another recent cross-sectional epidemiological survey of asthma, conducted in the Maghreb countries, the overall prevalence of asthma in the general population was estimated to be 3.6%, (moderate prevalence rate) with no relevant difference apparent between the 3 countries (Algeria, Morocco, and Tunisia). [14]

In a study conducted in Jordan, prevalence of asthma in children was found to be moderate, with no significant difference between the Amman city group and Bedouins (8.8% vs. 9.5%). It concluded that there is a 2-fold increase in the prevalence of asthma in Jordan in the last 10 years. [12]

A population survey on chronic diseases in 2010 revealed that prevalence of allergic asthma was 0.9%. Allergic asthma contributes 6.8% of the chronic diseases in Jordan. Asthma increases with age from 0.6% among those below 9 years to 1.4% in the age group 10-49 and 2.6 in the age group above 60 years.

Acute Respiratory Infection (ARI) is considered by health officials as the leading cause of death among infants in Jordan and the second leading cause of death among children between 1 and 5 years of age. According to the DHS97 survey, the percentage of children with ARI was 10.2%, but

the current death registry system is not capable of capturing all child deaths due to ARI. Globally the disease burden for Acute Respiratory Infections (ARI) is estimated at 94037000 DALYs and 3.9 million deaths. Diagnosis and attribution are difficult and uncertain because community studies of childhood mortality depend largely on verbal autopsies, which can be very unreliable for the diagnosis of ARI. Another difficulty is that ARI are often associated with other life-threatening diseases such as measles [33]. A study reports that 62% of all deaths are attributable to ARI; but most of these were associated with measles. When measles deaths are excluded, the proportion falls to 24%. Better estimates of burden of childhood pneumonia are needed and should be given high priority.

Hospital based studies have shown that up to 40% of the outpatient clinic visits among children 0-5 years are due to ARI and that 30% of all admissions in pediatric wards are ARI related. In a 1995 verbal autopsy assessment for mortality and causes of death in Jordan, it was found that crude death rate was 5 per 1000 people. Infectious diseases represented 11.7/100000 population and respiratory system diseases 29.7/100000 population; it also found that deaths for under one year-olds due to respiratory system diseases represent 7.8% of all causes of death [41]. In 2000, MOH introduced the BCG vaccine at one month of age (instead of at school entry) in addition to the introduction of the HIB vaccine. These two vaccines contribute largely to the reduction of ARI related diseases, such as Tuberculosis, Pneumonia, and Meningitis.

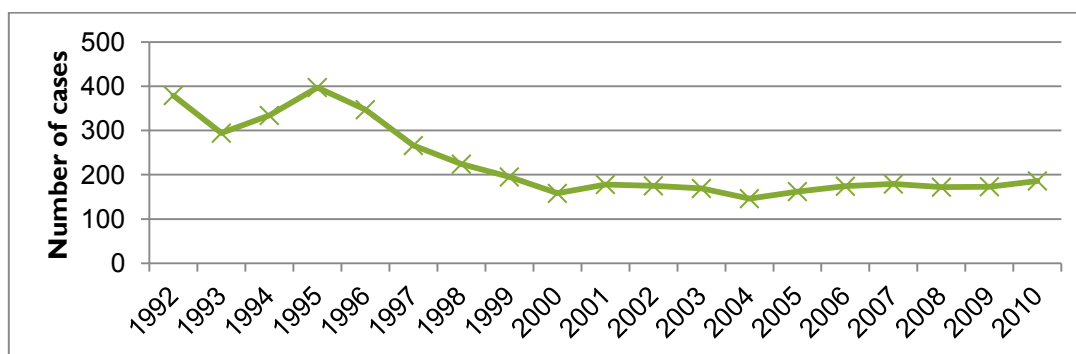
Burden of Airborne Vaccine Preventive Diseases

The incidence of airborne vaccine preventive diseases significantly decreased in the last decade; the number of reported cases of Measles decreased to almost zero in the last years after the last outbreak in 1997; it also applies for German measles and Mumps.

Burden of pulmonary TB

The median number of pulmonary TB reported cases during 1992-2010 was 139 cases. The number of cases ranges from 146 in 2004 to 397 in 1995. Figure 3 illustrates a secular trend decreasing over the period 1992-2010 [43].

Figure 3 Secular trend of pulmonary TB in Jordan (1992-2010)



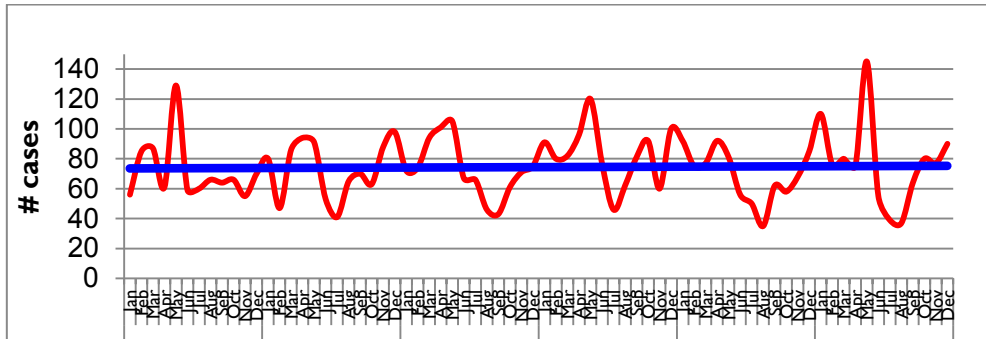
Rapid Vulnerability Assessment of AB&RD

The current burden of AB&RD in Jordan is not well known, there is no well-established surveillance system available for respiratory diseases. To estimate the magnitude and identify the burden of AB&RD, a rapid assessment was conducted, which included reviewing several records, as follows:

1. Number of patients with bronchial asthma and/or COPD from three selected areas (Basheer hospital (represents Amman), Mafrak hospital (represents Mafrak), and Iman hospital (represents Deir Alla):

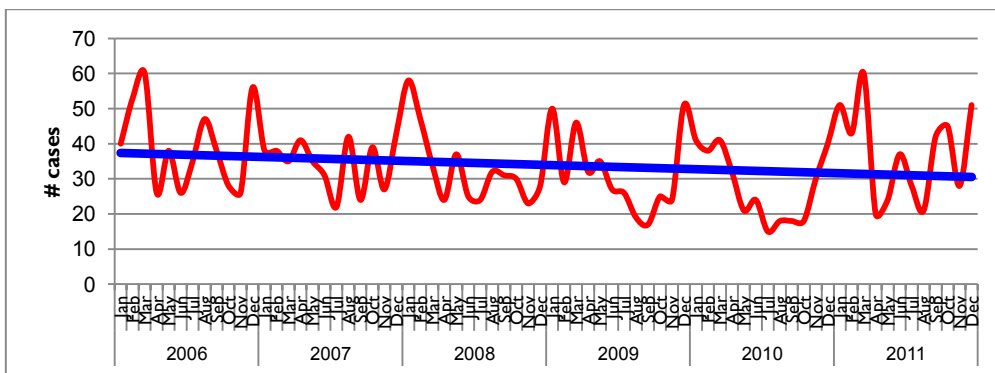
The annual average number of admitted cases of Bronchial asthma at Basheer hospital for the period 2006-2011 was 832 cases. There is no increase in the trend of the cases with time, but there is a constant seasonal pattern; increasing in spring (April-May) and decreasing in summer (July-August) as illustrated in Figure 4.

Figure 4 Bronchial asthma cases in Basheer Hospital (2006-2011)



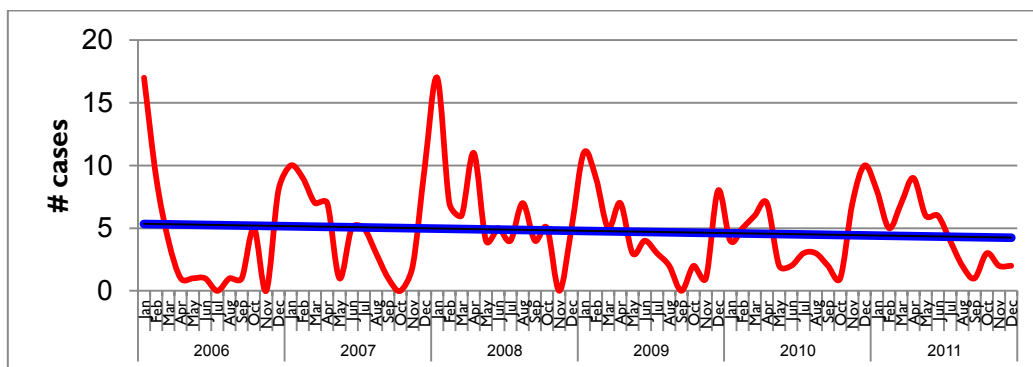
The annual average number of admitted cases of COPD at Basheer hospital for the period 2006-2011 was 393 cases. There is a decreasing trend in the number of cases with time and there is a constant seasonal pattern; increasing in winter (December-January) and decreasing in summer as seen in Figure 6.

Figure 5 COPD cases in Basheer Hospital (2006-2011)



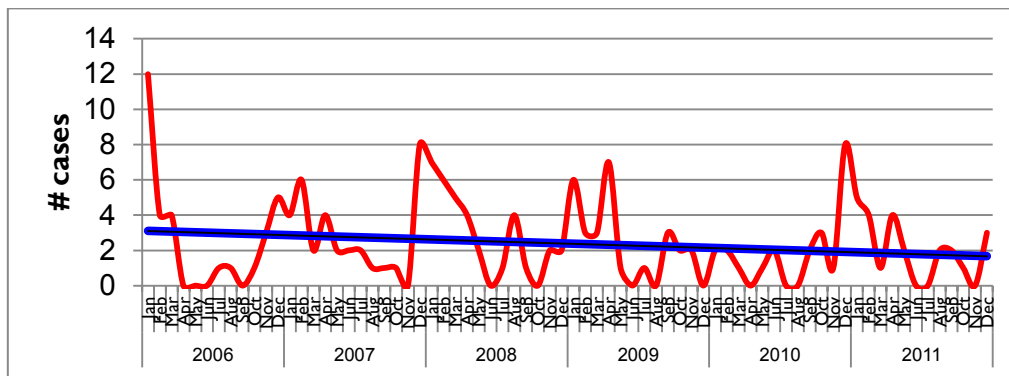
The annual average number of cases of bronchial asthma at Mafrak hospital for the period 2006-2011 was 328 cases. There is no increase in the trend with time, but there is a constant bi-seasonal pattern, (April-May) and (December-January) decreasing in summer (July August), Figure 6.

Figure 6 Bronchial asthma cases in Mafrak Hospital (2006-2011)



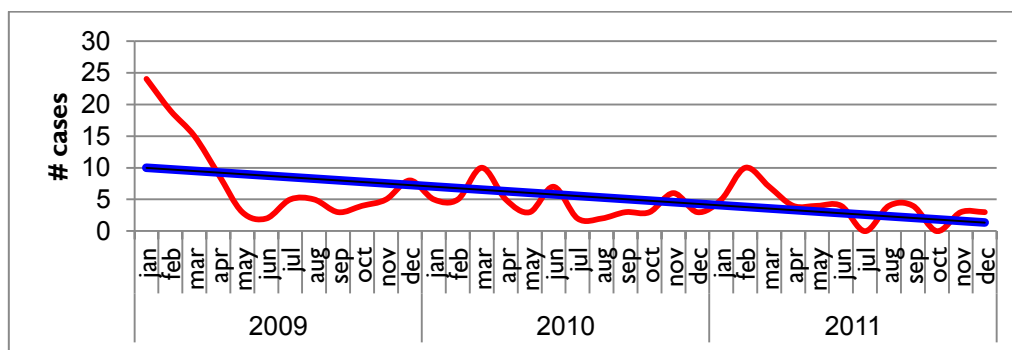
The annual average number of cases of COPD at Mafrak hospital for the period 2006-2011 was 172 cases; there is a decreasing trend of cases with time, but there is a constant bi-seasonal pattern, (April-May) and (December-January) as seen in Figure 7.

Figure 7 COPD cases Jordan in Mafrak Hospital (2006-2011)



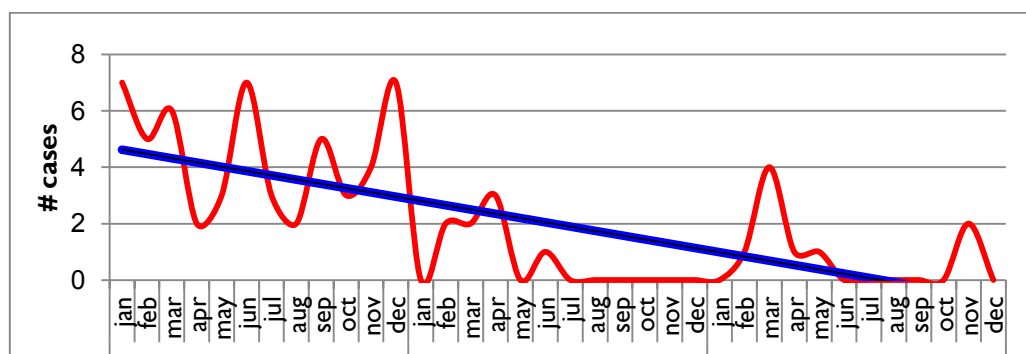
The available data from Iman hospital (Deir Alla) covered the period (2009-2011). The annual average number of cases of bronchial asthma was 68 cases with seasonal pattern in the winter (December-January) as shown in Figure 8.

Figure 8 Bronchial asthma cases in Iman Hospital (2009-2011)



The annual average number of cases of COPD from Iman hospital was 24 cases, with no constant seasonal pattern as seen in Figure 9.

Figure 9 COPD cases in Iman Hospital (2009-2011)



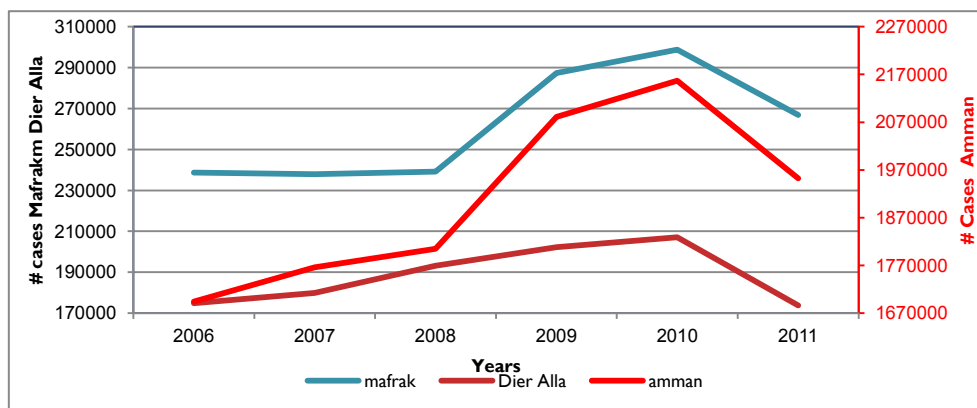
2. Number of patients with bronchial asthma and or COPD from Chest clinic at JUH (Nov-Dec 2011):

The total number of cases attending the Chest Clinic at Jordan University Hospital (November-December 2011) was 928 cases. Bronchial asthma represented 290 cases (29%) and COPD 127 (13%); whereas URTI represented 40 cases (4%).

3. Number of patients attending health centers for respiratory diseases in Amman, Mafrak and Deir Alla:

Data on the annual average number of cases attending health centers in the three selected areas during 2006-2011 and the percentage of cases with respiratory diseases show there was an increase in the number of cases in 2009 and 2010 as shown in Figure 10.

Figure 10 Distribution of cases attending the health center for respiratory diseases (2006 – 2011)



Current Programs and Activities to Manage AB&RDs

Multiple programs and activities are employed to manage AB&RD by MOH and other sectors:

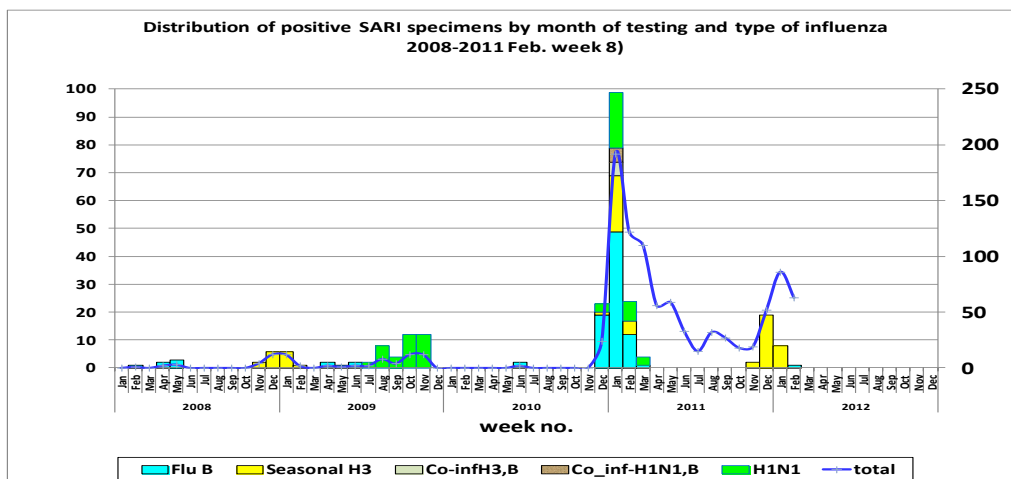
MOH

1. *Directly Observed Treatment Short course (DOTS)* is the internationally recommended strategy for TB control that has been recognized as a highly efficient and cost-effective strategy.
2. *Practical Approach to Lung Health (PAL)*. MOH in collaboration with WHO implemented the practical approach to lung health (PAL) strategy in Jordan to improve management of respiratory patients within health facilities. This approach improves standardization case management for priority respiratory diseases
3. *Sever Acute Respiratory Infections (SARI)*. Hospital based sentinel influenza surveillance established to provide information to public health authorities for adopting appropriate intervention measures and control. It started in January 2008. The main results are median age is 2 years, males constitute 59%, and 24% of patients have chronic medical conditions. Mortality from all SARI cases is 2.2% , mortality due to influenza 3.4%. Table 2 and Figure 11 show the distribution of cumulative specimens of SARI by etiology and by etiology and month.

Table 2 Distribution of cumulative specimens of Sever Acute Respiratory Infections by etiology

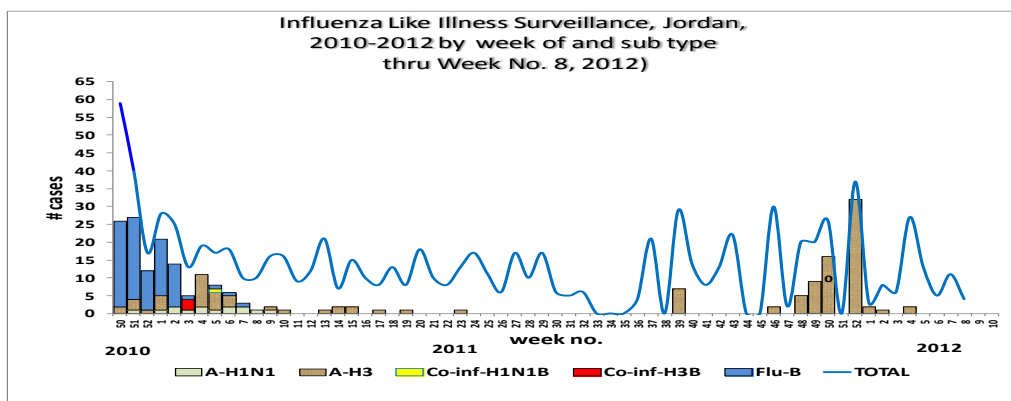
Viruses	No. Specimens Tested	Positive Specimens	
		No.	%
Influenza A	2157	114	5.3 %
pH1N1	2157	62	2.9 %
Seasonal H3 or H1	2157	52	2.4 %
Influenza B	2157	59	2.7 %
RSV	2157	393	18.2 %
Adenovirus	863	73	8.5 %
hMPV	863	67	7.8 %
Para influenza 1-3	863	66	7.6 %
Co-infection	2157	62	2.9 %
Overall	2157	706	32.7 %

Figure 11 Distributions of cumulative specimens for Sever Acute Respiratory Infections by month and etiology



4. *Influenza Like Illnesses (ILI)*. Outpatient sentinel influenza surveillance provides, parallel to SARI, information to health authorities about seasonality and pattern of influenza. Figure 12 shows the distributions of cumulative specimens for ILI by week and etiology (2010-2012).

Figure 12 Distributions of cumulative specimens for Influenza Like Illness by week and etiology (2010-2012)



5. *Integrated Management of Childhood Illnesses (IMCI)*. IMCI is a strategy developed by Division of Child Health and Development in WHO and UNICEF, using integrated guideline and updated technical findings to describe management of illnesses that cause more than 70% of the deaths in children less than 5 years in developing countries like (pneumonia, , diarrhea,etc). The guideline was developed in 2006, and the program was launched in 2007.
6. Instructions for exclusion of planting olive trees along public streets and sidewalks; and replace existing trees with other non-sensitizing trees by Greater Amman Municipality in order to reduce bronchial asthma attacks and other respiratory diseases.

MoEnv

1. *Jordan air quality monitoring system implemented by MoEnv and sponsored by AFD*: The goal of the air quality monitoring system (AQMS) project of Jordan is to continuously monitor ambient air pollution in three main cities in Jordan (Amman, Irbid, and Zarqa)in 12 locations.

Vulnerability Assessment of Impacts of Climate Change on AB&RDs

Jordan’s SNC to the UNFCCC projected climate change scenarios for 2005 – 2050. It projected that a general increase in temperature, and that summer warming is more substantial than winter warming. However, scenarios of precipitation do not agree with each other (Details in Chapter 1).

The SNC illustrated that the overall susceptibility of the Jordanian population to environmental health concerns has decreased in recent years as a result of the improvement in access to health facilities as well as the improvements in the environmental conditions.

Increase in temperature lead to higher incidence of some diseases, infectious respiratory diseases will be the most visible. SNC illustrated that there is an intermediary negative correlation between monthly rate of patients attending health centers for respiratory diseases and the monthly maximum temperature (MMT) ($r = -0.41$); r^2 value of 0.17 indicates that the variation in MMT accounts for 17% of the total variation in the monthly incidence rate of patients. It was estimated that increasing MMT 1°C increases the same rate by 5 patients /1000.

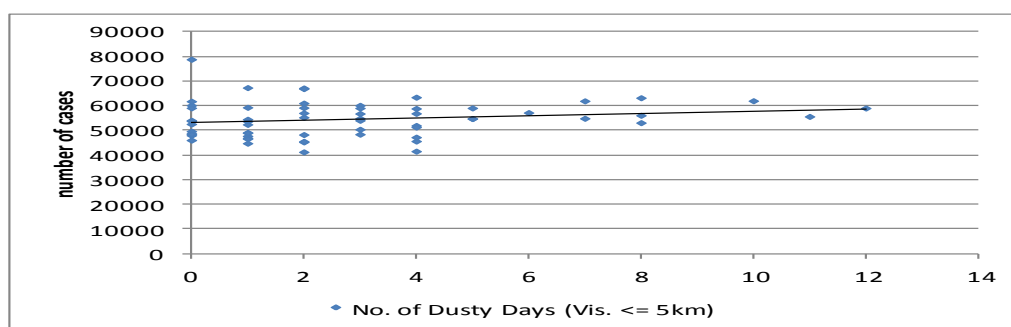
Climate data, scenarios, and projections for the next 25 years were obtained from the MD. Time series analysis, linear regression was performed to identify the correlation between the collected data on AB&RD and climate variables (temperature, precipitation, and sand storms). Epi Info Software was used for data entry and statistical analysis. Methods for analyzing the relationships between environmental data and health data sets are poorly matched at international and local levels.

Data Analysis

Linear regressions were performed to identify correlation between climate variables and the collected data from the three study areas. The collected data from Mafrak and Deir Alla was not reliable; thus, the analysis was restricted to Amman. The monthly number of attendees to health centres, monthly number of COPD and Bronchial Asthma from Al-Basheer Hospital were analysed.

Monthly number of attendees at health centres in Amman was correlated to monthly number of days with dust storms. Weak positive correlation was observed, coefficient of correlation $r = 0.163912$, and coefficient of determinants $r^2 = 0.026867$; only 3% of the variation in the number of attendees to health centres could be related to dust storms as shown in Figure 13.

Figure 13 Correlation between monthly number of attendees at health centers and monthly number of days with dust storm, Amman (2006-2010)



Monthly number of bronchial asthma cases admitted to Al-Basheer hospital was correlated to monthly number of days with dust storms in Amman. Intermediate positive correlation was observed; $r=0.311982$, and $r^2 = 0.097333$; 10% of the variation in the number of bronchial asthma admissions to hospital could be related to dust storms.

Monthly number of COPD cases admitted to Al-Basheer hospital was correlated to monthly number of days with dust storms in Amman. Weak positive correlation was observed; $r=0.165109$, and $r^2 = 0.027261$; only 3% of the variation in the number of COPD admissions to hospital could be related to dust storms.

Monthly number of attendees at health centres in Amman was correlated to monthly mean maximum air temperature. Intermediate negative correlation was observed, $r = -0.368756$, and $r^2 = 0.13598$; only 13% of the variation in the number of attendees to health centres could be related to air temperature.

Monthly number of bronchial asthma cases admitted to Al-Basheer hospital was correlated to monthly mean maximum air temperature in Amman. Intermediate negative correlation was observed; $r = -0.337411$, and $r^2 = 0.113846$; 11% of the variation in the number of bronchial asthma admissions to hospital could be related to air temperature.

Monthly number of COPD cases admitted to Al-Basheer hospital was correlated to monthly mean maximum air temperature in Amman. Relatively strong negative correlation was observed; 38% of the variation in the number of admissions to hospital could be related to air temperature.

Monthly number of attendees at health centres in Amman was correlated to Monthly Mean Relative Humidity (MMRH) (%). Weak positive correlation was observed, $r = 0.182082$, and $r^2 = 0.033154$; only 3% of the variation in the number of attendees to health centres could be related to MMRH.

Monthly number of COPD admitted to Al-Basheer hospital were correlated to MMRH (%) in Amman. Relatively strong positive correlation was observed; $r = 0.44809$, and $r^2 = 0.200785$; 20% of the variation in the number of COPD admissions to hospital could be related to MMRH.

Monthly number of bronchial asthma (BA) cases admitted to Al-Basheer hospital was correlated to MMRH (%) in Amman. Weak positive correlation was observed; $r = 0.10137$, and $r^2 = 0.010276$; 1% of the variation in the number of bronchial asthma admissions could be related to MMRH.

Other Factor which Influence AB&RD

Factors other than climate change, which influences air-borne and respiratory diseases, are population growth and demographic changes, urban overcrowding, remote rural areas; standards of living; accessibility of health care facilities; age (infants and children; elderly people and people with chronic medical conditions); heat stress; outdoor and indoor air pollution; undernourished populations, malnutrition; pregnant women; populations with tuberculosis (TB); immunocompromised persons; mentally or physically disabled people

Public health interventions to address the additional burden due to climate change

Programs must focus on improving surveillance and integrating relevant data:

1. Strengthening surveillance and monitoring programmes for respiratory diseases
2. Enhance vaccination programs for vaccine-prevented air borne and respiratory diseases
3. Enhance TB control program
4. Develop action plan for disaster risk management activities
5. Ensure availability of treatment and case management of airborne disease at all health levels
6. Action plan for engaging a wide range of stakeholders to ensure implementation of relevant policies, programmes and interventions
7. Monitoring health outcomes related to extreme weather events by:
 - Establishing early warning systems
 - Establishing emergency response plans
 - Establishing monitoring system for adverse health outcomes during and after an extreme weather event
 - Establishing educational programmes on the risks and appropriate responses to extreme weather events for individuals, communities, responders and health care workers

- Ensuring presence of sufficient clinics and health professionals, providing support, explaining options and giving directions on the use of drugs and preventative paraphernalia
- Establishing functional air quality monitoring system, and dissemination of data
- Monitoring health outcomes related to air quality:
 - alert on days with poor air quality
 - monitoring air quality and its health consequences;
 - implement educational programmes on risks of poor air quality and appropriate protection measures for individuals, communities and health-care workers
 - monitoring malnutrition in vulnerable populations

Adaptation Measures to Reduce Vulnerability and Enhance Preparedness against the Potential Negative Impacts of Climate Change on AB&RDs

Health sector needed adaptation measures

1. Strengthen surveillance and establishment of highly sensitive alert system by developing health forecast system for acute respiratory diseases
2. Prevention and control of emerging respiratory diseases
3. Strengthen existing emergency preparedness and disaster management
4. Support and strengthen preventative health programs and projects with community involvement
5. Vaccination campaigns for all available vaccine-preventive diseases sensitive to climate change
6. Capacity building and increasing awareness through regular training workshops and media
7. Provision of necessary equipment and medications
8. Environmental care through sustaining and improving sanitary conditions
9. Undertake research at population and individual level

Access to appropriate health care and medications to the management of allergic respiratory diseases such as asthma and chronic obstructive pulmonary disease (COPD) is fundamental; it is increasingly important that guidelines have to be strictly adopted on country level to deal with patients with asthma and COPD.

Additional needed adaptation measures by other sectors

Adaptation measures at the national level, in relation to air-borne and respiratory diseases, should include the following:

Aeroallergen Monitoring:

Establishing or improving surveillance or monitoring of atmospheric pollen and mold spore concentrations in certain stations in the country, especially in areas with increased concentration of pollens and mould spores; identify the responsible governmental body.

Aeroallergen Forecasting:

Enhancement of forecasting will enable both individuals with allergic respiratory diseases and their carers (parents, teachers, and health professionals) in more locations to better manage within-season variability of aeroallergen levels.

Allergenic Plant Management:

Allergenic plant management is used effectively in some countries as a defence strategy against important allergenic plants and the associated diseases. Better allergenic plant management and planting practices and policies would have a long-term reduction in the ambient pollen allergen concentration, which would contribute to a reduction of allergic respiratory disease burden. Large

cities in Jordan must have tight and detailed adaptive measures for management of allergenic plants and trees such as olive tree.

Air Pollutants Monitoring:

Availability of real-time monitoring on air pollutants, especially ground-level ozone and PM is vital in linking air-borne and respiratory diseases with air quality and climate change.

Urban/Settlement planning and building design:

Building design and heating, ventilation and air-conditioning can be used to control both indoor allergen production and exchange of allergens between the indoor and outdoor environments. There are aspects of urban or settlement planning that can play a role in the link between climate, aeroallergens and allergic respiratory diseases.

Education and Awareness

Awareness on the many aspects of allergic respiratory diseases is important. In the case of aeroallergens, stronger education programs directed at allergen avoidance are imperative. The trend of earlier pollen season starts should be clearly communicated to those with allergic respiratory disease and their carers, related health care professionals, and the public.

Research

Ongoing research is required on the impact of climate change on respiratory diseases; this includes further climate model studies of future changes in the green area in the country, which may affect atopy and asthma symptoms. It is particularly important to have researches involving long-term aeroallergen monitoring to monitor future trends in aeroallergen concentrations and seasonality. Similarly advanced experimental research on impacts of elevated [CO₂] and temperature on pollen and allergen production of more plant species is required. Modelling and surveillance of future changes in allergenic plant ranges is needed.

In the next 5-10 years, research should deal with issues such as asthma; it already affects large numbers of children and adults but definite rate of the disease in Jordan is not available..

Priority action areas and implementation responsibilities

Prioritization of the adaptation interventions were developed according to resilience, sustainability, potential multiplier effects, reliability and feasibility of interventions, as shown in Table 3.

Table 3 Prioritization of adaptation measures

	Action areas	Implementation responsibilities
1	Strengthen surveillance system for respiratory diseases by establishing a high sensitivity system to develop health forecasting for acute and chronic respiratory diseases	MOH, other private sector hospitals, Educational hospitals
2	Mapping and assessment of areas, which have potential effect on respiratory diseases through production of pollen or other allergens	Ministry of Environment Royal Scientific Society
3	Raising awareness on climate change and its effect on respiratory diseases in Jordan	MOH, MOEd

4	Establishment of air pollutants monitoring system focusing on ground level Ozone	MoEnv, RSS
5	Set guideline to improve management of bronchial asthma and COPD	MOH
6	Establish an integrated, efficient, and effective early warning system	MOH, Metrological Department
7	Develop public health preparedness and intervention plan for the health impacts due to climate change	MOH, Multiple governmental and nongovernmental sectors

See Chapter 8 for detailed Climate Change Adaptation Strategy and Plan of Action to Protect Health.

Early Warning System on Air-Borne and Respiratory Diseases and Climate Change

The goal of the Early Warning System is for the health system to be better prepared to face sudden or long-term challenges due to respiratory diseases as a result of climate change. EWS increases the perception of climate change related risks to anticipate and respond effectively to public health threats.

Objectives of the EWS

1. To build high alert warning system that creates and distributes reports to target populations who suffer from respiratory diseases;
2. To save human lives by avoiding or reducing health effects as COPD, morbidity, and mortality.

Structure of Early Warning System for VBDs

The assessment of the burden of climate change on respiratory diseases reveals that the most common effect will be on chronic respiratory diseases including bronchial asthma and COPD. Concerning acute infectious respiratory diseases, no effects are projected; on the contrary, the assessment illustrates a positive effect of the predicted increase in temperature and decrease in humidity due to climate change.

Data provided will be deposited into MOH Server (Climate Change Unit), which will create and deliver ongoing systematic reports that will be used in the air-borne and respiratory diseases early warning system monitored and implemented by the proposed Respiratory Diseases and Climate Change Unit in the MOH.

EWS Components

The principal components of the early warning system include:

1. *Identification and forecasting of weather conditions*

The main variables to alert health care workers as well as patients for bronchial asthma and COPD are the daily monitoring of meteorological data, mainly sand storms and dust storms, air temperature, and humidity. It is known that an increase in air temperature will lead to a decrease in

air humidity and drought. An increase in the wind speed coming from eastern or southern areas will generate sand or dust storms, which will affect patients with bronchial asthma. Decreasing air temperature and increasing humidity will affect patients with COPD.

Table 4 lists the needed variables, measurement units, periodicity of data collection, and responsible agencies for implementation.

Table 4 Needed variables for the EWS

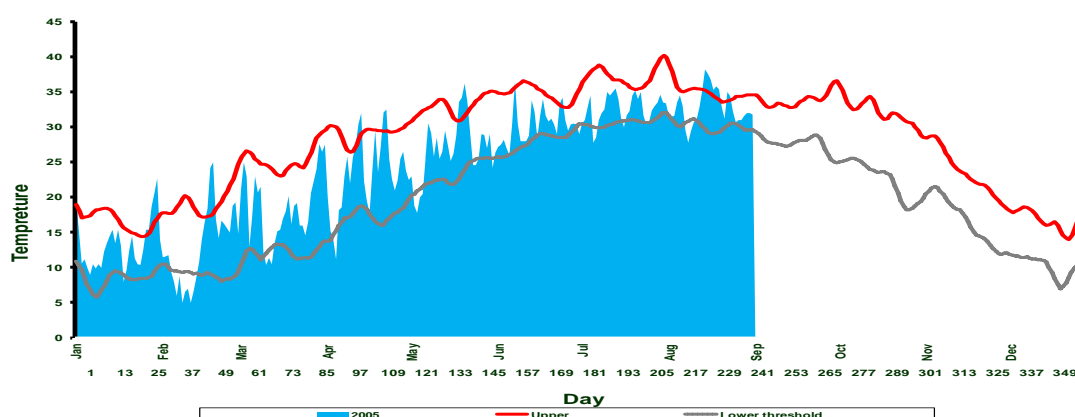
	Variable	Units	Periodicity	Responsibility
1.	Wind speed	Km/hr	Daily	Metrological Department
2.	Wind direction	Degree (0-359°)	Daily	Metrological Department
3.	Relative humidity	%	Daily	Metrological Department
4.	Visibility	km	Daily	Metrological Department
5.	Max. temperature	C°	Daily	Metrological Department
6.	Min. temperature	C°	Daily	Metrological Department

2. Prediction of possible health outcomes, based on past events

Five years daily maximum temperature and the horizontal visibility in vulnerable regions will be gathered retrospectively from the MD as background data to build a database. A region specific threshold will be created for each variable by calculating the upper threshold (90th percentile) and the lower threshold (10th percentile) from the last five years for the same day of the year. To increase the accuracy, 2 days before and 2 days after the respective day will be included in the calculation so as to compare the actual daily reading with 25 readings. The data will then be smoothed by calculating average reading for 5 days, 2 days prior, and 2 days after the actual reading to create the upper threshold. The same procedure will followed to create the lower threshold.

Figure 14 is a sample graph (assumption numbers) for the threshold for the daily maximum temperature in Amman through 2012.

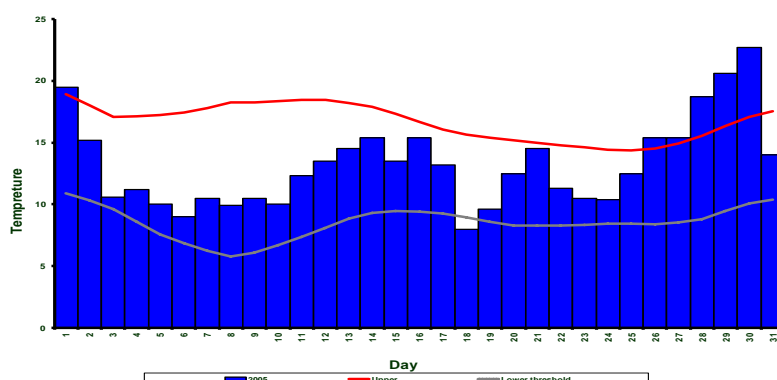
Figure 14 Sample graph (assumption numbers) for the threshold daily maximum temperature in Amman (2012)



This graph will be created from the database, which will be updated daily for the prediction of next 4 days for climate variables to monitor the variation in the reading and to detect and predict increasing or decreasing in the respective variable in relation to the threshold. This will form an initial step of developing the EWS for bronchial asthma and COPD. Similar graphs will be created for horizontal visibility to monitor the variation and predict unusual decrease in visibility.

Figure 15 is a sample graph "assumption numbers" for the threshold for the daily maximum temperature for Amman in January 2012.

Figure 15 Sample graph for the threshold for the daily maximum temperature in Amman (Jan 2012)



3. An effective and timely response plan

The EWS will function automatically as it will be programmed to send alerts to the concerned persons. The system will create an alert if there is an increase in the predicted temperature above the threshold and a decrease in the horizontal visibility less than "Area specific value assigned from MD" and is associated with wind originated from southern or eastern regions "60-210°" with speed Km/h that exceed "Area specific value assigned from MD".

Alerts will be in the form of direct phone calls to focal points, SMS, e-mails, or alert reports after the meteorological release. These alerts will be disseminated to health care providers in the vulnerable regions (e.g. to implement a prepared action plan in such situations), as well as to at risk persons who were registered in the system database (e.g. to avoid staying outdoor for long periods, or assure that they have enough supply of medication). In addition, alert reports will be distributed to concerned stakeholders, in particular Chest Diseases Association and the Private Hospital Association.

4. Ongoing monitoring and evaluation of the system and its components:

Monitoring of routine tracking of inputs, activities, and outputs, and evaluation of activities to determine the impact of the project outcome will be carried out continuously to identify the efficiency of the EWS, its successes and failures, and any needed modifications.

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CHAPTER 3 CLIMATE CHANGE AND WATER AND FOOD-BORNE DISEASES

Introduction

Infectious agents (such as bacterial, viral, protozoal) cause Water and Food-borne diseases (W&FBDs). Symptoms vary, but generally are from the gastrointestinal system. Children below the age of five are especially susceptible, and among the many forms of disease that they may encounter, by far the most severe, in terms of their clinical manifestations, are cholera, rotavirus infections and dysentery. (1) An important characteristic of infectious W&FBDs is the capability of person- to-person transmission.

Effects of climate change on W&F borne diseases may occur through:

Increased Temperature: it is likely to be associated with increased survival and abundance of microorganisms, and thus increased water and food borne diseases.

Decreased Precipitation: this will lead to decrease the availability of water, which may contribute to the consumption and use of unsafe water for drinking and other uses, causing many W&F borne diseases.

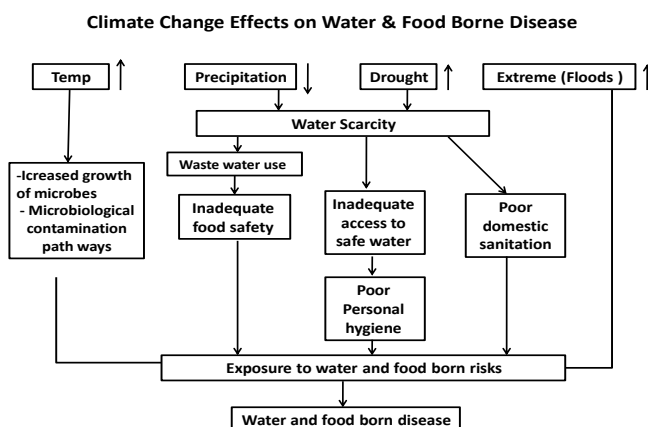
Drought: it is obvious that decrease of precipitation will lead to drought. The effects of drought are many and include reuse of wastewater, contamination of water sources, contamination of food sources, risk of water and food borne diseases, transmission to persons, person-to-person transmission, increased morbidity, increased mortality, population displacement, and resource conflicts.

Water scarcity: decreased precipitation, drought, and increased demand for water will lead to water scarcity or augment it.

Flooding: has been shown to cause epidemics of W&F borne diseases (1, 2, 3). These diseases after floods are thought to result primarily from contamination of water caused by disruption of water purification and sewage disposal systems. However, it has been hypothesized that the secondary effects of flooding, including crowding and subsequent focal-oral spread of gastrointestinal pathogens, may also contribute to spread of W&F borne diseases.

The impacts of climate change on W&F borne diseases are illustrated in Figure 1.

Figure 16 The impacts of climate change on W&F borne diseases



Climate Change and W&FBDs

Very few studies have estimated the potential impact of climate change on diarrhoeal disease. The WHO assessment of the global burden of disease restricted their estimates to the effect of increasing temperatures on the incidence of all-cause diarrhea and made no prediction of the effect of changing rainfall patterns (2). The relationship between temperature and diarrhoeal disease was derived from two published studies.

Time-series analysis was used to correlate measurements of temperature and relative humidity with daily hospital admissions at a single paediatric clinic for diarrhoeal disease in Lima, Peru. Admissions increased by 4% (95% confidence interval 2–5%) for each 1°C increase in temperature during the hotter months and 12% per 1°C (95% confidence interval 10–14%) increase in the cooler months, averaging an 8% increase per 1°C (95% confidence interval 7–9%) over the course of the study. (3)

Time-series analysis was used to correlate the monthly reported incidence of diarrhea throughout Fiji with variation in temperature, after allowing for the effects of seasonal variation and long-term trend (Singh, 2001). The reported incidence increased by about 3% (95% confidence interval 1.2–5.0%) for each 1°C increase in temperature. (4)

Studies have also been undertaken in industrialized countries that quantify the relationship between temperature and reported cases of Salmonellosis. Time-series analysis was used to estimate the relationship between weekly reports of cases of Salmonellosis and weekly mean temperature in several European countries. A study found that temperature can influence the transmission of *Salmonella* infections (food-borne disease), and has been estimated to be associated with about 35 % of all recorded cases (including in the Netherlands, England, Poland, Switzerland and Spain). Cases of *Salmonella* increase by around 5–10 % for each degree increase in weekly temperatures. (5)

Poisson regression was used to estimate the association between monthly variation in *Salmonella* infection and temperature in five cities in Australia. There was a positive association between monthly salmonellosis notifications and mean monthly temperature of the previous month in every city. Seasonal patterns in salmonellosis notifications were fully explained by changes in temperature. (6)

The reason for the most frequent occurrence of *Verocytotoxigenic Escherichia Coli* (VTEC) incidence during the summer months is unknown. However, it is most likely related to increased ambient temperature. It is possible that high environmental temperatures increase reproduction of VTEC on the farm and on food products during handling and preparation for consumption.

In the Province of Ontario, Canada, in a 72 month time-series based study on 3001 reported cases of VTEC demonstrated a marked seasonal pattern for occurrence of VTEC with peaks in July. (7) Many food-borne diseases show a strong seasonal pattern in most temperate developed countries. Some of the increase is likely attributable to changes in certain social behaviours associated with a higher risk of food-borne illness (e.g. barbecues, picnics, camping) and to increased risk of food spoilage. However, some of this seasonal increase is more directly associated with increased temperature.

A recent study in Canada found a link between ambient temperature and the occurrence of *Salmonella*, *Campylobacter* and *E. coli* O157 infections, above and beyond any seasonal trend. It was found that the relative risk of disease increased by 1.2 to 6.0% per degree Celsius above a statistical temperature threshold level. (8) Contact between food and pest species, especially flies, rodents and cockroaches, is also temperature-sensitive. Fly activity is largely driven by temperature rather than by biotic factors. (9)

In temperate countries, warmer weather and milder winters are likely to increase the abundance of flies and other pest species during the summer months, with the pests appearing earlier in spring.

Climate change and variability are among the multiple factors that can provoke changes in the nature and occurrence of food safety hazards. These hazards can arise at various stages of the food chain, from primary production to consumption, and climate change may have direct and indirect impacts on their occurrence.

There are many pathways through which climate related factors may impact food safety including changes in temperature and precipitation patterns.(10) All food borne pathogens and their associated diseases are potentially affected by climate change.(11) It is likely that some of the first detectable changes of global climate change on food safety will be seen as longer summertime peaks of food borne disease and/or increased geographic range. (12)

Campylobacter is the most commonly reported gastrointestinal bacterial disease, and is caused by the thermophile *Campylobacter*spp bacteria. In 2007, the European Union incidence was 45.2 cases per 100000 population (200 507 confirmed cases) and broiler meat as well as fresh poultry meat were the biggest identified sources of infections. (13) Colonization of broiler-chicken flocks with *campylobacter* increases rapidly with rising temperatures. The risk of campylobacteriosis is positively associated with mean weekly temperatures, although strength of association is not consistent in all studies. (14, 15, 16)

During times of drought, water scarcity results in poor sanitation and exposure of much of the population to potentially contaminated water. For example, an epidemic of cholera occurred in late 2009 in northern Kenya after a severe drought, with over 4700 cases reported in one month, including 119 deaths. (17)

The basis of treatment for diarrheal disease such as cholera is rehydration, which further exacerbates the situation due to the lack of adequate potable water available for this purpose. Malnutrition, which follows drought, increases the risk both of acquiring and of dying from an infectious disease. A study in Bangladesh found that drought and lack of food were associated with an increased risk of mortality from a diarrhoeal illness. (18)

Population displacement can lead to increases in communicable diseases and poor nutritional status resulting from overcrowding, and lack of safe water, food, and shelter. (19, 20, 21) Water scarcity affects water use in cooking, hygiene, and sanitation such as hand washing. The practice of hand washing is essential in preventing transmission of diarrheal diseases. A study found the reduction in diarrhea incidence among young children to be influenced by maternal hand washing before preparing the food to their children. (22)

Food poisoning is an important cause of morbidity in the general population and can lead to death in vulnerable individuals such as the elderly or sick people. The costs of treatment and the loss of working time also make it an important economic problem. (23) Furthermore, it is a problem that has been increasing rapidly. (24)

Water status in Jordan

Jordan shares the rivers providing much of its water with Israel and Syria. Over the years, conflicts have emerged over use of the water. Available yearly per capita share of fresh water in Jordan is among the lowest in the world estimated at about 150 m³. This share is continuously decreasing and is forecasted to go down to 90 m³ by 2020 without the construction of the strategic projects.

On the one hand, Jordan has very limited fresh water resources estimated at 780 MCM (million cubic meters) per year split between surface and ground water resources. Furthermore, the average yearly rainfall over Jordan is estimated at about 8.3 BCM (billion cubic meters) of which 94% is evaporated leaving very little addition to available water. On the other hand, the demand on water is ever increasing and is estimated at about 1.2 BCM. Clearly, there is a deficit between the supply and the demand. To bridge this gap, the Government of Jordan has put together a long-term plan to increase the efficiency of water use, improve the management of the water supply and improve wastewater treatment and reuse. Agriculture is considered the largest consumer of water in Jordan with 66 % of water allocated to the agricultural sector (540 MCM, 2004). The municipal sector (hotels, hospitals, schools, houses, government and private bodies) comes in as the second consumer with about 240 MCM (30% of the total consumption), while the industrial sector consumes about 40 MCM.

Decreasing trends in the annual precipitation by 5-20 % in the majority of the weather stations is apparent in Jordan during the last 45 years. Very few stations such as Ruwashed in the extreme east of Jordan and Ras Muneef in the northwest experienced an increase in the annual rainfall amount by 5-10%.

The rapid population growth, poor water management, insufficient wastewater treatment plants, and inappropriate pricing policies all contribute to the water scarcity problem. Continuous increase in the demand for water forces water agencies to look for alternative water sources such as treated wastewater. Reuse of reclaimed wastewater refers to a well-regulated and controlled use of properly treated (in well-designed and maintained treatment systems) and conveyed municipal and/or industrial wastewater.

Jordan has worked to manage irrigation with wastewater for several decades. Since the early 1980s, the general approach has been to treat the wastewater and either discharge it to the environment where it mixes with freshwater flows and is indirectly reused downstream, or to use the resulting effluent to irrigate restricted, relatively low-value crops. Given the diminishing per capita fresh water supply, the increasing dominance of effluent in the water balance, the overloading of wastewater treatment plants, local riparian water rights, and the need to protect domestic and export produce markets, effectively managing wastewater reuse, including enforcement of existing regulations, has become increasingly challenging.

Jordan's 24 wastewater treatment plants generate more than 110 million cubic meters of treated wastewater per year. This volume is significant and is expected to play an important role in meeting future demands for water in Jordan.

In addition to irrigated agriculture, which is likely to continue to be the largest user, reclaimed wastewater can be effectively used for environmental restoration and enhancements, irrigation of green areas (parks, golf courses, sports fields), urban development (waterfalls, fountains, lakes), road cleaning, car washing, fire fighting, toilet flushing, and/or industrial uses, but not for potable water supplies.

Assessment of Current Vulnerability of W&FBDs in Jordan

Diarrheal Disease Control Program in Jordan was established in 1982 when the last cholera outbreak occurred. The main goal of the Program is to decrease morbidity and mortality attributable to diarrheal disease especially among children less than five years old and prevent its complications such as dehydration and malnutrition.

Diarrheal disease (watery and bloody) is a compulsory notifiable disease. It depends on a passive surveillance system based on weekly and monthly reporting systems from all reporting sites. The health care providers in Jordan are the MOH, RMS, University Hospitals, Private Sector, and UNRWA.

Jordan is divided into 21 health-reporting sites that report on weekly and monthly basis to the Directorate of Communicable Diseases (DCD), along with UNRWA, which collects data from all refugee camps in Jordan.

The occurrence of diarrhea during the 10 years (1996-2005) has decreased progressively from 120559 cases in 1996 to 106164 cases in 2005. In the year 2006, the number reached 133200 cases as the UNRWA started on notifying the DCD. According to DCD Annual Epidemiological Report (2006), the incidence rate (IR) decreased from 27.2 per 1000 inhabitants in 1996 to 19.3 per 1000 inhabitants in 2005, and 23.7 per 1000 inhabitants in the year 2006 (the increase is attributed to reporting diarrhea cases by UNRWA). The average annual IR during the period 2001-2005 was 19.6/1000 inhabitants.

Age group distribution of cases during 2010 shows that 54% of diarrhea cases were among children below 5 years old; it was the same proportion during the past 10 years (Figure 3). 6% of diarrheal cases admitted to hospitals were among children less than five years old. The distribution of diarrhea cases indicates that it occurs throughout the year but peaks in May to summer months, as shown in Table 1. In 2010, the highest IR was at South Aghwar reporting site (Table 2).

Table 1 Distribution of diarrhea cases by month 2000-2010

Cases Of Diarrhoea by mc Jordan 2000 - 2010		حالات الاسهال موزعة حسب الاشهر والسنوات الاردن 2010- 2000										
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	الاشهر
January	4494	6058	5496	5405	6268	6085	6893	6445	7263	8011	8133	كانون ثاني
February	4470	4654	4430	4244	4788	4991	6757	6304	6087	7233	7547	شباط
March	5753	5478	5703	4961	7167	5763	7728	7194	7335	9145	10254	آذار
April	6593	7691	5589	6984	8289	6947	8344	10212	11913	8909	11116	نيسان
May	11118	13880	9962	8555	8968	9174	12154	14219	14198	10749	12899	ايار
June	12556	12030	14231	11905	12264	13154	16265	15454	16001	15000	13732	حزيران
July	11264	10923	14261	13741	10658	10262	16068	18001	15068	12012	11568	تموز
August	11828	9960	10356	11195	11339	11136	13556	14354	12497	10728	11754	اب
September	10488	9806	11310	12224	9643	10319	12389	16614	12963	11377	10569	ايلول
October	10257	10463	13138	9031	8633	10711	12637	13117	12247	10664	11664	تشرين اول
November	8307	7827	9166	7922	9263	9591	10797	11540	9560	8972	11965	تشرين ثاني
December	5640	6663	7222	7570	7154	8031	9612	7756	10513	9455	9927	كانون اول
Total	102768	105433	110864	103737	104434	106164	133200	141210	135645	122255	131128	المجموع

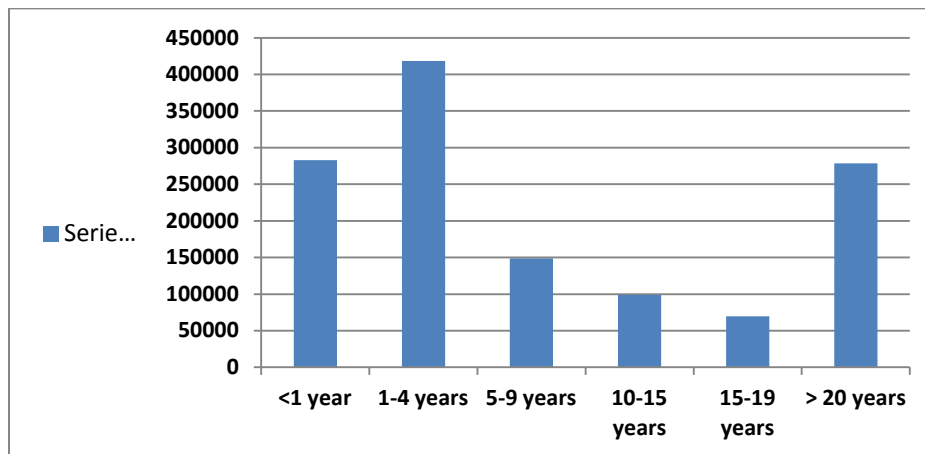
I.R/1000	20.4	21.0	22.1	19.7	18.8	19.3	23.2	24.6	23.2	20.4	21.5
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Table 2 Incidence rates (IR) at different reporting sites in 2010

Reporting site	IR 2010
Amman	5.7
East Amman	19.1
Madaba	39.7
Zarka	15.5
Balka	25.0

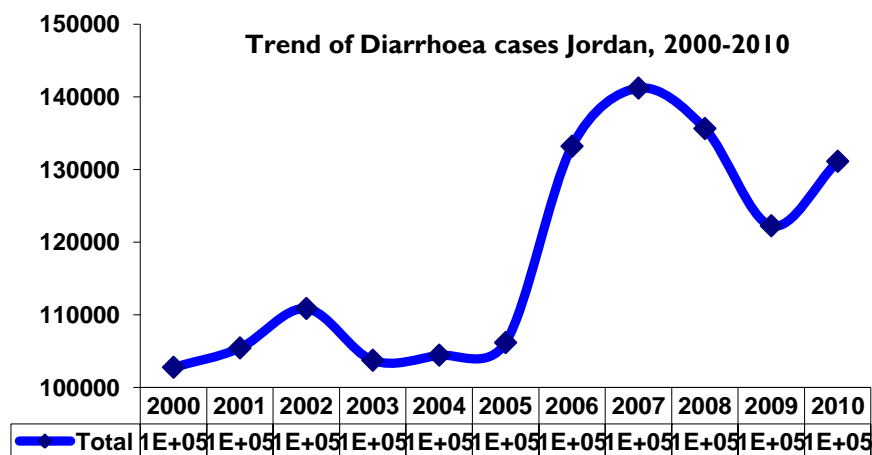
M. Agwar	63.5
DeirAlla	47.0
Irbid	18.4
Kura	19.7
Ramtha	30.4
N.Agwar	28.4
Banekenana	14.8
Ajloon	33.4
Jarash	17.6
Mafrak	29.5
N. Badia	51.4
Karak	14.4
Tafiela	19.2
Ma'an	36.0
Aqaba	20.9
South Agwar	101.5

Figure 3 Cumulative cases of diarrhea according to age group (2000-2010)



The data on diarrhea cases for the period 2000-2010 shows an increasing trend since 2006 as shown in Figure 4. This increase reflects improving the surveillance system and introducing other reporting sites like UNRWA.

Figure 4 Trends of diarrhea cases (2000-2010)



Vulnerable Regions

Three regions were selected for conducting the vulnerability assessment based mainly on climatic characteristics. Zarqa was selected as a semi-desert region, Ajloun as a mountainous region, and Deir Alla from Al-Aghwar (Lowland) region.

Zarqa Governorate

Zarqa is the third largest governorate in Jordan in terms of population, with an area of about 4080 km². The capital of Zarqa governorate is Zarqa City, which is the largest city in the governorate. It is located 25 km east of the capital Amman. The second largest city in the governorate is Russeifa. It borders Mafraq Governorate from the north and north east, Amman Governorate from the south and southwest, Jerash and Balqa Governorates from the west. It also shares an international border with Saudi Arabia in its southeastern edge. Most of the area covered by the governorate constitutes part of the Syrian Desert plateau. The heavily populated western regions of the governorate constitute part of the Zarqa River basin. The two cities of Zarqa and Russeifa are the second and fourth largest cities in Jordan.

The census of 2004 shows that the population of Zarqa Governorate for that year was 727,268 of whom 94.5% is considered urban population and 5.5% is a rural population. Jordanian citizens accounted for 97% of the population. The female to male ratio was 46% to 54%. The Jordanian Department of Statistics, population estimate for the year 2010 is 910,800 with a female to male ratio of 48.25 to 51.75 and a population density of 191.3 persons per Km².

Due to its close location to the populated cities in Jordan, Zarqa Governorate has the largest number of factories in Jordan; the only oil refinery plant in the country is located in Zarqa. The mean annual precipitation in Zarqa city is around 160 mm, while the rainfall in Al-Azrak (eastern part of the governorate) is about 60 mm.

Ajloun Governorate

Ajloun Governorate is located north of Amman. It has a population of 140000 and an area of 420km². Ajloun Governorate has the fourth highest population density in Jordan, after Irbid, Jerash, and Balqa Governorates, with a population density of 335 persons per km² (2010 estimate). It is bordered by Jerash Governorate from the southeast and Irbid Governorate from the north and west.

Ajloun is known for its high elevation, which makes it one of the coolest cities in Jordan, with average maximum temperature during January of 8.2°C, and minimum average temperature of 2.8°C. Snow is a common type of precipitation in the winter, due to that Ajloun city is well prepared to face winter. Mean annual precipitation in Ajloun is around 550 mm, as it receives the highest annual precipitation in Jordan.

Deir Alla

Deir Alla city, Balqa Governorate, lies in the middle Ghor through which King Abdullah canal passes. It is considered the centre of the province. It has a population of about 54000 and an elevation of -314 m, below sea level.

Several degrees warmer than the rest of the country, its year-round agricultural climate, fertile soils, higher winter rainfall and extensive summer irrigation have made the Ghor the food bowl of Jordan.

Vulnerable populations in the selected regions

The vulnerable populations in the three selected regions are children under 5 years of age, poor people, elderly, special groups (nurseries, schools), general population in specific conditions (water contamination of the public water network, populations in remote areas with limited access to medical care), and the mentally and physically disabled individuals who are living alone (this increases the risk of not seeking medical attention when needed).

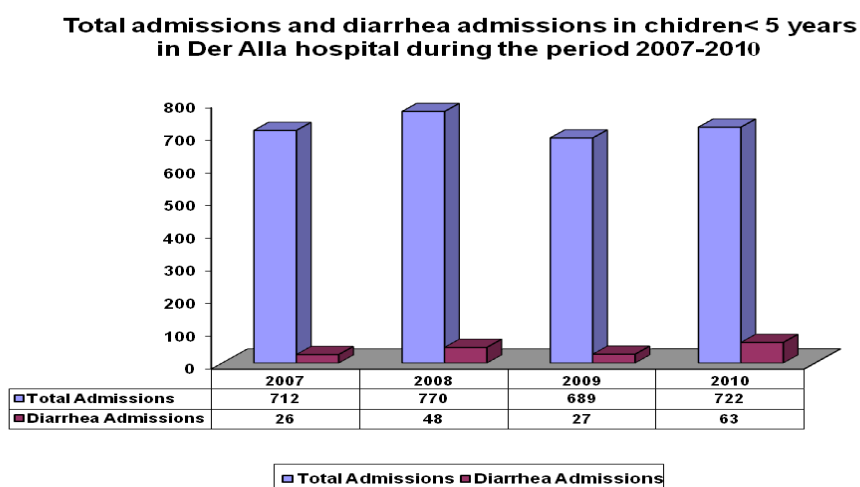
Current Status and Burden of Diarrheal Diseases in the Selected Regions

Diarrheal diseases are still considered a health problem in Jordan. This problem is more apparent in children less than 5 years of age. The 2010 Annual Report of Communicable Diseases showed that about 131000 cases of diarrhea were reported. The underreporting of diarrhea to public health authorities is present in Jordan as in other countries. There are many reasons for underreporting of diarrhea including unawareness of healthcare providers, lack of feedback, absence of training, and ignorance of case definition. Therefore, the number of actual diarrhea cases is much more than is being reported. Due to introduction of Oral Rehydration Solutions (ORS), free of charge, since the 1970's, mortality caused by diarrhea has been decreased dramatically. This modality of treatment is supported by WHO. No deaths related to diarrhea have been reported since many years.

Burden of diarrheal diseases

- Tens of thousands of Jordan's population, mostly children have diarrhea episodes every year;
- Studies showed that children with diarrhea are admitted to hospitals for a mean of 4 days;
- An important cause of admissions of children to hospitals is diarrhea as seen in Figure 5.

Figure 5 Total admissions and diarrhea admissions for children <5 years in Deir Alla Hospital (2007-2010)



- Patients with diarrhea need medications, laboratory investigations, and causes absenteeism from work or school;
- Absenteeism from work for parents of sick children treated at home or admitted to hospital;
- Children with diarrhea admitted to hospitals are estimated at 5% of all diarrhea cases;
- A study conducted in south Jordan revealed that Rotavirus was the causative agent of diarrhea in about 40% of admitted children with diarrhea. (29) The MOH estimated that the annual cost of diarrhea in children less than 5 years is about USD 5 million;

- Food poisoning outbreaks are a challenge for public health authorities. Jordan has experienced food poisoning outbreaks with hundreds of people affected in the relevant outbreaks (Zarqa 2006, Madaba 2007). Most food poisoning outbreaks occur in private homes (Figure 6).
- Food poisoning outbreaks can affect all age groups. Figure 7 shows the age distribution of food poisoning cases in 2010, which indicates that the highest number of cases were among age group 10-19 years.
- Factors that play a role in food poisoning include use of contaminated raw food ingredients, contact between raw and cooked foods, and poor personal hygiene by food handlers. A key aspect is that food poisoning is almost 100% preventable.

Figure 6 Distribution of food poisoning outbreaks in 2010

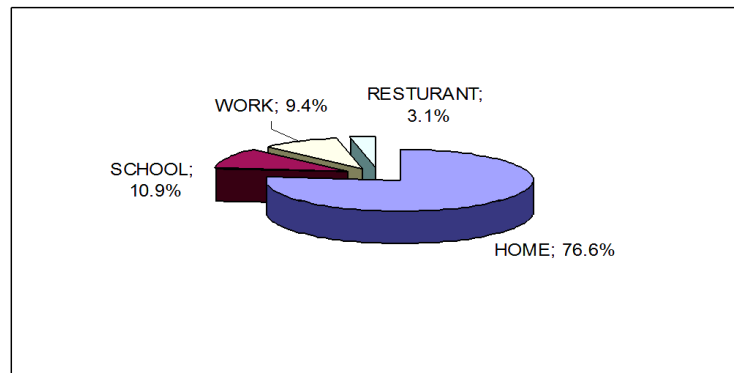
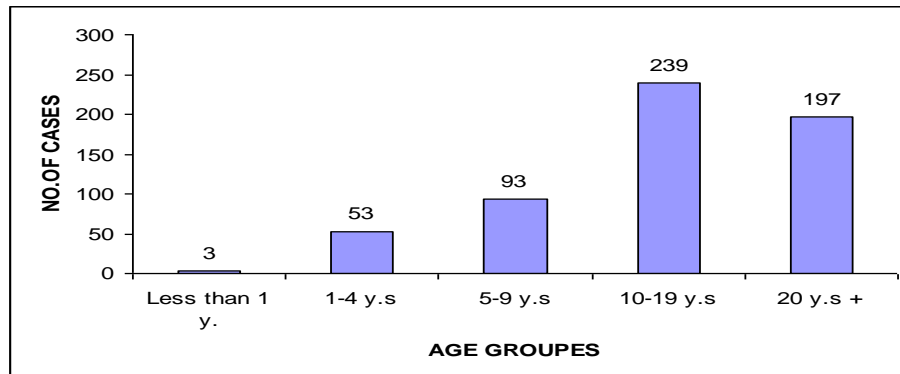


Figure 17 Age distribution of food poisoning cases in 2010



Trends in the incidence of W&FBDs

Data shows that the incidence of water and food-borne diseases usually increases during summer (Figure 8). The same applies in Zarqa and Ajloun for the last five years as shown in Figures 9 and 10. An exception to this trend is at Al Aghwar region, including Deir Alla, where diarrhea cases increase during the fall season, as shown in Figure 11. Explanation of this trend is that during this season farmers are using untreated organic fertilizers (manure) for cultivation of vegetables. This leads to presence of enormous numbers of flies in this region, which can transmit microorganisms responsible for diarrheal diseases.

Figure 8 Distribution of diarrhea cases per month for the last 15 years

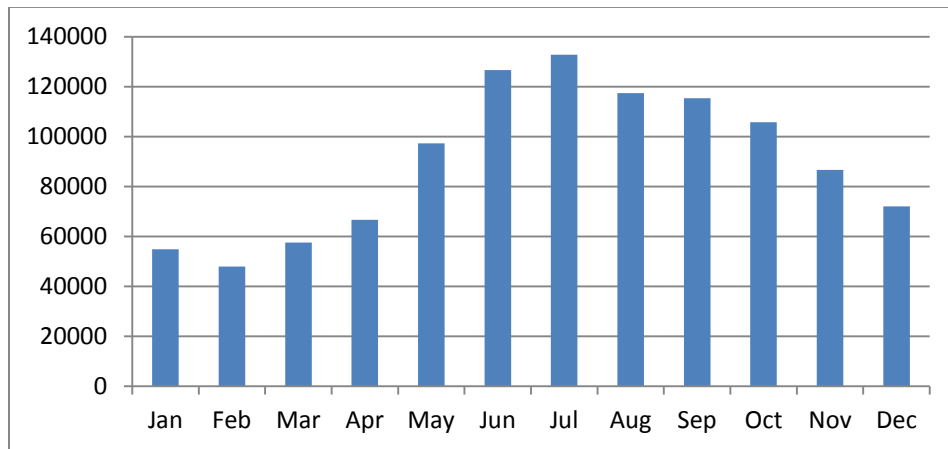


Figure 9 Distribution of diarrhea cases in Zarqa for the last 5 years

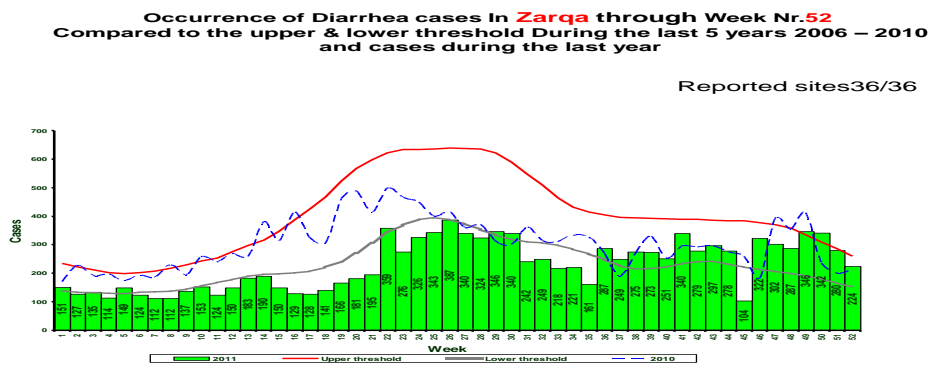


Figure 10 Distribution of diarrhea cases in Ajloun for the last 5 years

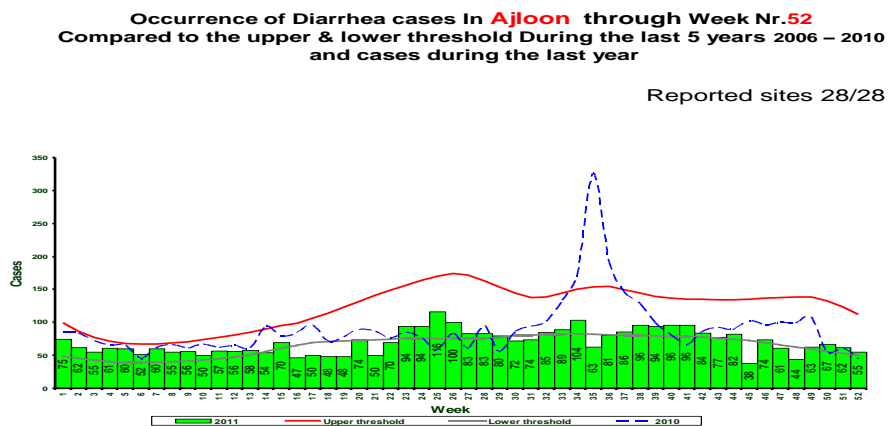
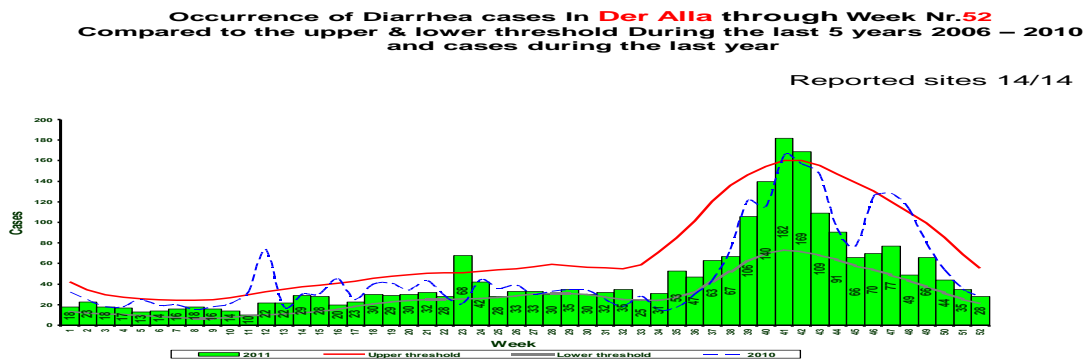


Figure 11 Distribution of diarrhea cases in Der Alla for the last 5 years



The distribution of diarrhea cases in the three regions is shown in Figure 12. Figure 13 shows the cumulative monthly distribution of diarrhea cases during the period from 1996 to 2010.

Figure 12 Distribution of diarrhea cases in the three regions for the period (2007-2010)

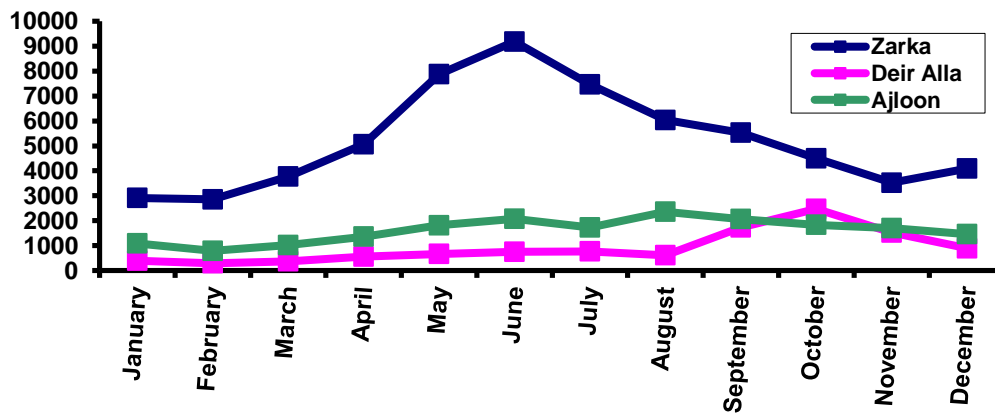
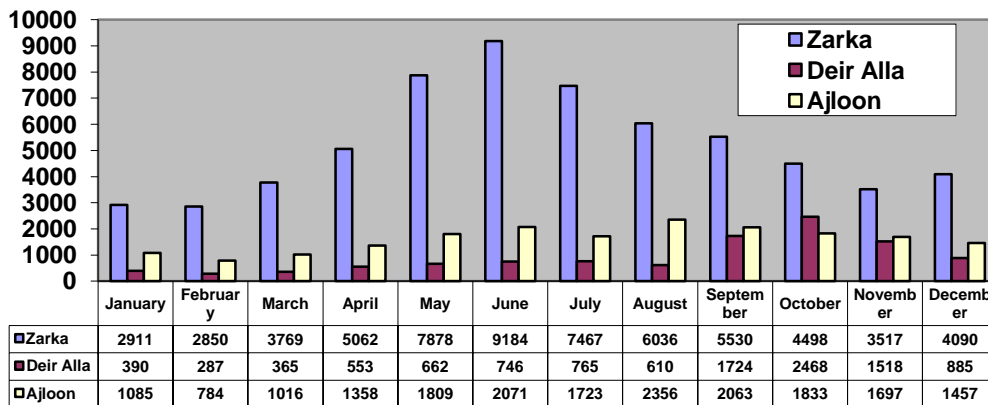


Figure 13 Cumulative monthly distribution of diarrhea cases during the period (1996-2010)



Factors other than Climate that Determine Vulnerability

Several factors other than climate influence vulnerability to water and food-borne diseases. These are:

Adequate safe water supply: The lack of adequate safe water supply leads people to other sources of water. The alternate sources are usually contaminated with pathogenic agents, which results in diarrhea outbreaks. A study showed that the use of safe household water decreases the incidence of diarrheal diseases by 40% (31, 32). In Jordan, more than 98% of houses are connected to public water network.

Sanitation: According to WHO, diarrhea morbidity could decrease by 32% with improved sanitation such as pit latrines, septic tanks, and composting toilets (33). Studies demonstrated a median reduction of 55% in all-cause child mortality associated with improved access to sanitation facilities (34). The greatest effect of improving sanitation systems will be in areas of high population density and wherever the entire community, rather than single households. An analysis of 21 controlled field trials related to water disinfection and safe water storage at the household level showed a reduction of 42% in diarrheal disease compared with other groups. (35)

Personal hygiene: Incidence of water and food borne diseases is affected by hygiene. Transmission of pathogenic agents from one person to another can occur due to lack of hygiene. Water and food borne diseases that can be transmitted by this mode include Salmonellosis, Shigellosis, and Typhoid fever. A recent review of the literature found that the single hygiene practice of hand washing with soap is able to reduce diarrhea incidence by over 40%. (36)

Food safety: Food-borne diseases can occur due to contamination during any stage of food processing. Many factors contribute to food borne diseases including verity, globalization, wars, and consumption of raw foods.

Political status: In countries with political instability and civil wars, infrastructures will be damaged with increased vulnerability to many diseases including water and food-borne diseases.

Natural disasters: Earthquakes, flooding, and other natural disasters are usually accompanied with increased vulnerability to many diseases including water and food-borne diseases.

Poverty (Household income): It is associated with poor housing, crowding, dirty floors, lack of access to sufficient clean water or to sanitary disposal of faecal waste, cohabitation with domestic animals that may carry human pathogens, and lack of refrigerated storage for food.

Population growth and demographic changes

Standards of living, growing socio-economic inequality; Nomadic and semi-nomadic peoples; displaced populations Bedouins and gypsies

Accessibility to health care facilities

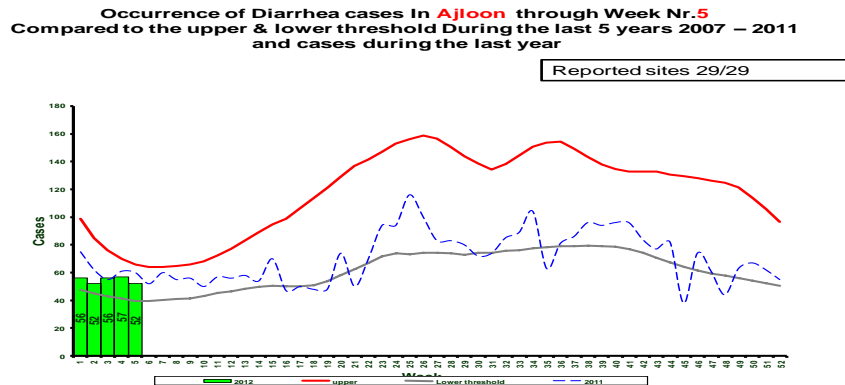
In addition to: Age and gender distribution; Life-expectancy at birth;The general health status and immunity; Current prevalence of climate-sensitive infectious diseases; Disease-specific risk groups; The structure and function of the health system;The density and geographical distribution of the population; and the magnitude of travel and trade, indicator for the risk of introducing new diseases

Current Programs and Activities to Manage W&FBDs

Ministry of Health

Diarrheal diseases are under surveillance by MOH since 1982. Health centers, clinics, and hospitals notify the reporting sites on weekly basis in normal conditions and immediately in case of outbreaks. The 21 reporting sites send reports to the DCD at MOH on weekly basis in normal conditions and immediately during outbreaks. DCD supervises the epidemiological status in Jordan and participate with the reporting sites in outbreak investigation. Every Wednesday, DCD issues the weekly epidemiological report for diarrhea and other infectious diseases. Figure 14 demonstrates an example of diarrhea cases in one reporting site.

Figure 14 Diarrhea cases in Ajloun during week (5), 2012



The green columns are the number of cases during the epidemiological weeks (the year has 52 epidemiological weeks). Every epidemiological week starts on Saturday and ends on Friday. The red line shows the upper threshold of cases for the last 5 years, the gray line shows the lower threshold for the same period, while the dotted blue line shows the number of cases during the last year. This graph explains the current status and provides instant comparison of the current status with that during the last year and the last five years, and it also detects outbreaks. The following are the current programs and activities at MOH to manage diarrheal diseases:

Integrated Management of Childhood Illnesses (IMCI): IMCI is a strategy developed by the WHO’s Division of Child Health and Development and UNICEF. It has been introduced in more than 30 countries around the world including Jordan, to address morbidity and mortality in children under five years. This strategy is under implementation in Jordan since 2008.

Cholera Surveillance: cholera is caused by the bacteria *Vibrio cholera*. It settles wherever poor hygiene permits it to infect humans. Though last outbreak of cholera in Jordan was in 1981, the disease is still endemic in many countries in Asia, Africa, South and Central America, challenging the health systems in these countries. In the neighboring country Iraq, many outbreaks of cholera occurred during the last years for example in 2007. (30) Strict laboratory based surveillance for cholera is running in Jordan. Stool samples from patients with diarrhea who attend health centers or hospitals are tested for *Vibrio cholera*. Ideally, 5 to 15% of diarrhea cases should be tested. This variation in the tested sample for cholera depends on the season (increases in summer) and the presence of an outbreak in the other countries with potential of transmission to Jordan.

Rotavirus Surveillance Program: 3 Sentinel sites were selected to study the incidence of rotavirus among admitted children < 5 years with diarrhea. Three hospitals represent the 3 regions of the country, namely, middle (Al Bashir hospital), north (Princess Rahma hospital) and south (Al Karak hospital). All admitted children < 5 years of age with diarrhea are tested for rotavirus. Other data are obtained

through a well-structured form. This type of surveillance illustrates the magnitude of diarrhea leading to admission and the magnitude and trends of diarrhea related to rotavirus. Results showed that about 46% of admitted diarrhea cases are due to Rotavirus (Table 3).

Table 3 Rotavirus among admitted diarrhea cases

Hospital	EIA +ve	EIA-ve	Total
Albashir	85 44.7%	105 55.3%	190 100%
Rahma	79 56.4%	61 43.6%	140 100%
Alkarak	83 41.3%	118 58.7%	201 100%
Total	247 46.5%	284 53.5%	531 100%

Water Quality Surveillance Programs: The Environmental Health Directorate (EHD) at MOH manages and supervises the Water Quality Surveillance Programs implemented by the Health Directorates in the governorates to ensure the safety of drinking water. These programs cover water resources including public and private wells; water distribution systems; reservoirs; major public base stations and pumping stations; and private household reservoirs (tanks). Water samples are collected according to an annual plan. The frequency of collection of water samples from different locations of the water supply system complies with the requirements of the Jordanian Standard No. 286/2008 on drinking water quality. Samples are tested for microbiological parameters in the Water Laboratories at the Health Directorates; whereas, chemical analysis of water samples is carried out at the EHD Laboratories in Amman. Weekly and monthly reports are issued on water quality.

Water samples are tested routinely for Total Coliform Count (TCC) and for *Thermotolerant Coli forms* (TTCC). Other occasional tests include nitrobacteria: *cholera, salmonella and shigella*. Water samples are considered safe if the MPN of TCC is < 1.1/100 ml and TTCC is not detected in 100 ml sample. Multiple Tube Fermentation (MTF) is the method in use for TCC and TTCC. Residual chlorine is measured every time a sample is collected for microbiological testing.

The following physical and chemical parameters are tested for once every year for protected ground water sources and once every three months for surface waters (unsafe sources): pH, turbidity, colour, TDS, TH, Fe, Cu, Mn, NH₄, Zn, Na, SO₄, Cl, NO₂, NO₃, Al, and F. Heavy metals are tested once a year.

The Central Public Health Laboratory (CPHL) of the MOH is a reference laboratory for *Salmonella*. The laboratory has the capacity to isolate, differentiate, and serotype *Salmonella* isolates. It is part of Pulse Net Middle East network for genotyping of *Salmonella* isolates and was certified for *Salmonella* preparation and analysis by NAMRU 3 in Cairo and CDC in Atlanta /GA. The CPHL is currently preparing *Salmonella* database for Jordan, naming of patterns, identifying unique patterns and clusters. In addition, CPHL isolates, differentiate, and serotype *Shigella* isolates.

The CPHL, in close collaboration with DCD and the Health Directorates, conducts laboratory surveillance for food poisoning outbreaks.

Jordan Food and Drug Administration

The Jordan Food and Drug administration (JFDA) is linked with the international bodies responsible for the rapid alertness of food crisis at the worldwide level (EFSA & Infosan), and follows up any related alertness in order to stop any hazard in the imported food as quickly as possible before reaching the consumers. JFDA controls and monitors imported food at border points and requests the necessary laboratory tests according to international standards.

JFDA inspects the food industries regularly and enforces GMPs and HACCP system, and examines their products at the licensing stage and when issuing export hygiene certification. In addition, periodic inspections of food establishments are carried out based on risk assessment. JFDA participates in the investigation of food poisoning outbreaks together with MOH and carries out the necessary action to stop further exposure to the contaminated foods.

UNRNWA

The United Nations Relief and Works Agency for Palestine Refugees (UNWRA) plays an important role in managing diarrhea in refugee camps; it notifies DCD about the number of diarrhea cases attending UNRWA clinics on weekly basis and immediately in case of unexpected increase of these cases. It also participates with MOH in outbreak investigations in refugee camps.

Ministry of Agriculture

The MOA developed a National Action Plan to control houseflies in the Jordan Valley, which is being implemented since 2003, in cooperation with the relevant ministries and agencies. The control campaigns are carried out twice a year.

The MOA issued Instructions No 4g/2004, which stipulates the conditions for reusing untreated and treated wastewater and brackish water for irrigation purposes. The Instructions prohibit using untreated wastewater for irrigation, as well as treated wastewater (reclaimed) for the cultivation of vegetables eaten raw; which, if found, are destroyed immediately.

MOA controls fresh fruits, vegetables, and fresh meat (imported or exported) through different agricultural quarantine centers distributed at the points of entry. The produce is examined directly by specialized agricultural engineers and veterinarians. Fresh products are examined at the MOA laboratories (toxicity laboratories in Baka'a and veterinary laboratories in Jawa).

Ministry of Water and Irrigation

The MWI, WAJ and the associated water companies (if the water system is located within the administrative area of the company) have full responsibility for public water supply systems, sanitation, and related projects, as well as planning, construction and maintenance of all water resources.

WAJ, among other activities, implements continuous monitoring programs to ensure safe drinking water is provided to consumers, which complies with the relevant national standard. Monitoring includes water resources, pumping stations, treatment plants, water reservoirs, and networks. Water sources, before and after treatment, are monitored to ensure the effectiveness of treatment and determine the stability of the water quality.

Preventive, proactive methodologies and programs are adopted to ensure the safety of water sources, such as watershed management, Water Safety Plans, and Public Awareness programs.

Ministry of Environment

The MoEnv, according to the Environment Protection Law No 52/2006, is the competent authority for the protection of environment in Jordan, including water resources. MoEnv monitors, through contracts with other agencies, ground water, including Beerain 2, Qnaya, and Safawi (Zarqa); dams; springs, including many sites in Zarqa; and wastewater treatment plants, including the ones in Zarqa and Kofranja (Ajloun). Environmental Impact Assessments for development projects focus on ground and surface water protection, among other environmental issues.

Royal Scientific Society

The RSS is the largest applied research institution, consultancy, and technical support service provider in Jordan. The Environment Monitoring and Research Central Unit (EMARCU) aims at managing, operating and maintaining the "National Project for Real-Time Water Quality Monitoring". Its ultimate objective is public health and environmental protection and sustainability. The Water Quality Monitoring and Assessment at the RSS undertakes major environmental monitoring programs to assess levels of pollution and to assess compliance with national standards and regulations. It collaborates with various national ministries, as well as international agencies in implementing an array of development projects. It is involved in various national and regional projects that focus on issues of water management and agriculture including, the adoption of innovative water treatment techniques, the reclamation of water for agricultural purposes and the use of biosolid fertilizers as well as implementation of community-based projects related to Integrated Wastewater Management, grey water, low cost technologies, and climate change.

The RSS implements project on Water Resources Monitoring at the Jordan Valley (2006-present). This is a continuous project that is carried out in cooperation with Jordan Valley Authority and aims at monitoring and assessing the quality of various water resources in the Jordan Valley, including: rivers, dams , springs, canals...etc, and its suitability for agricultural purposes, as well as identifying seasonal variations on water quality.

In addition, another ongoing project is carried out for the MoEnv, namely the National Project for Studying and Monitoring Water Quality in Jordan (1986-present). The project aims at assessing the water quality at different resources and its compliance with Jordanian standards and regulations. Moreover, the project provides a database for water quality at the targeted resources.

Planned Programs and Activities to Manage W&FBDs

Ministry of Health

- Extension of sentinel surveillance for rotavirus by adding 3 health centers, one health center from each region (middle, north and south) and introducing rotavirus vaccine to the current national program for vaccination, as recommended by the WHO. The current vaccination program contains vaccines against 10 diseases (Tuberculosis, Diphtheria, Tetanus, Whooping cough, Hepatitis B, Haemophilus influenza b, Measles, Mumps, Rubella, and poliomyelitis). Rotavirus vaccine dramatically reduces the burden of diarrheal diseases; many countries in the region have introduced this vaccine. The annual cost of the vaccine (3 doses for each newborn) is estimated at \$ 5 400 000.
- Promotion of Exclusive Breastfeeding: The strategies include the following:
 - Hospital policies and actions to encourage breastfeeding and discourage bottle feeding
 - Counseling and education provided by peers or health workers
 - Mass media and community education

- Mothers' support groups

The estimated annual cost is \$ 150 000.

- Sustain and strengthen water-monitoring programs to ensure that supplied public water meets the specifications of the relevant Jordanian standards and identify high-risk areas. In addition, a National Strategic Plan for scaling up WSPs will be developed to cover the Country, and educational and awareness campaigns will be increased, focusing on the adoption of hygienic practices that affect water and food safety.
- Develop the capacity of the Central Public Health Laboratory by introducing Campylobacter diagnosis and genotyping, and share data on genotyping with regional laboratories Members of Pulse Net Middle East.

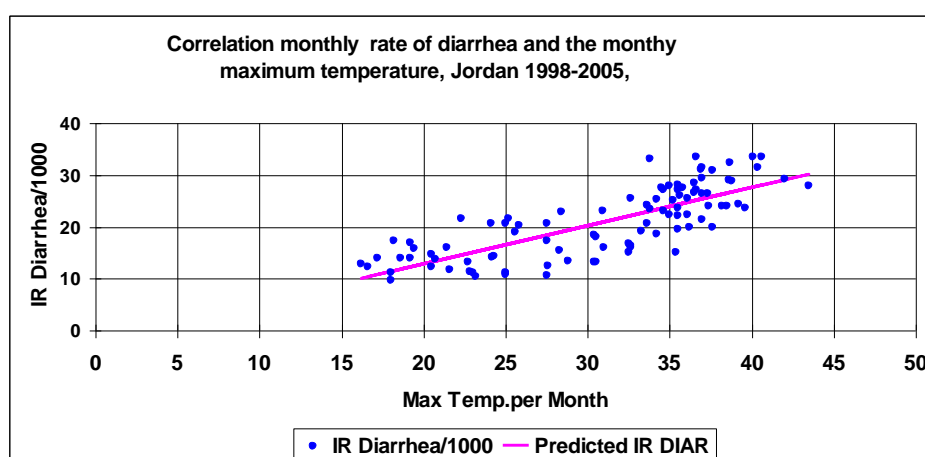
Vulnerability Assessment of Impacts of Climate Change on W&FBDs

Over the next decades, it is expected that several factors would influence the status of water and food-borne diseases. On the one hand, the positive expected aspects are improvement of sanitation and hygiene, introduction of new vaccines for some diseases such as cholera, rotavirus, typhoid, and E.coli, educational programs, and strict water monitoring programs and adoption of WSPs.

On the other hand, the negative expected aspects are increase in population with same running rates, economic constraints, political instability, increased shortage of water, emerging and re-emerging W&FBDs, and increase of slum areas.

It is evident that increased temperature and to lesser degree decreased precipitation, are the main climate variables that affect W&FBDs in Jordan. It was shown in Jordan's SNC that there is a strong positive correlation between diarrhea incident rate and the maximum monthly temperature (MMT), as shown in Figure 15 (Details in Chapter I) .The relationship has a coefficient of determination (R²) of 0.62, indicating that the variation in MMT accounts for 62% of the total variation in the monthly incidence rate of diarrhea. In other words 62% of the diarrhea cases could be attributed to the temperature. As MMT increases by 1°C, the incidence rate of diarrhea increases by 1 case/1000.

Figure 15 Correlation between monthly rate of diarrhea and monthly maximum temperature (1998-2005)



Adaptation Measures to Reduce Vulnerability and Enhance Preparedness against the Potential Negative Impacts of Climate Change on W&FBDs

The primary objective of adaptation is to decrease the burden of W&FBDs sensitive to climate change. It is a shared responsibility among a wide range of stakeholders.

MOH adaptation measures

- Strengthening of the current surveillance system, including establishment of effective and rapid reporting system
- Establishment of surveillance system for emerging and re-emerging diseases
- Constant special surveillance for rotavirus and cholera
- Undertaking epidemiological studies to detect further risk factors and vulnerable populations in high-risk areas for more effective adaptation measures
- Capacity building
- Logistical support and adequate supplies (including antiviral, medications, vaccines, etc)
- Increasing awareness among populations regarding climate change sensitive diseases and preventable measures
- Strengthen and activate the existing National Centre for Disaster Management
- Establish intersectoral coordination mechanisms, as many adaptation measures require many governmental sectors to be involved
- Improve access to medical care for vulnerable people who live in remote areas
- Strengthen regional collaboration and share experiences and information on adaptation among countries in the region
- Strengthen international collaboration with WHO, CEHA, and other organizations. MOH, as the focal point for IHR, is committed to notify IHR about any public health issue regarding W&F borne diseases of international concern
- Strengthen collaboration with the private sector and other non-governmental organizations involved in adaptation issues
- Develop and operate an Early Warning System, and effectively disseminate warning to stakeholders especially at the local level.

Jordan Meteorological Department

- Collaborate with MOH in implementing the EWS through timely dissemination of weather data
- Establish systems for weather data sharing with MOH and other sectors

JFDA

- Focus food inspection activities on food handled by street vendors, as these are most vulnerable to temperature rises and the need to restrict this type of trading food
- Strengthen inspection on the effectiveness and efficiency of various cooling methods which are used in food establishments for conservation of foods that needs refrigeration or freezing as the primary means to preserve it and maintain its validity
- Review, amend, issue regulations to control the introduction and spread of food borne diseases during food production, processing, transport and storage
- Improve surveillance programs for food-borne disease outbreaks
- Increase educational and awareness programs on appropriate food handling measures and HACCP

Non-governmental organizations and community leaders

- Develop awareness campaigns on climate change sensitive diseases and preventable measures
- Develop awareness campaigns on efficient and safe use of water and hygiene practices

CPHL

- Establish a laboratory based surveillance system that include diseases sensitive to climate change
- Capacity building
- Regional collaboration
- International collaboration

JSS

- working with other sectors in many activities such as successful management of recycled water
- Supports researches in many fields concerning W&F borne diseases such as quality of water

Ministry of Environment

- Foster issuing the National Climate Change Policy, to become a roadmap for all sectors in both adaptation and mitigation initiatives; with special focus on health impacts resulting from climate change and certain adaptation projects
- Activate the National Climate Change Committee to disseminate knowledge and information on the various activities, ongoing projects, and cross-cutting issues relevant to climate change, and guide research and studies to fulfill the needs and bridge the knowledge gap
- Incorporate impact of development projects on climate change in EIA; with special focus on health impacts
- Ensure that Jordan's Third National Communication to the United Nations Framework Convention on Climate Change (UNFCCC) addresses the impact of climate change on health

Ministry of Agriculture

- Intensify water harvesting (earthen dams and excavations) in various regions, especially in pastoralist areas
- Develop and direct agricultural research programs toward the efficient use of irrigation water and crop species and varieties tolerant to drought; and cooperate and coordinate with research institutions in this regard
- Development of irrigation water management in the Jordan Valley to reduce water loss and the involvement of organizations of farmers in planning and management of water programs
- The provision of soft loans for the implementation of agricultural water harvesting means
- Capacity building

Ministry of Water and Irrigation

- Ensure minimum household water requirements to protect health are met
- Reuse of treated wastewater (for green spaces)
- Develop new water resources
- Improvement of water quality, e.g. water treatment
- Improve reduction of water losses
- Introduction of water saving technologies like low-flow toilets and showers

- Studies on adaptation measures and adaptation alternatives that do not have negative health impacts
- Develop early warning system for upcoming droughts
- Education, awareness campaigns on climate change, its impacts on water scarcity and availability and adaptation

Qualitative Cost Benefit Analysis

A qualitative analysis is shown in Table 4 to highlight the benefits of implementing adaptation measure in terms of avoidable health impacts related to water and food-borne diseases.

See Chapter 8 for detailed Climate Change Adaptation Strategy and Plan of Action to Protect Health.

Table 4 Adaptation measures of climate change and W&F borne diseases and avoidable health impacts

Adaptation Measures	Avoidable Health Impact
Strengthen current surveillance program	Reduce risk of W&F borne diseases incidence
Undertake epidemiological studies to detect further risk factors and vulnerable populations	Improvements of preventive measures
Strengthen surveillance for rotavirus and cholera	Reduce risks of cholera and diarrhea
Capacity building	Reduce morbidity and mortality
Adequate supplies (vaccines and medications)	Prevention of diseases and efficient case management
Increasing awareness among populations regarding climate change sensitive diseases and preventable measures	Reduce incidence of W&F borne diseases
Establishment of intersectoral coordination mechanisms	Prevention of W&F borne diseases
Early warning system	Prevention of W&F borne diseases
Sanitation improvements	Prevention of W&F borne diseases
Education programs on appropriate food handling	Prevention of W&F borne diseases
Education for efficient use of water	Prevention of W&F borne diseases
Education about hygiene practices	Decrease incidence of W&F borne diseases
Establishment of a laboratory based surveillance system	Early detection and control of W&F borne diseases

Early Warning System on W&FBDs and Climate Change

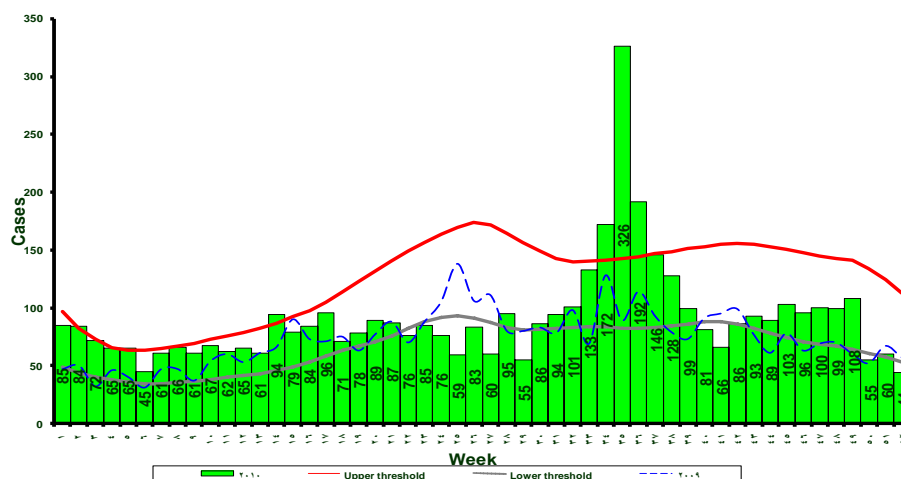
Jordan, similar to other countries, will suffer from climate change. The main climate change projections according to studies done regionally and globally includes increased temperature, decreased precipitation, drought, water scarcity, and flooding. Diarrheal disease (watery and bloody) is a compulsory notifiable disease in Jordan. It is included in Group B notifiable diseases (weekly reporting). Outbreaks of diarrhea are common in Jordan, with *salmonella*, *shigella*, and *rotavirus* as the main causative agents.

Increased incidence, morbidity, mortality, and burden of W&FBDs are among the predicted health outcomes of climate change, as shown in the previous sections. The projected increase will include diseases due to currently prevalent pathogens, emerging and re-emerging pathogens, and chemicals and toxins.

Case Study on the importance of developing an EWS for W&F borne diseases

The diarrhea outbreak that occurred in Ajloun during the summer of 2010 is an example of diarrhea outbreaks associated with the use of unsafe water due to scarcity of safe drinking water, which will be induced as a result of climate change. Before this outbreak, Ajloun city experienced 2 weeks of no water supplied through the public water network. As a result, inhabitants of the region looked for other sources of water. Among these sources was the Anjara spring, which is located inside a densely populated area. Water samples tested from this spring proved it was contaminated and unsafe for using. Some people insisted to use this water. There was a slight increase in diarrhea cases in Ajloun during the epidemiological week 33 (14-20/8/2010). The outbreak peaked during week 35, and the number of diarrhea cases went above the upper threshold in week 38, as shown in Figure 16. During the outbreak, notification of diarrhea cases by health centres and the only hospital there became daily to follow up the outbreak closely.

Figure 16 Diarrhea cases in Ajloun (2010) indicating the outbreak



An outbreak investigation was conducted by DCD, EHD, PHCL, and Ajloun Health Directorate. Laboratory investigations proved presence of *shigella* in stool samples from patients and in water samples from the spring. During this outbreak, epidemiological, laboratory, and environmental investigations were carried out, as well as educational campaigns for the public regarding the importance of using safe water. The MWI was requested to increase the quantity and frequency of

water supplied to Ajloun through both public network and tanks. Moreover, stricter measures in controlling the spring, as well as other springs were placed.

The interventions by MOH and the other relevant bodies illustrate the importance of having an immediate and comprehensive response plan during disease outbreaks together with well-identified, monitored, and reported indicators.

Objectives of the EWS

The EWS for W&F borne diseases would follow the *People-centered Early Warning Systems Model (P-CEWS)*. The aim of the P-CEWS is to empower individuals and communities facing hazards to act in sufficient time and in an appropriate manner to reduce personal injury, loss of life, damage of property, and the environment, and loss of livelihoods.

The Objectives of the EWS for W&F borne diseases are:

- Immediate response to potential outbreaks
- Proper interventions to prevent potential outbreaks
- Reduction of incidence of climate change sensitive W&F borne diseases
- Reduction of morbidity of W&F borne diseases
- Reduction of mortality of W&F borne diseases
- Reduction of economic burden of W&F borne diseases

Structure of the EWS

In terms of public health surveillance, Jordan is divided into 21 reporting sites. A set of health centers, clinics, and hospitals reports communicable and diarrheal diseases to the relevant reporting site.

Therefore, the EWS for W&F borne diseases sensitive to climate change will be functioning at 3 levels:

- 1- Central level: DCD,EHD,CPHL
- 2- Regional level: Reporting Sites
- 3- Health facilities level (health centers, clinics, and hospitals)

The characteristics of the planned EWS are:

- | | | |
|--------------------------------|------------------------------------|---|
| - Simple | - Clear responsibilities | - Reach people at risk |
| - Reliable | - Legal frame work | - Appropriate action plans |
| - Clear communication channels | - Warnings issued by one authority | - Cost effective |
| - Coordination | - Good governance | - Minimum false positive and false negative |
| - Continuous | - Transparent | - Flexible |

Staffing of EWS

A special unit will be established at the DCD in charge of the EWS for W&F borne diseases sensitive to climate change.

Timing of EWS

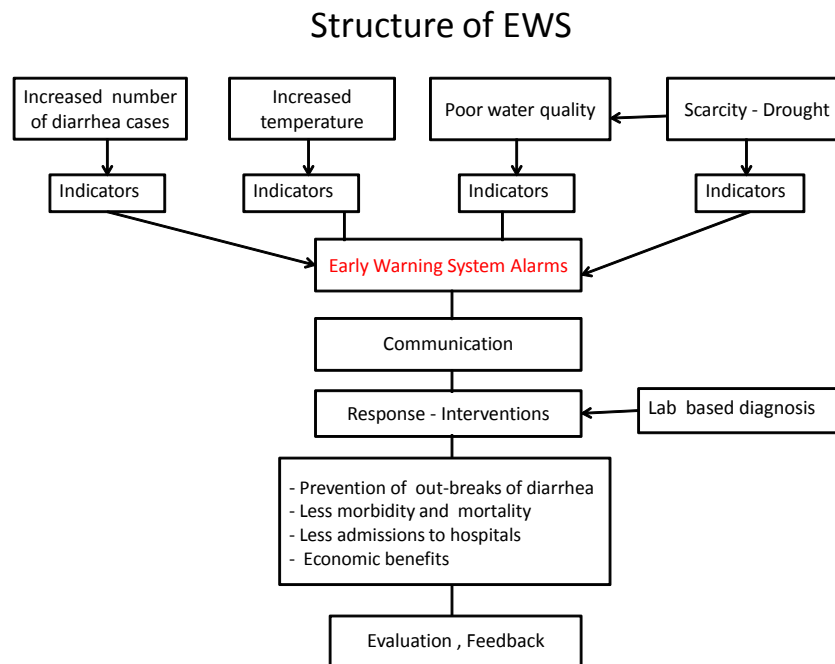
Several factors influence the occurrence of W&F borne diseases, in addition to climate variables. Therefore, the EWS would be functioning year-round and not limited to one specific season.

Participants of EWS

The system should be developed in collaboration with all relevant stakeholders to ensure that the issues of greatest concern are identified and addressed, thus increasing the likelihood of success. Stakeholders include the agencies that will fund the development and operation of the system. Participants of EWS include DCD, EHD, CPHL, MWI, WAJ, MOA, JFDA, and media.

The structure of the EWS is illustrated in Figure 17.

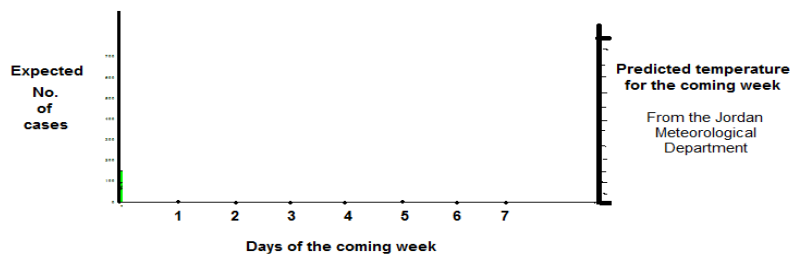
Figure 17 EWS for W&F borne diseases structure



EWS indicators

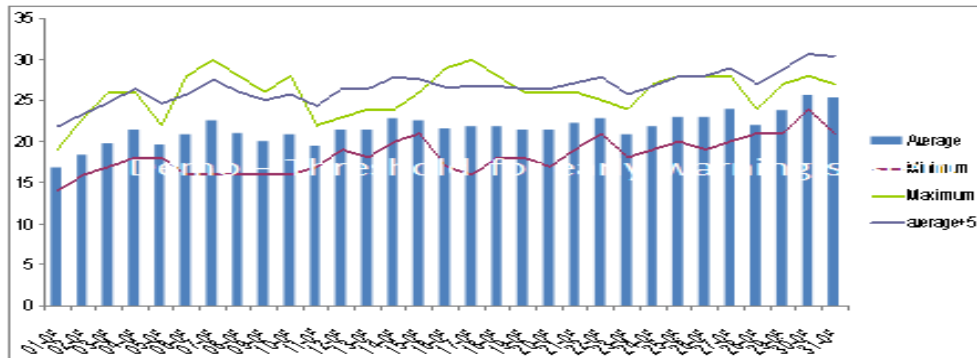
1. Increased temperature above the daily mean maximum for the different regions in Jordan: Threshold will be determined according to the last five years. The MD sends this indicator to the steering unit. The following graph (Figure 18) illustrates this indicator and the temperature threshold at which the EWS will operate and communicate the appropriate messages.

Figure 18 EWS indicator: predicted temperature vs. expected number of diarrhea cases



The temperature during May 2010 (Figure 19) gives an example of the threshold of temperature at which the EWS unit may trigger warning to stakeholders to take preventive measures.

Figure 19 Minimum, maximum, average, and 5-year average temperatures during May 2010



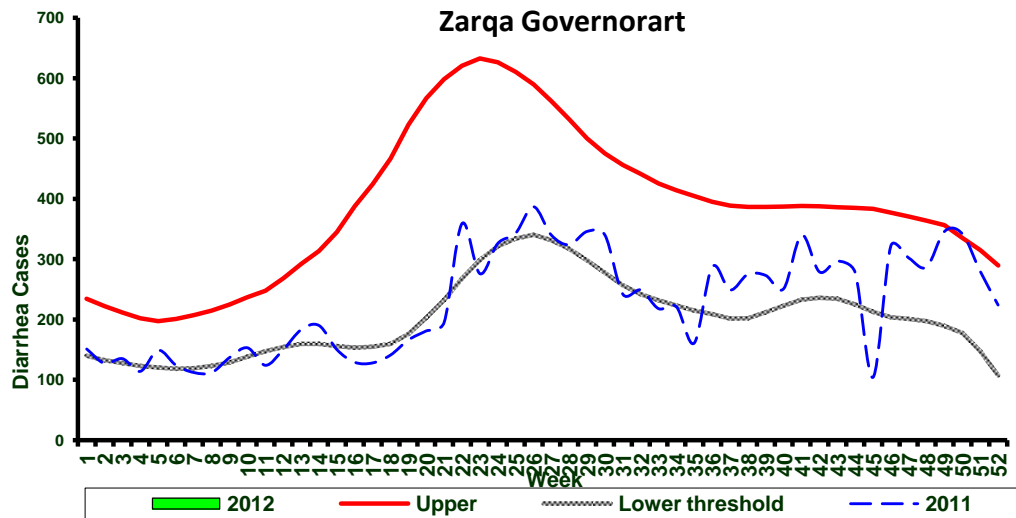
2. Water Quality Triggers (WQT) monitored by MOH and WAJ:

These triggers are activated by:

- Results of the continuous monitoring programs from the testing laboratories at MOH and WAJ
- Results of the investigation that MOH and WAJ or the water operator will carry out when receiving complaints from water users. The minimum threshold for this trigger is 3 houses having the same problem and receiving water from the same network
- The microbiological quality indicators exceeding the set limits in the relevant Jordanian Standard
- High chlorine demand for surface water bodies
- Trend analysis of the data from the monitoring programs of MOH/EHD and WAJ for finished and raw water. WAJ and MOH/ EHD must set the limits of the trends based on historical data (i.e. the past 2 years) for each source. The recent trends must not exceed the upper control limit set at 95% confidence limit.
- Malfunctions in the water treatment plants that would compromise the quality of the finished water. The threshold of this trigger will depend on the site of the treatment plan, the availability of potential contamination sources around the plant, the susceptibility to some weather conditions like flood, rain, etc. The supervisor of the treatment plant must inform MOH and WAJ about such cases.
- Special graphs will be designed to define the relationship between the number of diarrhea cases and the quality of water.

3. Number of cases with diarrheal diseases: The surveillance system in Jordan determines the upper threshold of diarrhea cases in all reporting sites (21 sites), and subsequently in all hospitals and health centers in each reporting site. The following graph shows the upper threshold for diarrhea cases in Zarqa. The upper threshold is the 90th percentile of the readings during the last 5 years (Figure 20).

Figure 20 The upper threshold for diarrhea cases in Zarqa



4. It is reported that in some situations, the early warning sign for poor water quality is the detection of outbreak. Then, outbreak investigation reveals that the outbreak is due to consumption of contaminated water, which is in turn due to scarcity of safe drinking water. In this case, EHD and occasionally MWI, participate in outbreak investigation. In outbreaks due to food poisoning, investigations determine the source and cause of the outbreak. JFDA is a key partner in outbreak investigation of food poisoning.
5. Number of admitted cases to hospitals with W&FBDs:

The number of admitted cases of diarrheal diseases is an important indicator for the EWS. The proportion of admitted cases is also an indicator of the severity and probable cause of the diarrheal disease. During outbreaks, notification of admitted cases changes from weekly to daily until the end of the outbreak.

Communication of the EWS

The dissemination of warnings often follows a cascade process, which starts at the national level and then moves outwards or downwards in scale to regional and community levels. Early warnings may activate other early warnings at different authoritative levels, flowing down in responsibility roles, although all are equally necessary for effective early warning. Once the EWS detects an indicator that may lead to outbreak of W&F borne diseases, an alarm will be communicated to the concerned sector such as vulnerable populations, health facilities (hospitals, clinics, health centers), DCD, EHD, Health Directorates, PHCL, JFDA, MWI, MOA, and media.

Mode of communication of alarms

The communication of alarms will be performed through rapid, efficient modes such as mass media (TV, Radio, and Newspapers), SMS, urgent official letters, telephone, Fax, and e-mail. The response plan will be implemented in the affected or at risk region.

Interventions will be implemented when:

- Reporting from EHD about detection of contamination of the public water in a specific area

- Reporting from JFDA about detection of contamination of food in a specific area
- Collected data of diarrheal diseases are above the determined thresholds on weekly basis from health facilities in each reporting site
- Collected data of cases admitted to hospitals with diarrheal diseases are above the determined thresholds on weekly basis
- Immediate reports by health system staff and other information sources; Immediate alerts are encouraged even outside weekly reporting.

Intervention

Interventions depend on the causative agents and sources of W&FBDs, and include:

- Stop providing the vulnerable population with the contaminated water
- Provide vulnerable population with alternative sources of water
- Check and repair the public network
- Remove microbiological contaminants by appropriate methods such as: chlorination of water, boil water advisory or order before consumption
- Education campaigns for the public
- Removal of contaminated food off the market
- Closure of blamed establishments
- Outbreak investigation (epidemiological, environmental, laboratory)
- Proper and prompt treatment of patients

Monitoring and Evaluation of the EWS

M&E will be carried out for all phases of the planning process, development, and implementation. The main objectives of M&E are:

- Stock-take lessons learned
- Identify strong and weak points of the system
- Recommend ways forward for maintenance and/or integration of the system
- Define the effectiveness and efficiency of the EWS system

Monitoring will be carried out using indicators from the available data on the above-mentioned indicators such as temperature, water quality, number of patients with diarrhea, and number of admitted patients with diarrhea.

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CHAPTER 4 CLIMATE CHANGE AND VECTOR-BORNE DISEASES

Introduction

Vector-borne diseases (VBDs) are very sensitive to weather parameters. Weather variables that may influence VBDs are temperature, rainfall, floods, drought, humidity, wind, and daylight duration. Gubler *et al.* (2001) listed a range of possible mechanisms whereby changes in temperature and rainfall affect the risk of transmission of vector borne diseases. Temperature can affect both the distribution of the vector and the effectiveness of pathogen transmission through the vector, namely:

- Increase or decrease in survival of vector
- Changes in rate of vector population growth
- Changes in feeding behaviour
- Changes in susceptibility of vector to pathogens
- Changes in incubation period of pathogen
- Changes in seasonality of vector activity
- Changes in seasonality of pathogen transmission

Whereas rainfall effects are:

- Increased surface water can provide breeding sites for vectors
- Low rainfall can also increase breeding sites by slowing river flow
- Increased rain can increase vegetation and allow expansion in population of vertebrate host
- Flooding may eliminate habitat for both vectors and vertebrate hosts
- Flooding may force vertebrate hosts into closer contact with humans

Other indirect factors that are not related to weather variables and climate may also have an impact on VBDs. These include population growth and population movement, conflicts and poverty, changes in human behavior and residential pattern, changes in land use (due to development projects), water projects, new agricultural projects and practices, economic development projects, housing projects, labor forces from endemic countries, international travel and imported vector-borne diseases cases from abroad, vector control programmes, resistance of disease vectors and pathogens, and public health infrastructure and access.

Climate Change and VBDs

Current evidence suggests that inter-annual and inter-decadal climate variability have a direct influence on the epidemiology of vector-borne diseases. This evidence has been assessed at the continental level in order to determine the possible consequences of the expected future climate change (Githeko *et al.*, 2000).

By 2100, it is estimated that average global temperatures will have risen by 1.0–3.5 °C, increasing the likelihood of many vector-borne diseases in new areas. The greatest effect of climate change on transmission is likely to be observed at the extremes of the range of temperatures at which transmission occurs. For many diseases, these lay in the range of 14–18 °C at the lower end and about 35–40 °C at the upper end (Githeko *et al.*, 2000; Houghton, 2007).

Many papers addressed the effect of climate change on VBDs (Table 1) (Lindsay & Birley, 1996; Sutherst, 1998; Linthicum *et al.*, 1999; Githeko *et al.*, 2000; Gubler *et al.*, 2011; Hay *et al.*, 2002). This

includes diseases transmitted by insects (Malaria, Dengue, Equine Encephalitis, Onchocerciasis, Trypanosomiasis, Filariasis, Leishmaniasis, Plague, Rift Valley Fever, Yellow Fever, and Tick-borne Hemorrhagic Fevers) and snail-mediated diseases (schistosomiasis).

Table 5 Climate change and impact of weather factors on vector-borne diseases (Modified after Gubler et al., 2001)

Climate change →	Weather parameters changes →	Vector, parasite and host effects →	Disease transmission dynamics →	Vector-Borne Diseases
Global and regional changes of climate parameters (natural and anthropogenic)	Temperature Rainfall Floods Drought Humidity Wind Daylight duration	Vector longevity Vector development Pathogen development Vector and rodent habitat Vector and rodent host distribution Vector and rodent abundance	Length of transmission season Intensity of transmission Disease distribution Disease risk	Malaria Leishmaniasis Schistosomiasis Other VBDs
Potential Mitigation and adaptation measures	Reduce green house gases emissions	Source reduction Vector control Rodent control Training and research	Medical staff education Public education prophylaxis Protective measures	Surveillance Diagnosis Treatment Vaccine

Schistosomiasis

Only a few attempts have been made to predict changes in the spatial distribution of schistosomiasis transmission due to global warming; results have been conflicting (Martens et al., 1997). Although an early model of global warming predicted that the area conducive for schistosomiasis transmission would expand (Martens et al., 1995) later models forecasted a decrease in the epidemic potential of schistosomiasis (Martens et al., 1997). Although the nature and extent of climate change on the transmission of schistosomiasis remain poorly understood (Morgan et al., 2001), there is consensus that the most sensitive areas are around the borders of the current transmission (Sutherst, 2004).

Mas-Coma et al. (2009) showed that trematodes, similarly as other helminths presenting larval stages living freely in the environment and/or larval stages parasitic in invertebrates easily affected by climate change as arthropods and molluscs as intermediate hosts, may be largely more susceptible to climate change impact than those helminths in whose life cycle such phases are absent or reduced to a minimum. Although helminths also appear to be affected by climate change, their main difference with microparasites lies on the usually longer life cycles of helminths, with longer generation times, slower population growth rates, and longer time needed for the response in the definitive host to become evident. Consequently, after a pronounced climate change in a local area, modifications in helminth populations need more time to be obvious or detectable than modifications in microparasite populations. Similarly, the relation of changes in a helminthiasis with climatic factor changes, as extreme events elapsed relatively long time ago, may be overlooked if not concretely searched for. All indicates that this phenomenon has been the reason for previous analyses to conclude that helminthiasis do not constitute priority targets in climate change impact studies.

More specifically, Zhou et al. (2008) gave evidences on the potential impact of rising temperature on the transmission of schistosomiasis in China. They found a temperature threshold of 15.4 °C for development of *Schistosoma japonicum* within the intermediate host snail (*Oncomelania hupensis*), and

a temperature of 5.8 ° C at which half the snail sample investigated was in hibernation. The combination of these temperature thresholds, together with the predicted temperature increases in China of 0.9 ° C in 2030 and 1.6 ° C in 2050 facilitated predictive risk mapping. They forecast an expansion of schistosomiasis transmission into currently non-endemic areas in the north, with an additional risk area of 783,883 km² by 2050, translating to 8.1% of the surface area of China.

Malaria

The distribution and seasonal transmission of malaria is affected by climate, as both vector and parasite are sensitive to temperature. Several factors within the life cycle of the malaria parasites and the mosquito vectors are related and affected to climatic changes. Rise in temperature and flooding are very much correlated to the increase in malaria cases in many parts of the world. Extreme weather events that cause flooding will intensify the transmission of desert malaria. Malaria parasites complete extrinsic incubation within the female mosquito in a shorter time as temperature rises (Turell, 1989), thereby, increasing the proportion of infective vectors.

The resurgence of malaria in Asia in the late 1960s and early 1970s provides a dramatic example of how quickly vector-borne disease trends can change. In India, Applying the criteria under the future climate change conditions (HadRM2 using IS92a scenario), it is projected that in 2050's, malaria is likely to persist in some districts, however, it may shift from the central Indian region to the southwestern coastal states of Maharashtra, Karnataka and Kerala.

Although there has been a reduction in precipitation in many parts of the African continent, there has been a mean increase of 300 mm per century in east Africa. Such changes are likely to support rapid development of malaria vectors and parasites in regions where there has previously been a low-temperature restriction on transmission. On the other hand, increased warming will have a negative effect at the high end of the temperature range of malaria vectors. The negative effect of reduced precipitation and drought has been seen in Senegal, where *A. funestus* has virtually disappeared and malaria prevalence has dropped by more than 60% over the last 30 years (Faye et al., 1995).

Martin & Lefebvre (1995) indicated that in a doubled CO₂ world the land areas where malaria can be potentially transmitted increased by 7–28%, depending on the global circulation model (GCM) used. Martens et al. (1995 & 1997) expected several million additional malaria cases by the year 2100.

Other scientist presented evidences that malaria transmission is not related to climate change. For example, Hay et al. (2002) investigated long-term meteorological trends in four high-altitude sites in East Africa, where increases in malaria have been reported in the past two decades. They showed that temperature, rainfall, vapor pressure in East Africa and the number of months suitable for *P. falciparum* transmission have not changed significantly during the past century or during the period of reported malaria resurgence. A high degree of temporal and spatial variation in the climate of East Africa suggests further that claimed associations between local malaria resurgences and regional changes in climate are overly simplistic.

In addition, elementary models suggest that higher global temperatures will enhance their transmission rates and extend the geographic ranges of some mosquito-transmitted diseases. However, the histories of three such diseases—malaria, yellow fever, and dengue—reveal that climate has rarely been the principal determinant of their prevalence or range; human activities and their impact on local ecology have generally been much more significant. It is therefore inappropriate to use climate-based models to predict future prevalence (Reiter, 2001).

Moreover, it is believed that adaptation strategies to climate change, such as irrigation schemes, can increase the risk of malaria (Ghebreyesus et al., 1999).

Leishmaniasis

Little was published on the effect of climate change and leishmaniasis. Speculations on the relationship between leishmaniasis outbreak and climate change has been reported from Arab countries. For example, it is believed that heavy rains in Sudan in 1985 and 1986 created ideal breeding conditions for the sand fly and resulted in an outbreak of cutaneous leishmaniasis in Khartoum with more than 10000 cases. Furthermore, there was a massive migration of population from endemic regions in the west of the country to the non-endemic Nile region north of Khartoum in 1984-85 following the drought in the west during this time (Neouimine, 1996).

Lindgren & Naucke (2006) gave a comprehensive account on leishmaniasis and the influences of climate and climate change epidemiology, along with its ecology and adaptation measures. They stated that with climate change, the distribution range of both the sand fly vector and the pathogen may extend northwards and into higher altitudes (WHO, 1999). In currently endemic areas, higher seasonal temperatures would lead to prolonged activity periods and shorter diapauses periods. This could result in an increased number of sand fly generations per year. In addition, higher temperatures are likely to accelerate maturation of the protozoan parasite, thereby increasing the risk of infection. However, if the climate becomes too hot and dry for the vector to survive, the disease may disappear from some localities even though the vector may adapt by resting in cool, humid places during the daytime.

Morillas-Márquez *et al.* (2010) studied the possible impact of climate change and the resurgence of leishmania in Spain. They speculated on the spread of the vector to new habitats that were not previously populated by sand flies, thus increasing the risk of transmission.

More recently, González *et al.* (2010) examined the effect of climate change and the risk of leishmania transmission in North America. This was based on the construction of ecological niche models using a maximum entropy algorithm for the distribution of two sand fly vector species and rodent reservoir species. These models predict that climate change will exacerbate the ecological risk of human exposure to leishmaniasis in areas outside its present range in the United States and, possibly, in parts of southern Canada. This prediction suggests the adoption of measures such as surveillance for leishmaniasis north of Texas as disease cases spread northwards. Potential vector and reservoir control strategies -besides direct intervention in disease cases- should also be further investigated.

Assessment of Current Vulnerability of VBDs in Jordan

Schistosomiasis

Schistosomiasis is a parasitic infection caused by species of the genus *Schistosoma*. In Jordan, one species is known to occur, *Schistosoma haematobium*, responsible for urinary schistosomiasis. This parasite has an intermediate host freshwater snail species, *Bulinus truncatus*. Schistosomiasis is associated with water development projects where new water bodies provide suitable breeding sites for the snail hosts.

For many years, Jordan was considered schistosomiasis free until 1975. Saliba *et al.* (1976) reported the first site infested with *Bulinus truncatus* in Muthalath Al-Masri, Jordan Valley and the first indigenous case. After that, *B. truncatus* snails have been found over a wide range of habitats covering the Jordan Valley, mountains of Jarash, most of the permanent water bodies, including dams, rivers, streams, irrigation pools, water ditches, and even water treatment plants.

Remarkable changes of water utilization patterns are continuing to occur in Jordan, this is exemplified by water extraction from the underground aquifers in remote and arid environments in the Eastern Desert and Wadi Rum area to meet the demand for the expanding modern agriculture

and drinking water. The several major changes that have occurred within the past two decades including the construction of dams in different parts of Jordan (Karamah and King Talal Dams), and changes in watercourses of natural water bodies, will allow the dispersal and range expansion of several freshwater snails into newly suitable habitats. Indeed, one of these dams, King Talal Dam, was the most heavily infested site for *B. truncatus*.

Most of the agricultural irrigation systems in the Jordan Valley and many parts of Jordan depend on the dripping system, where water ponds (Plastic, cemented or mud) are constructed to pump water. Such ponds hold water all-year-round and offer suitable breeding sites for the intermediate host snail.

The Snail Intermediate Host, Bulinus truncatus

Abdel-Azim & Gismann (1956) conducted the first malacological study on freshwater snails of Jordan. In this report, no snails that act as intermediate host for schistosomiasis were recorded in Jordan. After the discovery of the first indigenous case of *Schistosoma haematobium*, over 60 water bodies were examined for the snail host. One site was found positive for *Bulinus truncatus*, Muthalath Al-Masri, in the Jordan Valley (Saliba et al., 1976).

Since then, and through an extensive survey for most freshwater bodies conducted since 1980, many breeding sites for the snail intermediate host (*Bulinus truncatus*) for *S. haematobium* were identified in many parts of the country (Burch et al., 1989). In 1980, the *Bulinus* snails were discovered for the first time in the largest water body of Jordan, King Talal Dam.

Since 1975 and until 1998, 60 breeding sites were identified in four Governorates (Ministry of Health Records). Most of the known populations were concentrated along the Jordan Valley and the Yarmouk River (Balqa and Irbid Governorates). Other major sites include Zarqa River, King Talal Dam, and Jarash Roman Pools. An additional site in the southeastern desert was found to harbor the snail (Arbaji et al., 1998). Later, another site was discovered in Burq'a area in the eastern desert of Jordan.

The snail intermediate host, *B. truncatus* inhabits various types of freshwater habitats, including dams, temporary ponds, agricultural ditches, irrigation canals, and side ponds along streams or rivers.

Within the past 12 years, the number of infested sites by the snail intermediate host drastically declined in the Jordan Valley and increased enormously in Ghore es Safi area (Table 2) due to the continuous changes in irrigation schemes, which created new breeding sites for the snail intermediate host. Many sites known to be major breeding sites for *B. truncatus* such as King Talal Dam are by now void of the snail intermediate host. The current shift in the distribution of *B. truncatus* is not well understood. Perhaps the high level of pollution in King Talal Dam and in other previously breeding sites stands as one of the main causes for the disappearance of the snail intermediate host. Besides, continuous efforts to control the snail intermediate host lasted for over 30 years in many sites in the Jordan valley.

Table 6 Number of sites found infested with *Bulinus truncatus* snails in different governorates in Jordan from 1999-2011

Year	Balqa	Jarash	Irbid	Mafraq	Tafilah	Karak Ghore	Aqaba
1999	18	3	2	1	1	78	0
2000	5	0	1	0	1	156	0
2001	9	0	1	0	1	184	1
2002	11	1	2	0	2	335	0
2003	16	0	1	0	2	388	1
2004	5	0	1	0	1	359	0
2005	0	0	1	0	2	611	0
2006	2	1	2	0	2	365	0

2007	0	0	0	0	2	325	0
2008	0	0	1	0	2	353	0
2009	1	0	1	0	2	581	0
2010	0	0	1	0	2	355	0
2011	1	0	1	0	2	350	0

Historical Background

Saliba *et al.* (1976) reported the first indigenous case of *Schistosoma haematobium* in Jordan. Later on, a total of 45 indigenous cases of urinary schistosomiasis were reported from Al Hassa stream near Burbeita hot spring in Tafila Governorate during 1984-1987 (Saliba *et al.*, 1986). During the second half of 1977, the Ministry of Health conducted a urine screening survey for about 17000 Egyptian workers, where 8% of them were found positive for *Schistosoma haematobium*. Two further cases were reported in 1989 from Rweished (Burqu' Dam), in northeastern Jordan.

Autochthonous cases of urinary schistosomiasis were reported from Ramah area, Jordan Valley. Eight Jordanian juveniles (seven males and one female) ranging in age from 10 to 15 years were diagnosed in 1995 as having the disease. Epidemiologic investigation showed that the patients did not leave Jordan and that the seven males swam frequently in 1994 in an irrigation pool present in a farm at Ramah, in the southern Jordan Valley. The female patient had frequent contact with the pool water since she often went to the farm to obtain water for domestic animals. *Bulinus truncatus* snails were found in the pool and in pools on other farms in the area (Saliba *et al.*, 1997).

Thirty-two autochthonous cases of *Schistosoma haematobium* were reported from Ghore es Safi, Karak lowlands, Jordan. All infected persons were males with ages ranging from 9-46 (Arbaji *et al.*, 1998).

During 1997-2003, 89 cases were discovered from Ghore es Safi. In 2008, 2 local urinary schistosomiasis cases were reported from the same area. Jordan is still under risk of repeated outbreaks of urinary schistosomiasis

An annual average of 22000 urine samples for *S. haematobium* was collected during the period 2002-2011 from foreign workers mainly Egyptians residing in different parts of Jordan lowland with an average infection rate of 0.8%. The main cause of low infection rate is due to active surveillance in the lowland of the country where most of the foreign workers are subjected to regular urine analysis. In 2011, a sample of 17,589 people was examined for urinary schistosomiasis infection by the MOH, 122 of them were found infected (0.7% infection rate).

The occurrence of indigenous cases in Jordan nine years after finding the snail intermediate host, and eight years after the influx of foreign infected persons indicates that Jordan is vulnerable to the disease, especially after the intermediate host has become entrenched and has widened its distribution in the country. The efforts of the MOH to locate and treat Jordanian patients and to control the snails at Seil Al-Hasa have undoubtedly minimized the risk of schistosomiasis, but this cannot be maintained without extensive efforts.

Current Status and Burden of Schistosomiasis in Jordan

The total number of reported or confirmed cases of schistosomiasis dropped drastically since 1995 up to 2011 (Figure 1, Table 3). The total number in 1995 was 1283 cases, reaching a minimum of 82 cases in 2010, and include foreign workers in addition to local cases.

The decline in the number of reported cases is mainly due to the implementation of new control strategy (mass therapy against schistosomiasis with Praziquantel) in Egypt where most of imported cases come from, and due to the intensive efforts of Parasitic and Zoonotic Diseases Department

(PZDD) in providing treatment for infected persons all over the country. Work permits, especially for labor force originating from schistosomiasis endemic areas require laboratory examination for schistosomes. In addition, continuous efforts in surveillance and active case detection are still a priority in PZDD's programs.

Figure 1 Reported cases of urinary schistosomiasis during 1995-2011

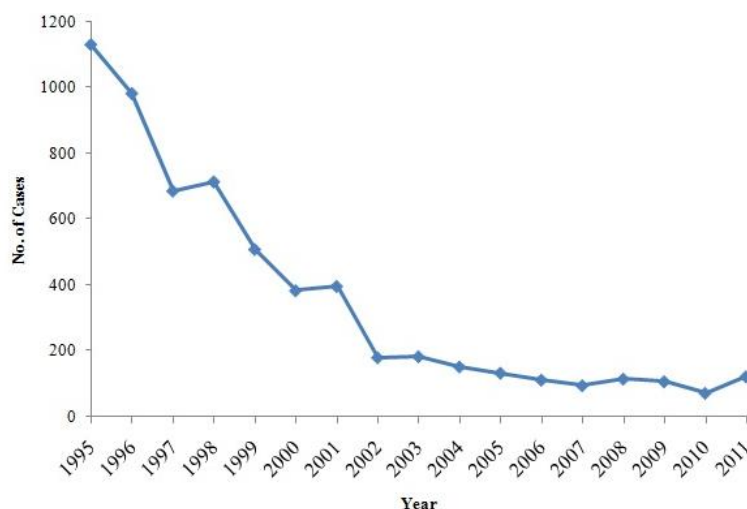


Table 7 Number of reported urinary Schistosomiasis cases by gender during 1995-2011

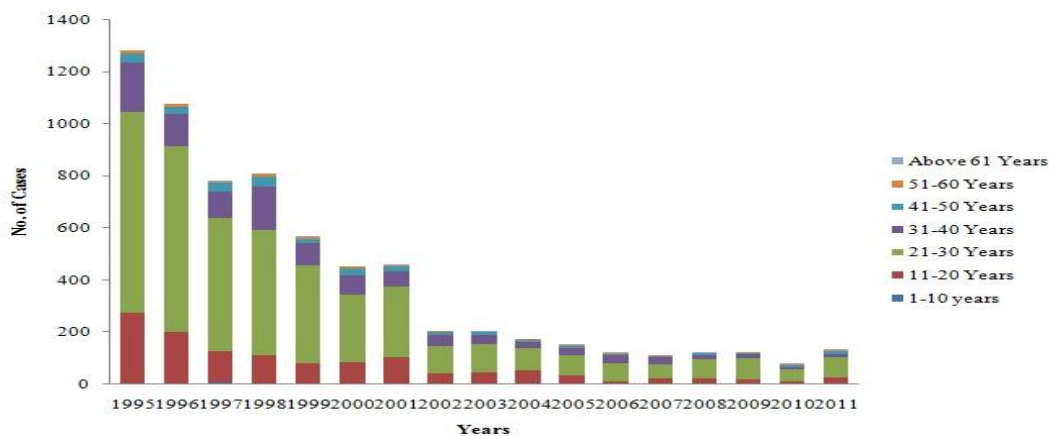
Year	Female	Male	Total
1995	6	1277	1283
1996	4	1075	1079
1997	4	780	784
1998	6	804	810
1999	5	564	569
2000	4	448	452
2001	9	451	460
2002	0	206	206
2003	1	205	206
2004	1	175	176
2005	0	155	155
2006	2	121	123
2007	4	110	114
2008	2	124	126
2009	3	120	123
2010	2	80	82
2011	4	130	134
Total	57	6825	6882

Vulnerable groups to schistosomiasis irrespective of climate change

Almost all cases were reported among males (99.2%), while only 0.8% of cases were among females (Table 3). This is due to the fact that the majority of infected workers are males coming from Egypt, with few females either of the local or imported cases.

By age, age group between 21-30 years old represented the highest percentage (62.3%) of cases, followed by age group between 11-20 years old (Figure 2). This is because both age groups represent age groups for the majority of Egyptian workers in Jordan. Age group over 60 years old represented the lowest number of reported cases (0.2%). On the other hand, children under the age of 10 constituted 0.29%.

Figure 2 Number of reported cases of urinary Schistosomiasis by age groups during 1995-2011



By nationality, Egyptians ranked the highest percentage (88%) of the total imported cases (Table 4). Source of infection for cases was investigated. Egypt ranked first as a source of imported infection followed by Yemen and Sudan. Other countries such as Pakistan, Chad, Saudi Arabia, Syria, Iraq, Somalia, and Oman constituted origins of active cases.

Table 4 Number of imported cases of urinary schistosomiasis according to origin of infection

Year	Chad	Egypt	Iraq	Oman	Pakistan	Saudi Arabia	Somalia	Sudan	Syria	Yemen	Jordan
1995	0	1252	0	1	0	0	0	5	0	18	7
1996	0	1060	0	0	0	0	0	3	1	8	7
1997	0	734	0	0	0	0	0	2	0	13	35
1998	0	792	1	0	0	0	0	3	0	12	2
1999	0	553	0	0	0	1	0	1	0	14	0
2000	0	431	0	0	4	0	0	0	1	7	9
2001	0	408	0	0	0	0	0	3	0	15	34
2002	0	193	0	0	0	0	0	0	0	13	0
2003	0	191	0	0	0	0	0	0	0	8	7
2004	0	164	0	0	0	1	0	2	0	9	0
2005	0	145	0	0	0	3	0	4	0	3	0
2006	0	118	0	0	0	0	0	2	0	3	0
2007	0	96	1	0	0	0	0	7	0	10	0
2008	1	111	1	0	0	0	0	6	0	5	2
2009	0	106	0	0	0	0	1	8	0	8	0
2010	0	65	0	0	0	0	0	6	0	11	0
2011	0	121	0	0	0	0	0	4	0	9	0
Total	1	6540	3	1	4	5	1	56	2	166	103

Vulnerable regions to schistosomiasis irrespective of climate change

By governorates, Irbid reported the highest number of cases; most infected workers are employed in farmland in the upper Jordan Valley. Other cases were detected in Zarqa, Al Balqa and Madaba Governorates.

Schistosoma haematobium requires the presence of the freshwater snail, *Bulinus truncatus*. Table 2 shows the number and distribution of sites infested with the snail intermediate host for the past 10 years. Evidently, Karak Governorate, and more specifically, Ghore es Safi area, has the highest number of breeding sites from which *B. truncatus* snails were recovered. This makes the population in this area at a higher risk to acquire infection with *S. haematobium*, pending the presences of infected people. Indeed, in the past years (from 1997 to 2008), several outbreaks of *S. haematobium* occurred among the local population in Ghour es Safi.

Local transmission of *Schistosoma haematobium*

A total of 103 local cases were reported for the period 1995-2008. By Sex, only a single 12 years old female was found infected, while 102 cases were reported among males at various age groups. Young children from age 1 to 15 years old constituted about 50% of the infected population, while age group between 16-29 years represented 29.2% of the sample (Table 5). Evidently, young groups were the most vulnerable group. This is mainly due to water contact pattern exhibited by these age groups such as swimming in irrigation canals and other related activities. On the other hand, females do not practice such activities and this explains the extremely low percentage of infection. Local transmission occurred in Karak and the Jordan Valley areas (Table 6). Ghore es Safi was found to be a main source of local transmission.

Table 5 Distribution of indigenous cases of urinary schistosomiasis by age groups in Jordan 1995-2008

Age group	No. of cases	%
1-10	6	5.8
11-15	50	48.5
16-20	30	29.2
21-30	11	10.7
31-40	3	2.9
Over 40	3	2.9
Total	103	100

Table 6 Distribution of local urinary schistosomiasis cases by place of residence during 1995-2008

Year	Karak (Low-Land)	Al Balqa (South Shuneh)	Total
1995	0	7	7
1996	0	6	6
1997	33	1	34
1998	2	1	3
2000	9	1	10
2001	34	0	34
2003	7	0	7
2008	2	0	2
Total	87	16	103

Malaria

Historical Background

Jordan was one of the debilitated countries with the malaria parasite through history (Christophers, 1920; Berberian, 1946; Lumsden & Yofe, 1950; Logan *et al.*, 1953). It was one of the common diseases seen by physicians and one of the health problems facing the first Jordanian Government during the second decade of the twentieth century. A report published in 1944 by the United States War Department concerning the health conditions in Jordan, indicated the importance of malaria

during that period, and the high infestation rates among the inhabitants of Trans Jordan (Anon., 1944). The Jordan Valley was blamed for being the major malarious area in addition to villages on the plateau that are close to mosquito breeding sites. Malaria was hyperendemic in the lowlands below the sea level. In other areas, it was hypo- to mesoendemic and epidemic-prone, with hyperendemic pockets. In the years 1964-1970, the number of malaria cases dropped rapidly from 664 cases to 86 cases, respectively.

Two different forms of *Plasmodium* parasites are also known; *Plasmodium vivax* and *Plasmodium falciparum*, with predominance of the former. Malaria eradication program started in 1959. Alicata & Dajania (1959) used Daraprim as a drug of choice for treating malaria patients.

After 1973, it appears that Jordan became malaria free. This is due to the extensive measures applied by the Department of Malaria, which included the continuous surveillance and spraying of areas at high risk and tracking all the imported cases by examining travelers coming from endemic countries. Check stations at the ports of entry require blood smear from all passengers coming from malaria endemic areas.

Mosquitoes of Jordan

Lumsden & Yofe (1953) conducted the first comprehensive study on the status of malaria in Jordan. They recognized 11 species of *Anopheles* to occur in Jordan. *Anopheles sergenti* and *Anopheles superpictus* accounted for about 84% of the larvae identified during their study. There are several *Anopheles* species in Jordan, four are capable of vectoring malaria; *A. sergenti*, *A. superpictus*, *A. claviger* and *A. scharovi* (Shapiro et al., 1944; Lumsden & Yofe, 1953).

Recent studies on the mosquitoes of Jordan were carried out during 1995-1996. Nineteen species of *anopheline* and *culicine* mosquitoes are reported from larval collections made in northern Jordan and the Jordan Valley (Amr et al., 1997). A countrywide survey for mosquito larvae was conducted in 1996 and 1997. Twenty-three species are recorded raising the number of mosquito species known from Jordan to 28. Larvae of *Culex (Barraudius) pusillus* Macquart; *Culex (Maillotia) deserticola* Kirkpatrick; and *Culex (Neoculex) territans* Walker are recorded for the first time in Jordan (Al-Khalili et al., 2000).

Persistence of Local Malaria Transmission Risk

In the course of its implementation, transmission of malaria was interrupted in 1970. Over the last 42 years, nine small isolated incidents of local transmission had occurred in different foci mainly in the lowlands resulting in 52 introduced cases. The major episode occurred in 1990 (33 cases) in the Karak lowlands and the last episode of locally introduced occurred in 2010 (2 cases) in the Dead Sea area (Az Zarat). During the last 10 years (2002-2011), from 45 to 160 imported cases of malaria were detected annually, predominantly originating from Asia and Africa and reflecting the size of travel.

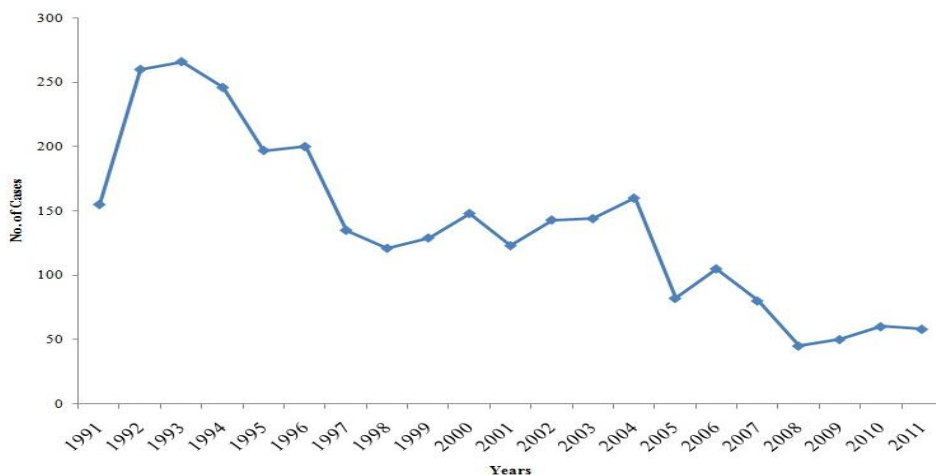
Malaria receptive areas are in the North and Middle West adjacent to the Jordan Valley and Dead Sea, where about 9% of the country population live. There is an intense population movement between Jordan and malaria endemic countries. The competent *Anopheles* mosquitoes are widely distributed in rural and populated areas, 13 various *Anopheles* mosquitoes species are known to occur in Jordan. Competent malaria vectors are *An. sergenti*, *An. superpictus* and *An. sacharovi*. Both vulnerability and receptivity are high and the risk of malaria reintroduction is still possible.

In conclusion, reintroduction of Malaria is still threatening in receptive areas of Jordan due to the favorable epidemiological and climatic factors in lowlands (lowest point in the world) and the intense population movement to and from Malaria endemic countries specially the presence of migrant workers working in the lowlands in agriculture, industry, and tourism.

Current Status and Burden of Malaria in Jordan

The total number of reported or confirmed cases of Malaria fluctuated since 1991 up to 2011 (Figure 3). The total number in 1991 was 159 cases, reaching a minimum of 45 cases in 2008. The cases presented include imported and local cases. The number of reported cases varies reflecting the size of movement between Jordan and other endemic countries. However, Figure 3 shows a decreasing trend of the reported cases, which can be attributed to the Malaria control programs implemented in endemic countries and in part due to preventive control measures taken by travelers to endemic areas. During this period, 2907 cases were detected and confirmed by PZDD. By sex, 20.7% of the reported cases were among females, whereas the majority of cases were reported among males. Jordanians constituted the highest percentage of diagnosed cases since 1991, followed by Sri Lankans, Sudanese, Yemenis, Pakistanis, and Indians. The highest number of reported cases was in 2004 reaching as high as 128 cases.

Figure 3 Reported cases of malaria since 1991-2011



Malaria cases reported among Jordanians

A total of 1323 cases of malaria were reported and diagnosed among Jordanian citizens from 1991-2011. However, most of these cases are imported from other countries. Only eight cases were acquired in Jordan and were classified as introduced cases.

Many Jordanians seek employment in other countries that are known to be endemic in malaria. Analysis of data indicates that age groups between 20-40 years old constituted the highest percentage. This age group represents the working force of Jordanians serving in many countries in Africa, especially the Peace Keeping Forces (PKF) for the United Nations. In addition, it is shown that most cases were acquired in Pakistan, Eastern Timor, Ivory Coast, and others. Many of these cases were among students and members of PKF. Parasite species of reported malaria cases among Jordanians is determined by the malaria parasite species circulating in the countries origin of infection. The majority of reported cases among Jordanians 1063 (80.3%) are due to *P. vivax*, 248 (18.7%) due to *P. falciparum* and 1% of cases are due to other species.

Geographical distribution of potential sites for malaria transmission

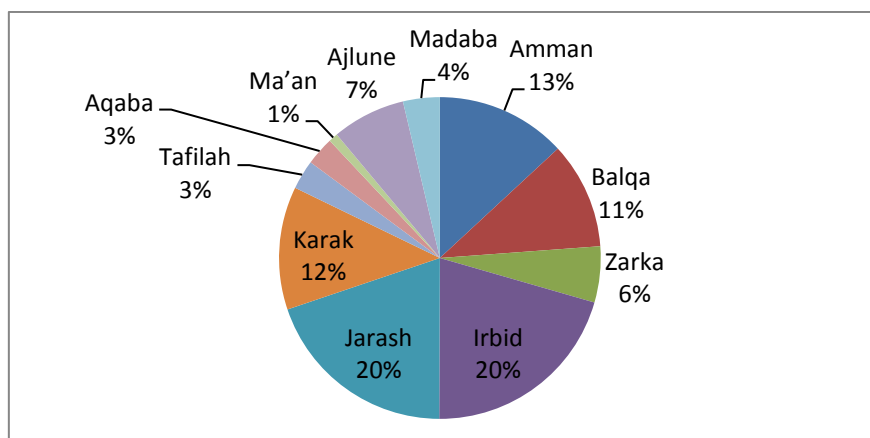
A total of 1115 water bodies of different forms have potential for breeding of *Anopheles* mosquitoes (Table 7). These sites can be classified to creeks, springs, rivers, dams, and seepages. Balqa Governorate has the highest number of water bodies suitable for breeding vector mosquitoes of malaria. The total population at risk of exposure to the malaria parasite through their vectors

constituted about 541700 individuals. This is about 10% of the total population of Jordan. Irbid and Jarash Governorates have the highest population at risk, followed by Amman and Balqa Governorates (Figure 4). High priority in monitoring and control measures should focus on such areas to avoid outbreaks. In the past, outbreaks of malaria took place in the Jordan Valley (Ghore es Safi, Ghore Kated, etc).

Table 7 Distribution of water bodies suitable for breeding of malaria vector mosquitoes in Jordan according to Governorates

Governorate	Water body					Total
	Creak	Spring	Dam	Seepage	River	
Amman	11	46	0	65		122
Balqa	67	199	4	56	1	327
Zarka	7	24	0	27		58
Irbid	60	78	4	35	1	178
Jarash	7	55	1	80		143
Karak	56	25	1	33		115
Tafilah	5	14	1	15		35
Aqaba	5	8	1	10		24
Ma'an	1	8	0	15		24
Ajlune	3	10	0	18		31
Madaba	7	15	1	35		58
Total	229	482	13	389	2	1115

Figure 4 Populations at risk of malaria inhabiting various Governorates in Jordan



Leishmaniasis

Cutaneous leishmaniasis, a disfiguring disease that leaves its marks on its victims, is caused by the protozoa, *Leishmania major*. Leishmaniasis is an endemic disease in Jordan and many other Mediterranean countries (Lysenko, 1971). The life cycle of this protozoan parasite involves the interaction of sand flies belonging to the genus *Phlebotomus*, reservoir rodents (*Meriones* sp. and *Psammomys obesus*) and man. The sand flies are in close contact with these rodents, since they inhabit and breed in the rodents' burrows. Female sand flies inject the promastigote stage of the parasite while feeding on man's blood. Face and the upper and lower limbs are the most frequent sites of attack by the sand flies, and where the diagnostic lesions appear.

Two clinical forms of leishmaniasis are known to occur in the Middle East and in Jordan in particular; cutaneous leishmaniasis, caused by *Leishmania major* and *Leishmania tropica*, and visceral Leishmaniasis, caused by *Leishmania archibaldi* and *L. infantum*.

Historical Background

Cutaneous leishmaniasis (CL) has been known to be endemic in Jordan since the early 1920s. Zoonotic cutaneous leishmaniasis (ZCL) caused by *Leishmania major* is the main form of the disease in Jordan. The parasite has been isolated and identified by iso-enzyme electrophoresis from human cases, the sand fly vector *Phlebotomus papatasi* and from the reservoir host *Psammomys obesus*. The presence of a secondary reservoir of *L. major* is highly suspected in certain endemic foci in Jordan but remains to be confirmed.

Oumish *et al.* (1982) reviewed the incidence of cutaneous leishmaniasis during the period 1973-1981. They found the Jordan Valley to be the main focus for disease transmission. Saliba *et al.* (1985) studied the epidemiology of an outbreak that occurred during the winter of 1983 near Mowaggar area. They found that the Fat Sand Jird, *P. obesus*, carries the amastigotes form of the disease. Most of the human cases were reported during January, February, and March.

The disease has been reported from different active foci of transmission in the country mainly in the Jordan Valley. Rodent control in Karamah village, Jordan Valley by the physical destruction of *P. obesus* burrows from 1992 to 1994 was successful in reducing the frequency of leishmanin skin test positivity from 19.9% to 4.4% in children from 3 months to 2 years (Kamhawi *et al.*, 1993).

An endemic focus of cutaneous leishmaniasis caused by *Leishmania tropica* was identified in the district of Bani Kinana, northern Jordan. Fifty-five autochthonous cases were detected from February to September 1994 in a population of about 50 000. Most cases (74.5%) were from the villages of Malka and Um-Quais. The lesions were typically small, dry and mostly located on the face and extremities. Multiple lesions were common. Incidence was higher in females than in males and familial clustering of cases was observed in houses on the outskirts of villages. A leishmanin survey showed a 23.3% positivity rate in the populations of Malka and Um-Quais. The rate of positivity was low in the younger age groups and increased with age. There was some evidence that the disease is a zoonosis in this focus (Kamhawi *et al.*, 1995).

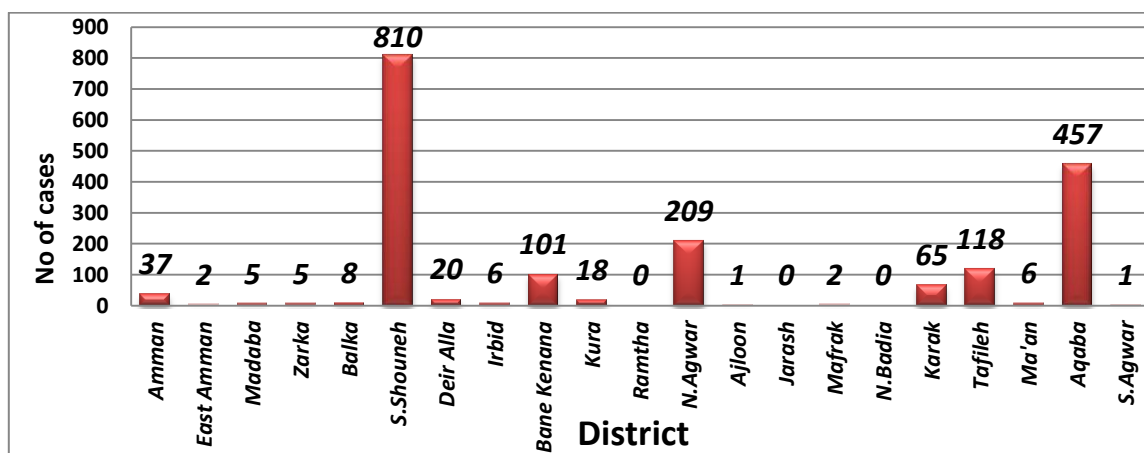
Khoury *et al.* (1996) investigated the extent of cutaneous leishmaniasis in Jordan during 1983 to 1992 based on data collected from the dermatology departments and the laboratories of the RMS and the MOH as well as from private dermatologists. They reported 2295 cases, whereas males represented 80%. The majority (80%) were < 25 years with the highest percentage (31%) occurring in the 16 to 20-year age group. The lowest number of reported cases was reported in June compared to the maximum in October, and the highest number recorded per year was 463 in 1992. For the decade, the Jordan Valley was the most important locality where 43% of the cases were reported. They also indicated that the incidence rate per 100,000 ranged from 1.89 in 1989 to 14.39 in 1984 and the period prevalence for the decade was 5.36 per 100,000.

Mosleh *et al.* (2009) reported on two temporally distinct outbreaks of human cutaneous leishmaniasis that occurred during 2004/2005 and 2007/2008, as well as scattered cases of the disease observed close to the Dead Sea, in Jordan. About 20% of the workers were found infected with the causative parasite. Workers living in air-conditioned rooms during the 2007/2008 outbreak were not infected; however, 26 of a neighboring group of 124 workers, living in non-air-conditioned rooms, developed the disease.

Current Status and Burden of Leishmaniasis in Jordan

According to the MOH annual reports, 1871 cases of CL were notified during the period 1997-2011 (Figure 5), with an average number of 125 cases per year and a range of 5 to 354 during this period. Out of the total cases 810 (43.3%) were reported from South Shouneh Health Directorate in the Jordan Valley and 457 (24.4%) were reported from Aqaba Health Directorate (Wadi Araba) followed by North Agwar, Bane Kenana and Tafileh (Wadi Al-Hassa) .

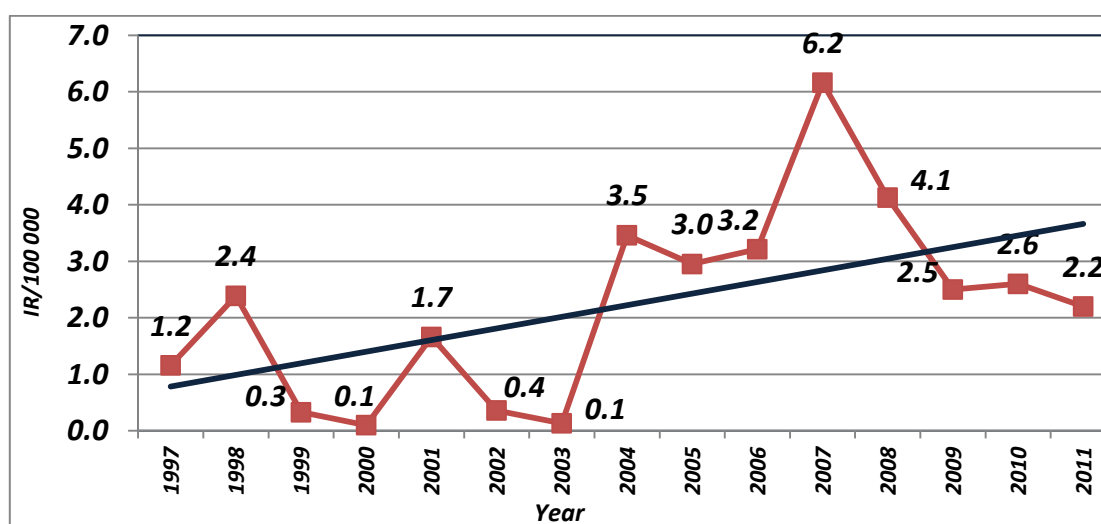
Figure 5 Reported C.L. cases by district 1997 to 2011



The annual average incidence rate of reported cases during the period 1997-2011 was 2.2/100,000 population. The trend of CL during the last 8 years (2004-2011) has increased, the reported annual average number of cases during the same time period was 197 and the annual average incidence rate for the same time period was 3.4/100000 population (Figure 6).

Almost 70% of Jordan's territory constitutes a potential biotope for *L. major* transmission and the disease is expected to spread in areas undergoing major population movements and/or environmental changes. CL is currently a public health problem in Jordan. The disease is expected to spread in areas undergoing major population movements and/or environmental changes.

Figure 6 Incidence rate/100.000 of C.L. from 1997 to 2011 in Jordan

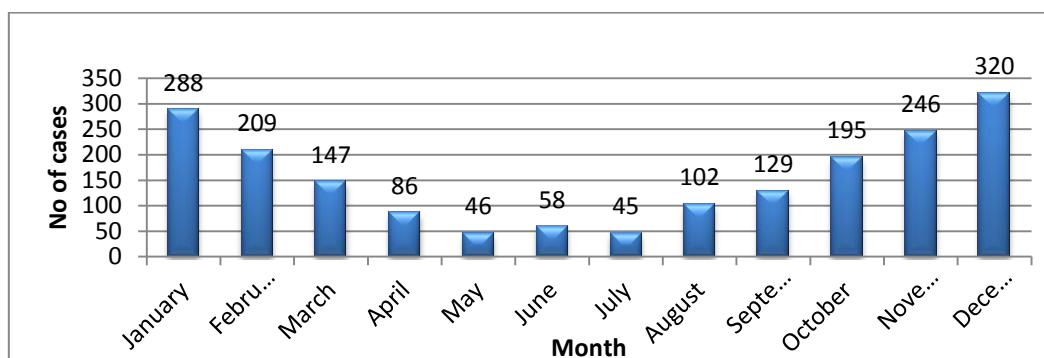


The most affected age groups are those below 20 years old. The percentage of reported cases among those (≥ 20) years old represent only 39.3% of the total reported cases indicating that the cumulative percentage in the age groups below 20 years are 60.7% of cases. The distribution of C.L. by gender indicates that the disease is more prevalent in males (67% of cases) than in females (33%

of cases). It seems that males are almost twice as much vulnerable for acquiring cutaneous leishmaniasis. The male to female ratio is 2:1.

The cumulative distribution of reported cutaneous leishmaniasis cases by month shows a seasonal pattern of occurrence of the disease (Figure 7). This seasonality indicates that most cases are reported during the cold months of the year. Thus, the transmission curve is expected to be a mirror shape of this curve taking into consideration the long incubation period of the disease and the period elapsing between the date of onset and the date of reporting of cases.

Figure 7 Cumulative monthly distribution of C.L. cases reported from 1997 to 2011



Analysis of 813 investigated C.L. cases from 2003-2011 by nationality showed that Jordanians were the most affected (95.2%) followed by Egyptians (20 cases) and Syrians (19 cases).

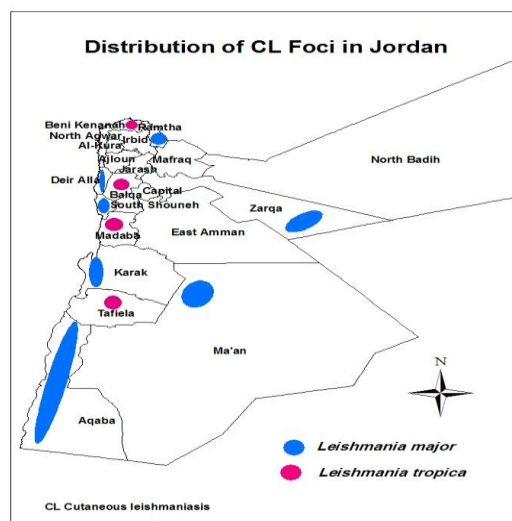
According to population size, Northern Ghore population is at higher risk to infection with Cutaneous leishmaniasis (Table 8), owing to its high population density compared to other parts of active foci. Collectively, areas along the Jordan Valley are at higher risk of acquiring the disease. This is true for historical cases of CL in the Jordan Valley. Desert areas in the eastern part of the Country and the Wadi Araba area are still vulnerable, with reported cases as outbreaks. Figure 8 shows the foci of *L. major* and *L. tropica* in Jordan.

Table 8 Cutaneous leishmaniasis cases by area since 2001-2010 in Jordan

Governorate/District	Area	No. of Cases	% of Cases	Population	% of Population
Balqa	Aira and Yarqa	6	0.4	308600	3.9
South Shounah	Al Kafraïn, New Shoubah, Al Zarah, Al Rameh, Al Rawdah, Karameh, Al Nahda, Swaymeh, Al Jofeh, Al Jawafrah, South Shounah	639	42.8	34500	17.1
Dair Alla	Dair Alla	15	1.0	54400	21.3
Bani Kanaeh	Um Qais, Al Hemma, Malka, Al Mikhybah, Al Mansorah	104	7.0	89100	6.3
Northern Ghore	Al Mashareh, Al Ma'abar, Wadi Al Rayan, Abu Habial, Tabakat Fahl, Al Krymeh, Abu Sido, Al Qarn	202	13.5	100000	39.2
Karak	Al Rabbeh, Sail Al Hasa, Al Lajoun, Smakeyeh, Al Nakheel	42	2.8	201900	1.6
Tafilah	Sail Al Hasa, Jisr Al Shohadah, Al Borbita, Afra	95	6.4	87900	3.9

Aqaba	Al Qurairah, Disah, Rahmah, Al Rishah, Bair Madkhour, Qryqrah	391	26.2	125600	6.7
Total		1494	100	254900	100

Figure 8 Map of Jordan showing foci of *L. major* and *L. tropica*



Visceral Leishmaniasis (VL)

Little is known about the epidemiology of VL in Jordan with only 15 cases reported to the MOH from 1962 to 2011. In 2002, two Jordanian children aged less than two years belonging to a nomad community in Wadi Araba, South Jordan died from VL. For the first time in Jordan, *Leishmania* species was identified, from one child, by gp63 PCR-RFLP (polymerase chain reaction followed by restriction fragment length polymorphism analysis) as *Leishmania archibaldi* (N. Gargouri, Third World Congress on Leishmaniasis, 10-15 April 2005, Palermo-Terrasini, Sicily, Italy). The disease could be zoonotic in nature with wild canines acting as reservoirs in a sylvatic cycle. VL due to *L. infantum* is suspected to be transmitted by *P. major syriacus*. Although VL is not considered a public health problem in Jordan, the experience of Jordan's neighboring countries over the last decade has shown the possibility of the emergence and spread of this potentially fatal disease.

Vectors of Leishmaniasis in Jordan

Several studies investigated the sand flies of Jordan. Lane *et al.* (1988) reported 13 species of sand flies from different bioclimatological regions of Jordan. Kamhawi *et al.* (1988) reported on the sand flies of Aqaba area in southern Jordan, and recorded eight species, three of which belongs to the genus *Phlebotomus*. Eleven species of sand flies were recorded in the southern Jordan Valley, including *P. Kazeruni*, *P. Tohbi* and *Sergentomyia squamipleuris*. *P. papatasi* was the most abundant species collected from domestic habitats (Janini *et al.*, 1995).

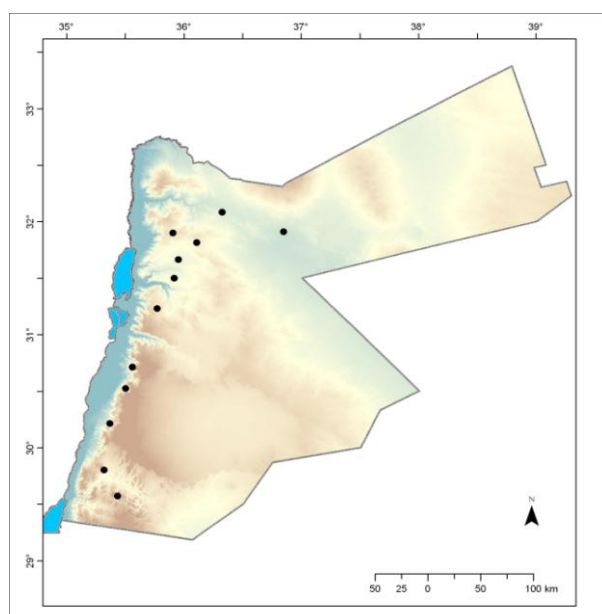
Later, Kamhawi *et al.* (1995) reported 21 sand fly species including additional records (*Phlebotomus jacusieli*, *P. tobbi*, *P. perfliewi goliioeus*, *P. mascitfi*, *P. arabicus*, *P. halepensis*, *Sergentomyia palestiniensis* and *S. toizi*). Janini *et al.* (1995) investigated the status of sand flies as vectors of cutaneous leishmaniasis in the southern Jordan Valley during 1992. Of 686 *Phlebotomus papatasi* females collected from burrows of the Fat sand Jird, 14 harbored promastigotes in their guts. Their findings present the first direct evidence of the role of *P. papatasi* as a vector of *L. major* in Jordan.

So far, 11 species of sand flies of the genus *Phlebotomus* are known to occur in Jordan. In this review we ignored species of the genus *Sergentomyia* since they are not incriminated in *Leishmania* transmission.

The main reservoir host for Leishmaniasis in Jordan

Amr & Saliba (1986) studied the ecology of this species, where they reported on its diurnal activity, feeding habits, burrow system, and association with other animals. The Sand Fat Jird is a colonial species forming large colonies constructed close to *Anabasis* sp. shrubs. It was found to share burrow with the Syrian hamster. In some areas, previously known to harbor dense colonies of this Jird disappeared entirely; whereas new colonies are established in new areas away from the original foci. Distribution of this species is associated with the presence of chenopods (i.e. *Anabasis articulata*, *A. syriaca* etc). The distribution of *Psammomys obesus* colonies is shown in the Map of Jordan (Figure 9).

Figure 9 Distribution of the Fat Sand Rat, *Psammomys obesus*



Factors other than Climate that Determine Vulnerability

Several factors that determine vulnerability of VBDs in Jordan are independent of climate change. For each of the three diseases, some intrinsic or extrinsic factors determine the formation of outbreaks.

Schistosomiasis

- Irrigation schemes and development of agriculture projects are the main factors that allow the snail intermediate host to invade new areas. This is true in southern Jordan as well as in some remote deserts with intensive farming projects.
- Movement of workers originating from endemic countries in newly established areas may serve as a source for local infection and transmission. Hundreds of thousands of Egyptian workers serving in the agricultural sector are found all over the country.
- Construction of dams, pools, and other forms of water harvesting projects provide suitable habitats for the breeding of the snail intermediate host.

Leishmaniasis

This disease is endemic to Jordan and is dependent on the distribution of the reservoir host, *P. obesus*.

- Distribution of the reservoir host and associated vegetation that consists of *Anabasis sp.*
- Population movement (e.g. Army personnel, workers, etc) to areas known as hot spots for the disease. This usually takes place in newly developed areas within the vicinity of the high density of the reservoir host.
- Establishment of agricultural projects in areas with dense populations of the reservoir host.

Malaria

Jordan is considered as a malaria free country; almost all cases resulted from other countries. However, the mosquito vectors are still viable in Jordan.

- Movement of infected persons coming from malaria endemic countries to areas that have breeding populations of the vector mosquitoes especially in the Jordan Valley.
- Formation of new habitats for vector mosquitoes as a result of the development of irrigation schemes all over the country. Some of these newly formed water bodies may serve as breeding sites for vectors of malaria.

Current Programs and Activities to Manage VBDs:

Control of VBDs and Disease Vectors is one of the essential functions of MOH. However, other national institutions have responsibilities either for specific sectors and/or for specific vectors. For example, GAM and other Municipalities are responsible for the control of various insects and *Culex* mosquitoes because they cause nuisance to people and are potential vectors of disease. MOA is responsible for the control of houseflies in areas where agricultural activities are carried out. The RMS Directorate is responsible for all vector control activities within its areas of jurisdiction.

Ministry of Health VBDs control and curative interventions

VBDs control programs and activities, which include preventive and curative measures aimed to protect health and reduce VBDs burden, are managed mainly by the MOH. The PZDD within the Directorate of Communicable Diseases (DCD) at MOH, plan and implement Malaria and schistosomiasis control programs and activities.

Control measure and activities include detection of VBD cases by active and passive case detection; early diagnosis, prompt and adequate treatment; post-treatment follow up of cases to detect treatment failure and relapses; control of disease vectors and reservoir host by environmental and engineering methods; and control of disease vectors and intermediate host by chemical methods (Larviciding and Mollusciciding).

The key impact Indicators are the presence or absence of vectors and hosts; reduction of vector density; reduction of active *P. obesus* borrows; reduction of the intermediate host of urinary bilharzias; burden rates (incidence, prevalence and mortality) of vector-borne diseases; and cost effectiveness analysis of prevented cases where applicable.

PZDD is composed of five central technical units, namely, laboratory, surveillance, entomology, operation, and schistosomiasis (bilharzias) units. These five units are replicated at the lower administrative units by six peripheral units for Malaria and Bilharzia control. The peripheral VBDs control units share a common budget, which is devised on the central level. The peripheral units carry out day-to-day activities related to vector control and provide feedback to the central level where the main planning and budgeting take place.

Monitoring is carried out at the peripheral units' level by supervisors and inspectors of central units on daily basis. The central level units carry out their own monitoring of VBDs and vector control

operations through missions to particular peripheral regions where the activities are checked by their staff. Feedback of the central units monitoring is communicated immediately to the peripheral unit staff to corrective actions, if required. Daily missions from the central units are sent to different peripheral area to carry out monitoring activities.

Surveillance, diagnosis, and treatment of Malaria and Schistosomiasis (Bilharzia) cases are conducted mainly by PZDD and its six peripheral units and cover all regions and districts of Jordan. Diagnostic and curative services for Leishmaniasis are addressed by the health facilities in the 22 peripheral health districts including public and private health sectors all over the country.

Resources for VBDs control include facilities, human, financial and material resources of VBDs control programs available at MOH and other sectors at the national level. There are neither quality control entomology laboratories nor insectaries in the country. There is a need to establish a National Vector Control Unit (NVCU) provided with national central quality control entomology laboratory and insectaries.

Table 9 lists the equipments and insecticides available at the central and peripheral levels for VBDs control programs-MOH. In addition, the vector control unit at the central level has four light traps and two mechanical aspirators.

Table 9 List of equipments and supplies of insecticides available to MOH at the beginning of 2012

Offices	Cars	Spraying Pumps	Spraying machines	Binocular Microscope	Insecticides		
					Temephos 50EC (L)	Deltamethrine 2.5EC (L)	Niclosamide 70WP (kg)
Amman	4	215	2	20	364	14	575
Irbid	1	47	0	4	104	12	0
North Aghwar	1	52	0	4	60	40	0
Dayr-Alla	2	35	1	3	100	60	0
South Shuneh	1	45	0	1	120	60	0
Al-Karak	1	120	0	3	150	40	0
Al-Safi/South Aghwar	1	70	1	2	150	60	500
Total	11	584	4	37	1048	286	1075

On the other hand, staff, equipment, and facilities are available at the Vector Control Directorate, GAM. These include 20 Space spray machines, 14 spray pumps, 15 Cars, 2 Microscopes, 40 personnel working in spray teams, and 4 Supervisors

Control activities against sand fly vector and *Psammomys obesus* are usually addressed through inter-sectoral coordination and collaboration between the PZDD at MOH and other governmental sectors. Such control activities are managed and supervised by the Vector Control Operations Unit and Entomology Unit. These units are essentially responsible for the control of Malaria and Bilharzia vectors. Occasionally they are asked to respond to sand flies (vector of Leishmaniasis) and *Psammomys obesus* (reservoir of Leishmaniasis) control as well. Vectors of emerging vector-borne

diseases (during regional epidemics) are also controlled in collaboration with other ministries, local authorities, and municipalities.

Efficacy of current programs and activities

Malaria Control Program was able to maintain Jordan free of indigenous malaria cases since 1970 through the implementation of different anti-malaria parasite and anti-vector control measures. Reported malaria cases after 1970 were all classified as imported, relapses, introduced, and induced malaria cases; no indigenous malaria cases had been reported since that year. The potential risk of local malaria transmission and reintroduction of malaria is still possible and increasing in light of the continuous lack of human and material resources without adequate replacement.

Jordan was free of local Bilharzia transmission until 1975, when the first local urinary Schistosomiasis was reported. The Bilharzia Control Program, which was established in 1980, was able to maintain Jordan free of stable transmission of urinary schistosomiasis, but local small and limited outbreaks occurred.

Cutaneous Leishmaniasis is endemic in Jordan. There is no specific control programme for Leishmaniasis. Control activities against the vector and the reservoir host are usually conducted using human and material resources available at the Malaria and Bilharzia Control Programs and in coordination and collaboration with other sectors. The country average incidence rate of CL from 1997 to 2011 is 2.2/100.000 people, which is a low incidence rate compared with the disease occurrence in neighboring countries.

It is evident that there is insufficient funding for vector control program development as well as shortage in all categories of staff required for vector control operations. If this situation continues, it may lead, on the long term, to increased costs to the health sector and an expected increase in mortality and morbidity due to vector-borne diseases, especially under the current state of environmental change and increased population movement.

Planned Programs and Activities to Manage VBDs

Malaria and Schistosomiasis (Bilharzia) Control Programs are continuous programmes and renewed every year, they are planned and implemented by PZDD. Control interventions, capacity building and training activities and joint projects with international organization are all planned at the central level taking into consideration needs, gaps, constraints, and obstacles facing the implementation of control interventions and activities against vectors and VBDs control. The Planned control interventions are:

1. Detection of VBDs by active and passive surveillance
2. Confirm diagnosis as soon as possible
3. Prompt and radical treatment of VBDs cases and follow up cases
4. Control of disease vectors and hosts by environmental management like canalization and drying of stagnant water, Clearance of vegetation from breeding sites and destruction of *Psammomys obesus* borrows.
5. Control of vectors and intermediate host by chemical methods like the use of Temephos (insecticide) for larviciding to kill mosquito larvae, and the use of Niclosamide (molluscicide) to kill the intermediate snail host.
6. Control of adult mosquito and sand fly vectors of malaria and leishmaniasis by environmental methods and imagociding

For strengthening and building the national capacities for VBDs, the following procurements and training activities are planned to be carried out:

1. Recruit additional staff members and workers to replace the shortage in human resources
2. Procurement of drugs, insecticides, equipments, materials and cars
3. Increase political and financial support for VBDs control programmes
4. Renew of policies and strategies for VBDs control and adoption of Integrated Vector Management Strategy
5. Training on disease surveillance and diagnosis of VBDs
6. Training on identification of vectors and entomology techniques
7. Training on pesticides management and control operations
8. Training on Bilharzia and Leishmaniasis control activities

In addition, there are joint projects with international organizations, such as:

1. A joint program with WHO will be conducted during the next years including training activities on VBDs control, GIS and mapping of positive sites of the intermediate host snails of Schistosomiasis
2. A regional WHO/ UNEP and GEF project “Demonstration of Sustainable Alternatives to DDT and Strengthening of National Vector Control Capabilities in MENA” where Jordan is one of the participating countries and was requested to focus on the capacity-building component and the safe disposal of obsolete stocks of DDT and POPs

Despite some challenges and gaps facing control programmes and activities, it was possible to maintain VBDs under control during the past 4 decades. It is expected that VBDs programs will become weaker in the future; this is because of the weak political and financial support for VBDs programs. VBDs problem is not felt as a priority health problem at high-level decision makers in Jordan, and this low political commitment will decrease the available human, material and other logistic resources. The region also witnesses an unstable political situation with consequent migration of people from neighboring countries carrying some VBDs like bilharzia, malaria, and leishmaniasis from their origin country.

Based on the current status of VBDs in Jordan, number of imported and local cases of schistosomiasis is on the decline. This is mainly due to the treatment strategies of foreign workers residing in Jordan and active detection and treatment of cases. Malaria cases are sporadic and mostly originate from endemic areas. Mobility of Jordanians into endemic areas is the main cause of imported malaria. Therefore, it is most unlikely to have future outbreaks, unless certain circumstances fall into place in one specific area known to have breeding populations of the vectors as well as having infected persons. Efforts of MOH over the past 50 years succeeded in the declaration of Jordan as malaria free country. All outbreaks are of foreign origin so far.

Leishmania remains as an endemic disease with unpredictable outbreaks. This is evident from the published articles and the number of reported cases. Based on all these various risk factors, we expect that the potential risk of local spread and transmission of VBDs will increase and extend to new regions inside the country.

Vulnerability Assessment of Impacts of Climate Change on VBDs

Future Climate Change Projections in Jordan

Previous local studies that investigated the weather records showed an increase in the magnitude and frequency of extreme temperatures. Higher temperature and lower precipitation are expected because of climate change (Details in Chapter I). Water resources, environment, and other related issues such as rangeland and livestock are most likely to be vulnerable to climate change.

Unfortunately, the climate change studies conducted in Jordan are limited and only focused on the impacts of climate change on water resources, agriculture, and livestock sectors. None of these

studies addressed or reported any suggestion or recommendation on the impact of climate change on human health (Details in Chapter 1).

The Impacts of Climate Change on VBDs over the Next 20 Years

Perhaps the best scenario that can address the effect of climate change on VBDs in Jordan is related to temperature increase. This is based on the projected analysis by the MD for the next 50 years. Their analysis projected an increase of about 2°C; however, with poor projection for changes in the rainfall.

Regions and populations/groups that are likely be at highest risk

Increase in temperature will be associated with droughts in certain areas, especially the Jordan Valley, Mountains, and the Eastern Desert. All areas addressed above in each section will be at higher risk of transmission. Perhaps the Eastern Desert will become an area of higher risk due to future planning of water harvesting projects to combat water shortage due to temperature rise. This will create new sites for the vectors (i.e. snail intermediate host and mosquitoes breeding sites). Dam construction, irrigation schemes, and all forms of water harvesting are expected to occur in many parts of the country including the Jordan Valley and the Eastern Desert. All these forms will certainly have an impact on the intermediate hosts or vectors responsible for the transmission of schistosomiasis, malaria, and leishmania.

Schistosomiasis

Under the current circumstances, urinary schistosomiasis in Jordan is not considered endemic, but related to movement of infected work force originating from countries where *S. haematobium* is endemic. Changes in irrigation schemes to combat climate change along with import of workers from affected areas remains the only factor for the increase of number of local cases among Jordanians.

Malaria

Construction of dams and formation of new habitats suitable for mosquitoes breeding may result in expansion of the range for some vector species in new areas. However, higher risk among the local population depends on movement of infected people (i.e. workers and or military personnel serving in endemic areas etc) to newly established breeding sites.

Leishmaniasis

Perhaps leishmaniasis will be the main vector disease affected by climate change in Jordan. Increased temperature may well lead to droughts and decreased absorption of rainfall into the soil. This will subsequently affect the growth of the chenopods (*Anabasis articulata*), thus affecting populations of the reservoir host, the fat Sand Jird. This could be materialized in two dimensions; namely decline of Fat Sand Jird populations in desert areas due to drought and suppressed growth of chenopods, or Increase of Fat Sand Jird populations in mild areas as chenopods may expand into such areas as a result of drought.

Adaptation Measures to Reduce Vulnerability and Enhance Preparedness against the Potential Negative Impacts of Climate Change on VBDs

Local epidemiological and ecological conditions of vector-borne diseases are various, and adaptation options of each vector-borne disease might be different, thus adaptation options are considered separately for each disease.

Malaria: Adaptation Interventions

Despite the global decreasing prevalence of malaria due to intense control programs, malaria cases are imported every year among Jordanians and foreign residents from malaria endemic African and Asian countries. Several *Anopheles* mosquito species with potential capacity of malaria transmission are still prevalent in Jordan. Local environmental and ecological conditions are also adequate for local transmission. Some imported malaria cases may escape the surveillance system and form a potential source of the parasites causing local autochthonous outbreaks of malaria. It is expected that climate change would increase malaria vector density, seasonal activity, and geographical distribution, so the vector capacity will increase and the local autochthonous malaria outbreaks will be more likely.

Public health and health care adaptation interventions

1. Strengthen vector control programs by:
 - Development, adoption and implementation of integrated vector management strategy for vector control.
 - Strengthening of national vector control capacities
 - Establishment of effective surveillance and sentinel sites for malaria vector
 - Use of effective and safe insecticide for the control of malaria vectors
 - Introduction of new biological vector control methods
 - Encourage the distribution and use of local predator fish for vector control
 - Elimination of breeding sites
2. Improve and strengthen surveillance system for the detection of malaria cases.
3. Strengthen diagnostic and treatment facilities.
4. Education for health care givers and the high-risk communities on malaria and its prevention.

Community and individual adaptation measures

1. Elimination/control of small and manmade vector breeding sites
2. House protection by screening windows and air-conditioning
3. Use of bed nets, repellents and clothing

Other sectors' adaptation measures

1. Inter-sectoral collaboration for vector control
2. Provision of equipments and spraying machines for vector control.
3. Elimination and reduction of vector breeding sites.
4. Encourage growing of natural fish predators of vector.
5. Encourage research on new control strategies.

Schistosomiasis: Adaptation Interventions

With the climate change projections and scenarios, the mean average temperatures and droughts are expected to increase. This will increase water demand and construction of water projects. These water projects will create new adequate biotopes and breeding places for the intermediate host, increasing the potential local outbreaks and transmission of urinary schistosomiasis.

Public health and health care adaptation interventions

1. Strengthen Schistosomiasis Control Program by:
 - Strengthen surveillance of the intermediate host in suitable breeding sites
 - Use of effective chemical control against the snail intermediate host

- Encourage environmental management and natural predators to control the snail intermediate host
 - Management of suitable breeding sites for the snail intermediate host
2. Improve and strengthen surveillance system efforts for urinary schistosomiasis case detection.
 3. Strengthen of diagnostic and treatment facilities.
 4. Education of the community and high risk groups on prevention of schistosomiasis.

Community and individual adaptation measures

1. Avoid contact with contaminated water bodies.
2. Avail latrines and swimming pools.
3. Public awareness through media (TV, newspapers, radio, etc.)

Other sectors' adaptation measures

1. Undertake educational programs on prevention for high risk groups (school children and farmers).
2. Strengthen snail control efforts.
3. Encourage research on natural predators of the snails.
4. Request health evaluation of planned development projects such as housing, water harvesting, agriculture, tourism and industrial projects.

Cutaneous Leishmaniasis: Adaptation Interventions

Cutaneous leishmaniasis (CL) is focal in nature; new foci of CL have been identified in the recent years. An increasing trend of CL has been shown since 2004. Leishmaniasis transmission is linked with temperature and humidity. Incidence of CL is likely to be increasing during the next 20 years period in parallel with the expected increase of temperature.

Public health and health care adaptation interventions

1. Establishment of leishmaniasis control unit.
 - Strengthen sand fly surveillance and control.
 - Use of effective and safe insecticide.
2. Improve and strengthen surveillance system for leishmaniasis.
3. Enforce the mandatory notification of human CL cases.
4. Strengthen diagnostic and treatment facilities.
5. Education for health care providers and community on management of cases and prevention.

Community and individual adaptation measures:

1. Avoid endemic areas during night.
2. House protection by the use of screens, fans and air conditioners.
3. Use of bed nets, repellants and clothing for self-protection from sand fly.

Other sectors' adaptation measures:

1. Strengthen inter-sectoral collaboration and efforts for sand fly control.
2. Elimination of breeding places and displace them far from population clusters.
3. Provision of equipment and machines for the control of rodent reservoir and destruction of host colonies.
4. Health evaluation of planned projects like housing, water, agriculture, touristic and industrial projects.

Potential risks and benefits of adaptation measures implemented by other sectors:

- Extension of agriculture and banana cultivation projects form new breeding habitats of disease vectors increasing the requirements for vector control
- Construction of dams and new water projects as water scarcity adaptation measure may form adequate habitat for various vectors and intermediate host increasing the need for intensified vector control efforts
- Construction of some new housing projects in areas considered as CL foci, may be the cause of exposure of inhabitants to the risk of CL infection
- The use of some new irrigation methods like pipe or drip irrigation may have beneficial effects and protective effect against VBDs by decreasing breeding and density of disease vectors and the risk of exposure.

Human and Financial resources needed for implementation:

Human and material resources available at Malaria Control Program (MCP) and Bilharzia Control Program (BCP) are usually used for the control of malaria and bilharzias in integrated vertical control programs. These resources are also used for the control of CL vector and reservoir in cooperation with other sectors. The current annual government expenditure for VBDs control cover the costs of human resources, medications, diagnostic kits, equipment, transportation and other material resources used in the implementation of Malaria Control Program and Bilharzia Control Program interventions. There is no specific budget line for CL control; the control interventions of CL are conducted using resources of peripheral Health Directorates, MCP, BCP, and sometimes resources from sectors other than the health sector. By 2030, vector breeding sites, vector density, distribution, and VBDs risk most likely will increase because of projected increasing temperature and climate change impact. Additional human and material resources and budgets are needed to cover the increased control intervention requirements. Human resources and expenditure of VBDs control interventions during 2011 is used to estimate the expected needed resources in 2030, as shown in Tables 10 and 11.

Table 10 Human resources of VBDs control staff for the central and peripheral level by category in 2011 and expected additional staff needed in 2030

Staff Category	No. of staff in 2011	Additional staff needed in 2030
Physicians	3	1
Administrative Unit	59	7
Surveillance Unit	120	20
Laboratory Unit	18	6
Entomology Unit	39	10
Operation Unit	346	100
Bilharzia Unit	17	10
Total	602	154

Table 11 Comparison between the current cost of VBDs control interventions and the expected cost by 2030 (in US Dollars)

Item	Current cost (2011)	Expected cost increase/year	Estimated cost (2030)
Salaries	1.950.000	58.500	3.120.000
Incentives	45.000	1.350	72.000
Perdiem	30.000	900	48.000
Facilities	40.000	1.200	64.000
Drugs	15.000	450	24.000
Insecticides	35.000	1.050	56.000
Spraying pumps	15.000	450	24.000
Transport Fuel	30.000	900	48.000

Transport Maintenance	20.000	600	32.000
Miscellaneous	125.000	3.750	200.000
Total	2.305.000	69.150	3.688.000

Cost-benefit analysis of adaptation measures and avoidable impacts on VBDs:

The quantitative cost-benefit analysis of adaptation interventions to overcome the impact of climate change on VBDs cannot be estimated where the real cost of a vector-borne disease case in terms of morbidity and mortality are not available. To accomplish such analysis it is necessary to estimate the expected additional risk and burden of VBDs including economic loss and cost of morbidity and mortality. At the same time, calculate the cost of additional control interventions needed.

However, it is known that most VBDs cause severe morbidity, absence from work, chronic health effects, complications, and deaths affecting the quality of life and loss of years of life. If the necessary adaptation interventions are not implemented, malaria will be reintroduced, urinary schistosomiasis transmission will be established, and the level of CL endemicity will be increased. It is sure that the cost of control programs and cost of additional adaptation interventions due to the effect of climate change will not exceed the value of benefits from preventing many VBDs cases and maintaining the free status of Malaria and Bilharzia and the low level of CL incidence. A qualitative cost-benefit analysis is shown in Tables 12 and 13.

See Chapter 8 for detailed Climate Change Adaptation Strategy and Plan of Action to Protect Health.

Table 12 Qualitative analysis of adaptation measures and avoidable health impacts of climate change on VBDs

Target VBDs	Adaptation Measures	Avoidable Health Impact
Malaria, Bilharzia and Leishmaniasis	Enforce legislation and regulations of VBDs control	Reduce risk of VBDs incidence
Malaria, Bilharzia and Leishmaniasis	Strengthen vector control program	Reduce risk of exposure to disease vector
Malaria, Bilharzia and Leishmaniasis	Strengthen surveillance of VBDs	Reduce risk of local VBDs spread and outbreaks
Malaria, Bilharzia and Leishmaniasis	Strengthen diagnosis and treatment	Reduce morbidity and mortality
Malaria, Bilharzia and Leishmaniasis	Education and awareness	Prevention of exposure to disease vectors Reduce VBDs incidence
Leishmaniasis	Establishment of Leishmania Control Unit	Reduce incidence of Cutaneous Leishmaniasis
Malaria, Bilharzia and Leishmaniasis	Environmental health impact assessment of new development projects	Prevention of new vector breeding sites Reduce vector density
Malaria, Bilharzia and Leishmaniasis	Early warning system	Prevention of exposure to disease vectors

Table 13 Costing of activities related to adaptation strategies and measures to reduce impacts of CC on VBDs risk and burden in Jordan

Adaptation Measure	Steps needed	Activities	Quantity	Estimated cost/year (JD)
Enforce legislations and regulations of VBDs control	Review legislation Develop legislations Ratification and dissemination	Committee formation and engage expert	Legislations and regulations for VBDs control enforced	5,000
Strengthen national vector control capacity	Procure equipments and materials Recruit human resources	Training on entomology techniques Training on anti-vector control interventions Request of 6 cars	2 Training Courses/Year 2 Training Courses/Year	4,000 4,000
	Provide transportation		2 cars/year	30,000
Strengthen surveillance system of VBDs	Recruit human resources	Training on surveillance	2 Training Courses/Year	4,000
Strengthen diagnosis and treatment	Establish and strength facilities in high risk areas Procure diagnostic tests Procure medication	Training on diagnosis Training on Treatment	2 Training Courses/Year 2 Training Courses/Year	4,000 4,000
	Education and awareness on VBDs prevention, control and management	Review of educational materials Development of new educational materials Develop guidelines	Use of various mass media for awareness Educational campaigns Production of guidelines and leaflets on VBDs prevention and control	Educational massages 2 educational campaigns 1000 Leaflets 200 Guidelines
Establishment of Leishmaniasis Control Unit	Take high level support Procure human and material resources	Establishment of a Leishmaniasis Control Unit at MOH	2 Training Courses/Year	4,000
Environmental health impact assessment of new development projects (EHIA)	Take high level support Develop regulations	Establish national committee for EHIA Communicate regulations	4 training Courses/Year on EHIA for public health inspectors	8,000
Early warning system (EWS) for VBDs and disease vectors	Early detection of VBDs cases Vector and Host surveillance Strategic deposit of control materials and equipment Maintain a state of preparedness for VBDs control	Inter-sectoral collaboration and coordination Procure resources and equipment	An EWS for VBDs and disease vectors has been established	10,000
Total estimated cost	85,000 JD/year over 5 years implementation period			

Early Warning System on Vector-Borne Diseases and Climate Change

Epidemics pose a significant threat worldwide, particularly in those areas that are already affected by other serious hazards, poverty, or under-development. Epidemics spread easily across country borders, as Globalization increases the potential of a catastrophic disease outbreak.

The FAO, the World Organization for Animal Health (OIE), and WHO has formally launched a global early warning system for animal diseases transmissible to humans in July 2006. The Global Early Warning and Response System for Major Animal Diseases, including Zoonoses, monitors outbreaks of major animal diseases worldwide (UNEP, 2012). A malaria early warning system is not yet available and the need for system development is pressing, especially in Sub-Saharan Africa where malaria causes about one million deaths every year. The IRI institute at Columbia University provides malaria risk maps based on rainfall anomaly, which is one of the factors influencing malaria outbreaks and distribution, but no warning is disseminated to the potentially affected population (UNEP, 2012).

In addition, the Malaria Atlas Project (MAP) supported by the Wellcome Trust, the Global Fund to Fight AIDS, Tuberculosis and Malaria, the University of Oxford-Li Ka Shing Foundation Global Health Program and others, aims to disseminate free, accurate and up-to-date information on malaria. The MAP is a joint effort of researchers from around the globe working in different fields (from public health to mathematics, geography, and epidemiology). MAP produces and makes available a range of maps and estimates to support effective planning of malaria control at national and international scales (UNEP, 2012).

In the above sections, the links between climate change and vector-borne diseases are identified. These links, as identified by Gubler *et al.* (2001), considered both temperature and rainfall effects on vector borne diseases, as summarized in Table 14. A range of possible mechanisms exists whereby changes in temperature and/or rainfall could affect the risk of transmission of vector borne diseases.

Table 14 Links between Climate change and VBDs

Effect	Possible outcomes
Temperature effects	Increase or decrease in survival of vector Changes in rate of vector population growth Changes in feeding behaviour Changes in susceptibility of vector to pathogens Changes in incubation period of pathogen Changes in seasonality of vector activity Changes in seasonality of pathogen transmission
Rainfall effects	Increased surface water can provide breeding sites for vectors Low rainfall can also increase breeding sites by slowing river flow Increased rain can increase vegetation and allow expansion in population of vertebrate host Flooding may eliminate habitat for both vectors and vertebrate hosts Flooding may force vertebrate hosts into closer contact with humans

Objectives of the EWS

The general objective of the EWS on VBDs and climate change is:

Early prediction of increased risk of VBDs occurrence and epidemics due to climate change.

The secondary objectives are:

- Reduction of local epidemics of Malaria
- Reduction of local epidemics of Urinary Schistosomiasis

- Reduction of incidence and epidemics of Cutaneous Leishmaniasis

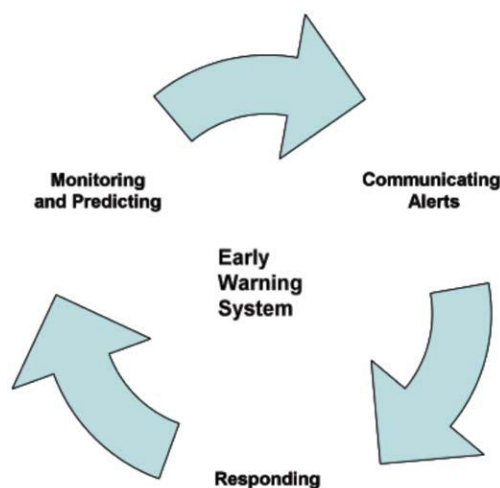
Structure of Early Warning System for VBDs

The early warning system is a multi-factorial process that includes several inputs in order to come up with a reliable certainty to take the necessary measures to reduce the effect of climate change on VBDs. It consists of two dimensions, namely, time and certainty of the possible effect. Other components of the early warning system include climate forecast, environmental observations, sentinel cases, early cases, epidemics, response, and early actions.

The EWS Unit of VBDs and Climate Change has to be established at MOH-CDD. The main stakeholders involved in the EWS on VBDs are institutions and agencies that may contribute in providing essential information on weather parameters, climate trends, and environmental conditions; and communities and organizations that may play important role in the response plan to prevent and reduce the impact of climate change on VBDs. These are MD, GAM, RMS, MOA, MWI, MoEnv, Jordanian Universities, MOM, and Media.

The main source of climate data is the MD. Such data should be consolidated in a format that will allow health officials to issue warnings and take necessary steps to combat VBDs outbreaks. Other stakeholders would have an important role in the EWS communication and response plans. Figure 10 demonstrates the EWS operational aspects.

Figure 10 Early Warning System operational aspects (After UNEP, 2012)



The monitoring and prediction stage involves many stakeholders. Previous reports have comprehensively explained the monitoring leading role taken by the VBDs unit in the MOH to monitor and treat the three VBDs under study. Moreover, meteorological data are vital to give an early warning to the health sector. Any change in temperature or rainfall would certainly affect the breeding and colonization of vectors (mosquitoes, freshwater snails, and sand flies). A joint and continuous cooperation between MOH and Meteorological Department is an essential component of the EWS for monitoring the temperature and rainfall and predicting trends and changes of these important weather factors. Regular surveys, monitoring, and observation of environmental changes are also necessary to identify any new favorable environmental conditions for vector breeding and transmission of VBDs. At the same time, surveillance for vectors in previously known hotspots for the population dynamics of vectors will be conducted on regular monthly bases, and related to any change in climatic data. This includes active daily surveillance countrywide. Similarly, early case detection in areas that are known to be vulnerable will be among the first priorities of the health sectors in Jordan.

Communication Plan of the EWS

Communication and dissemination of clear warning signals on the expected risk of VBDs spreading and information on adaptation measures and preventive actions needed to reduce the risk of VBDs has to be disseminated as soon as possible. These warning signals will be sent to decision makers at MOH, vulnerable communities, and all other relevant stakeholders, partners and concerned sectors. At the same time, the EWS has to be sure that alarming signals reach the target organizations and vulnerable communities.

The alarming signals on imminent risk, information on response actions and adaptation interventions will be disseminated through the most popular, accessible and fastest means of communications such as:

1. Telephone, Fax, and Emails directed to decision makers, relevant stakeholders and partners.
2. Mass media including TV and Radio directed mainly to vulnerable communities.
3. Urgent SMS messages directed to intervention teams, health facilities and involved organizations.

The type of messages and information include:

- Warning messages about place and time of VBD risk of spread and epidemics.
- Public awareness about the use of personal protective measures against disease vectors and prevention of VBDs.
- Warnings of people about visiting areas with high potential risk of disease transmission and acquiring the infection.
- Instructions for the application of control actions and insecticides spraying against vectors and reduction of breeding sites.
- Issuing emergency measures to hospitals, health facilities, and other health care providers on diagnosis, reporting, and treatment of cases.
- Active detection and prompt treatment of cases in vulnerable areas with active transmission.

Response Plan of the EWS

The response actions will be implemented in vulnerable areas. These areas are previously identified during the VBDs vulnerability assessment. The information collected and analyzed by the EWS Unit on climate parameters, together with the information collected by the surveillance system on vectors' activities and human cases will indicate and predict the places at higher risk of VBDs transmission.

EWS Indicators

The main local indicators of cutaneous leishmaniasis are:

1. Incidence of CL/100,000 population
2. Number and distribution of active *Psammomya obesus* colonies, the reservoir host of *L. major*

The main local indicators of Urinary Schistosomiasis are:

1. Incidence of local urinary Schistosomiasis
2. Number of positive Water bodies for *Bulinus truncatus* snails

The main local indicators of Malaria are:

1. Incidence of local malaria cases
2. Density of larval *An.* Mosquitoes in breeding sites under control measures
3. Density of adult *An.* Mosquitoes density

Interventions and response actions will be implemented at different levels of predicted risk:

1. When alerts by the MD are issued to the EWS–VBDs Unit due to favorable climate and environmental conditions for vector multiplication and breeding.
2. When the Surveillance System in the VBDs Division at MOH indicates an increase of vectors' densities and activities.
3. When the Surveillance System detects local human cases or epidemics of any one of the three VBDs.

Response Actions and Interventions

Various interventions and actions will be taken according to the environmental, entomological, and epidemiological situation. These interventions may include some or all the following response actions:

1. Public awareness about preventive measures of VBDs.
2. Entomological surveys to determine vector capacity of disease transmission.
3. Anti-vector control measures.
4. Control of animal and intermediate host of CL and Urinary Schistosomiasis.
5. Surveillance, detection, diagnosis and treatment of human VBDs cases.
6. Distribution of presumptive treatment at communities suspected to be infected with VBDs.

The response plan and actions will be decided by decision makers and communicated to be implemented in collaboration with different stakeholders according to the predetermined role of each stakeholder in the response plan. A specialized and trained control team will implement control of vectors and manage human cases at the national level. The community is responsible to apply personal and house control protective measures against vectors. Public media has the role of disseminating warning signals, information, and public awareness messages that will be prepared by the VBDs Division in the MOH.

Resources required for the implementation of the response plan

1. Trained and skilled human resources on vector and host control.
2. Trained human resources for the diagnosis and treatment of human cases.
3. Adequate financial resources for EWS Unit and other working teams and equipment.
4. Provision of equipment and other logistics including communication tools.
5. Provision of diagnostic kits and medications.
6. Provision of spraying machines and insecticides.
7. Preparation of education and awareness materials.

Monitoring and Evaluation of the EWS

Monitoring and evaluation (M&E) will be conducted in all phases of the EWS planning and implementation. M&E plan for correction of EWS should be set and considered to increase the accuracy, reliability, and efficacy of the EWS.

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CHAPTER 5 CLIMATE CHANGE AND NUTRITION AND FOOD SAFETY

Introduction

Under nutrition remains one of the world's most serious but least addressed socioeconomic and health problems. In developing countries, nearly one-third of children are underweight or stunted. Under nutrition, including micronutrient deficiencies (also referred to as "hidden hunger") is caused by inadequate dietary intake and disease, which in turn stem from food insecurity, poor maternal and childcare practices, and inadequate access to clean drinking water and safe food, sanitation and quality health services.

The human and socioeconomic costs of under nutrition are enormous, falling hardest on the poorest, especially on women and children. Under nutrition interacts with infectious disease, causing an estimated 3.5 million preventable maternal and child deaths annually (WHO, 2008). The resulting impacts in terms of lost national productivity and economic growth are huge, and the recent food and economic crises and economic downturn have magnified the challenge of hunger and under nutrition (FAO, 2008).

Climate Change, Nutrition, and Food Security

Climate change directly affects food and nutrition security of millions of people (FAO, 2008). The main concern about climate change and food security is that changing climatic conditions can initiate a vicious circle where infectious disease causes or compounds hunger, which, in turn, makes the affected populations more susceptible to infectious disease. The result can be a substantial decline in labor productivity and an increase in poverty and even mortality. Essentially all manifestations of climate change, drought, higher temperatures, or heavy rainfalls have an impact on the disease pressure, and there is growing evidence that these changes affect food safety and food security (Schmidhuber et al., 2007).

Nutrition insecurity is a major consequence of climate change. Climate changes will have serious impacts on the four dimensions of food security, namely, food availability, food accessibility, food utilization, and food system stability. Effects are already being felt in global food markets and are likely to be particularly significant in specific rural locations where crops fail and yields decline. Impacts will be felt in both rural and urban locations where supply chains are disrupted, market prices increase, assets and livelihood opportunities are lost, purchasing power falls, human health is endangered, and affected people are unable to cope (FAO, 2008).

Evidence for climate change effects on crop yields is strong. Many studies expected that shifts in farming systems and increased crop water requirements, in addition to the increased incidence of pest attacks, would result in reducing crops yields, particularly in mid-latitudes. The negative impacts of climate change will result in increased food prices. This will decline the purchasing power of consumers especially the poor. Declining food consumption may lead to malnutrition, undernutrition, hunger, and diseases (MoEnv, 2009).

Even before the recent food, fuel, and financial crisis, it was estimated that globally there were 20 million 5-years old children with severe acute malnutrition, with 1 million dying annually. Clearly, much more needs to be done to deal with this problem, with or without the current crisis. The United

Nations estimates that up to 1 billion people globally are now at risk of food insecurity. Although food security and nutrition are linked, simply ensuring access to an adequate quantity of food does not guarantee adequate nutrition, particularly adequate intake of essential micronutrients.

Evidence over the last few decades from developing countries has confirmed that rapid increases in food prices can lead to relatively rapid increases in maternal and child undernutrition levels. During the Indonesian financial crisis in 1997–1998, wasting increased in Javanese women, although without increases in child undernutrition, suggesting that mothers maintained their children's food intake even at their own expense. Increased levels of anaemia in mothers and children were associated with a reduction in consumption of high quality foods. The combined effects of the crisis were particularly severe for children conceived and weaned during the crisis (Darnton and Cogill, 2010).

Half of the consequences of malnutrition are attributable to environmental issues, especially poor water quality, sanitation, and hygiene. Poor nutritional status, especially in infants and young children, makes infections worse and more frequent. Diseases attributable to environmental factors also have the potential to affect a child's future cognitive functions and educational performance (<http://go.worldbank.org/KD6G3BVDZ0>).

In Asian and African countries with marginal water resources, reduced food availability is coupled with increased likelihood of infection as water becomes scarcer and its hygienic conditions becomes poorer (Black et al., 2010).

While multiple biological and social factors affect malnutrition, the fundamental determinant is the availability of staple foods. In countries with low diversity of agricultural crops and limited financial resources, malnutrition is expected to be the main problem resulting from climate change.

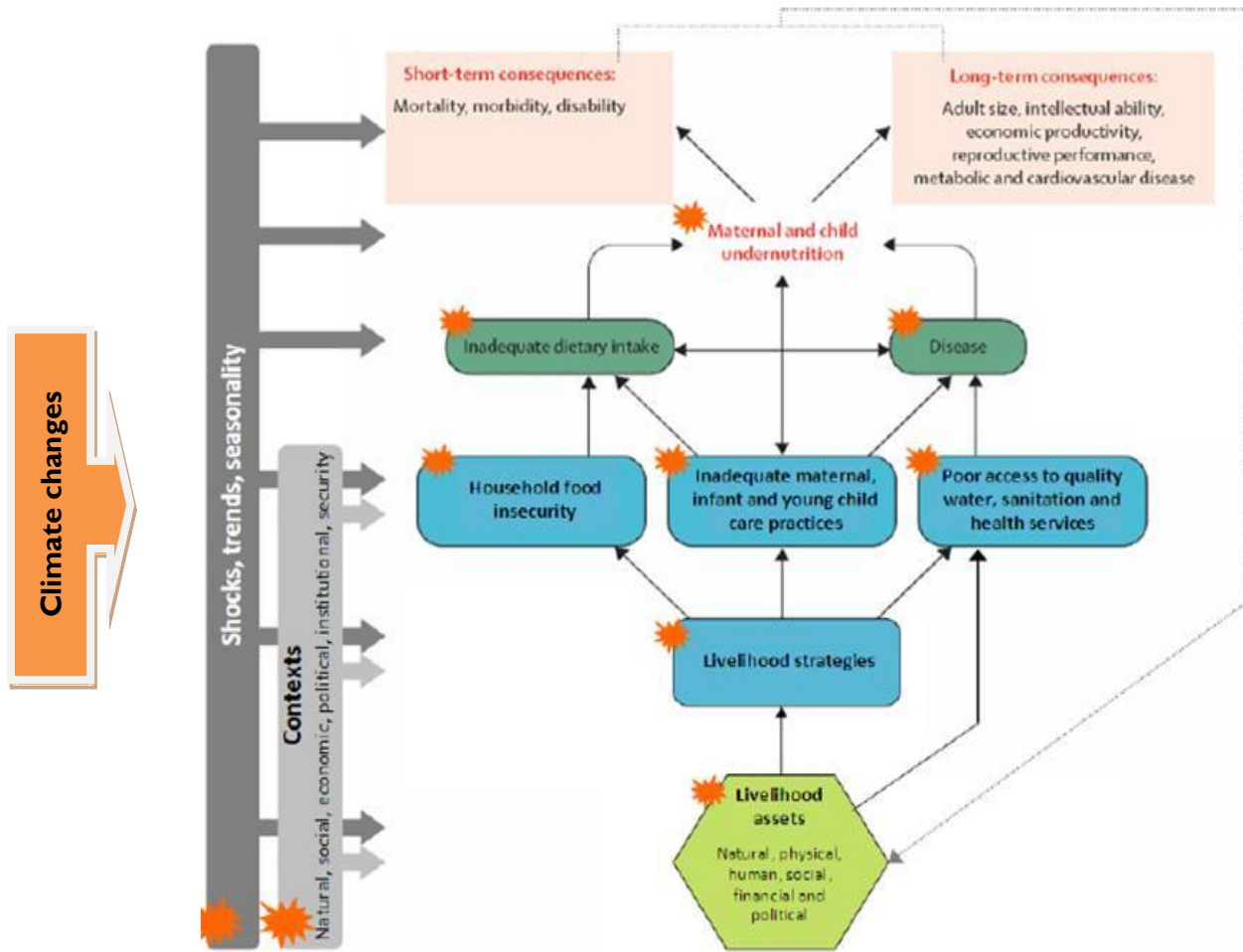
According to the World Bank figures of 2008, the consequences malnutrition – mortality and impairment of cognitive development and educational performance will be a high economic burden: up to 9% of a country's GDP in the Sub-Saharan Africa or South Asia. In addition, literature indicates that poor children under the age of 5 are most vulnerable to the health impacts resulting from environmental health risks. For every death prevented from an environmental health intervention, additional deaths from other diseases are averted (Mills-Reincke phenomenon). In Asia and Africa, this multiplier effect is in the range of 1.5-1.9 (<http://go.worldbank.org/KD6G3BVDZ0>).

The causality analysis framework below shows the relationship between climate change and nutrition and food security. It is based on short and long-term consequences of climate change. The main components of this framework are the inadequate diet, household food insecurity, diseases, and poor access to quality water (crucial in Jordan, as marginal water resources will dominate under climate change).

Risks to Food Security in Jordan

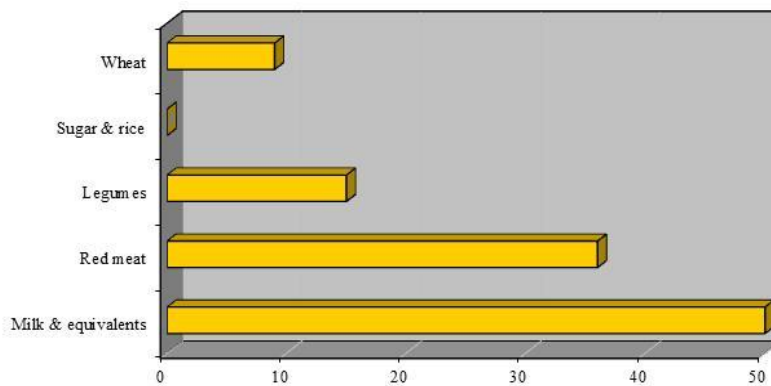
Due to limited water and land resources, food security in Jordan is not achieved without food imports to meet the needs of the escalating population growth rate. Therefore, food security in Jordan is dependent on the domestic food demand of foreign food market supply for food items of strategic value, such as, wheat, sugar, and rice. The average self-sufficiency degree (SSD) for these items in the second half of the nineties is shown in Figure 1.

Causality Analysis Framework.



☀ Impact and/or threats of climate change(WHO,2008)

Figure 18 Self-sufficiency (%) of food during 1990-1999 (Source: Foreign Trade Year Book)



The problem of food security risk will increase as food demand increases as the result of a continuously growing population and the changing food consumption patterns of Jordanians. During

1988-1989, Jordan faced tightened economic conditions due to loss of some markets, unemployment, poverty, increased food demand, and high debts. In an effort to overcome these problems, Jordan implemented the “Economic Adjustment and Restructuring Programs.” These programs required the privatization of economy, lifting subsidies for both consumers and producers, and elimination of food pricing systems.

Malnutrition and Micronutrient Deficiencies in Jordan

Malnutrition in Jordan

The most recent Micronutrient national study of 2010 showed 3.5% of children were wasted, 2.5% were underweight, and 10.8% were stunted; and that 8.8% of the children were at risk for overweight and 1.8% at risk for obesity. Statistical significant differences are observed between geographical regions while no significant differences are observed across subgroups (including sex, age, region, and residence) of wasting, stunting, overweight, or obesity (MOH, 2010).

Anthropometric Status of Children

Adequate nutrition is important for child development. The window between birth and 59 months of age is a critical time for optimal growth and healthy development. Often this period is marked by sub-optimal growth due to malnutrition, micronutrient deficiencies, and disease.

The WHO recommends that a Z-score cut-off point of < -2.0 be used to classify low height-for-age, low weight-for-age, and low weight-for-height for estimating the prevalence of malnutrition. With any of the indicators, a population prevalence of malnutrition less than 2.3% is regarded as the surveyed population being similar to the WHO reference/standard population and thus free from malnutrition based on that indicator.

Height-for-Age

A low height-for-age indicates shortness, or growth stunting, which reflects a long-term deficit of adequate nutrition and/or a history of illness and disease such as diarrhea and acute respiratory infection. On a population level, a high prevalence of stunting is usually associated with poor socioeconomic conditions and a greater risk for frequent and/or early exposure to adverse environmental conditions such as illness and inadequate nutrition (WHO, 1995). A decrease in the prevalence of stunting usually parallels improvements in economic conditions.

Weight-for-Age

Low weight-for-age, or underweight, can serve as an indication of malnutrition caused by both acute and chronic conditions. In addition, underweight can be used on an individual basis, for children under two years of age, to assess growth faltering by comparing a child’s growth progression in comparison to a reference group (Cogill, 2001). On a cross-sectional basis, however, weight-for-age is less useful than height-for-age or weight-for-height in defining nutritional status. In most populations where there are few children with low weight-for-height, the weight-for-age status provides essentially the same information as height-for-age.

Weight-for-Height

Low weight-for-height, or wasting, is an indicator of thinness or acute under-nutrition and is often the result of severe food shortage and/or prolonged severe illness. Unlike the wide variation in stunting rates observed in developing countries, the prevalence of wasting is usually less than 5% in most

countries provided there is no severe food shortage. Therefore, a wasting prevalence of more than 5% is of concern; a prevalence of 10% to 14% is considered serious; a prevalence of 15% or higher is considered critical (WHO, 1995).

Micronutrient Deficiencies (MNDs) in Jordan

Vitamin A Deficiency (VAD)

Improving vitamin A status of young children leads to significant reductions in mortality rates. VAD is linked to the nature of foods available and feeding practices. Interventional studies of 1999 and 2002 showed that vitamin A deficiencies were significant public health problems among schoolchildren in poor areas. Both studies showed that Vitamin A supplementation had a significant positive impact on SRC levels, anaemia indicators, and STC. Furthermore, the positive impact of supplementation was found to be modulated by dietary fat levels and vitamin A supply from animal sources (Khatib et al., 2002).

Public Health Significance of vitamin A

Applying the IVACG (Criteria proposed by the International Vitamin A Consultative Group) and WHO thresholds for vitamin A deficiency (originally defined for children 6 – 71 months) to children, suggests that vitamin A deficiency is a public health problem of moderate severity in children in the southern region and severe importance in children in the northern region.

Vitamin A is an essential nutrient required for the immune system, cell function and growth, and epithelial maintenance (WHO, 2009). When an individual is vitamin A deficient, a range of disorders can result affecting bone growth, vision, gene transcription, and skin health. Vitamin A deficiency (VAD) is the leading cause of preventable blindness globally. The groups most vulnerable to VAD are infants, young children, pregnant women, and lactating women (WHO, 2009).

Iodine Deficiency Disorders (IDD)

A national survey of young children (cohort 8-10 years) from all governorates concluded that IDD was 38% for all grades as indicated by goitre palpation and urinary iodine excretion (MOH, 1993). The study provided clear evidence that moderate or lower degrees of IDD existed in Jordan. In 2010, the national monitoring survey revealed that the prevalence of IDD dropped to 4.5% (Barham and Massad, 2010).

Anaemia and Iron Deficiency Anaemia (IDA)

The most susceptible groups to anaemia and IDA are preschool children, women of childbearing age, and adolescent girls. The 2002 Jordan National Survey on IDA showed that anaemia affected 32% of Jordanian woman in reproductive age, with a prevalence of iron deficiency of 41% and that of iron deficiency anaemia of 22% (MOH, 2002). Iron status indicators suggest a moderate level of public health burden among women of reproductive age at the national level.

Public Health Significance of Anaemia

WHO classifies the severity of the public health problem of anaemia based on the prevalence of persons suffering anaemia in a population (WHO, 2001). Table I includes classifications of the severity of anaemia as defined by the WHO.

Table 8 Severity of the public health problem of anaemia as defined by WHO

Category of the Severity of the Public Health Problem of Anaemia	Prevalence of Anaemia in the Population (%)
Severe	≥ 40.0
Moderate	20.0 – 39.9
Mild	5.0 – 19.9
Normal	≤ 4.9

Iron is an essential micronutrient and functions as a component of proteins and enzymes. It is a necessary component of hemoglobin in red blood cells and myoglobin in muscle tissue. A deficiency of iron leads to impaired work performance, fatigue, developmental delay, cognitive impairment, and adverse pregnancy outcomes (WHO, 2001). Iron deficiency is one of the leading causes of anaemia, yet not all cases of anaemia are caused by iron deficiency and, in populations not suffering from malaria, iron deficiency does not necessarily develop into anaemia.

Assessment of Current Vulnerability and Risk of Nutrition and Food Security in Jordan

Two dimensions for the vulnerability analysis are considered. These are:

Vulnerable Population

As an indirect effect, low-income people everywhere will be at risk of food insecurity owing to loss of assets. The most vulnerable populations that can be exposed to malnutrition in Jordan are:

- Children under 5 years living in poverty
- Children aged 0-4 living in remote areas
- Pregnant women living in poverty pockets
- Women of childbearing age who are malnourished
- Urban poor people
- Almost all the population in remote area

Geographic dimension (vulnerable areas)

Since nutrition programs and surveys are presented for the northern, middle, and southern parts of Jordan, the same geographical dimension was considered; Mafraq, Amman, and Ma'an were selected to represent them, respectively.

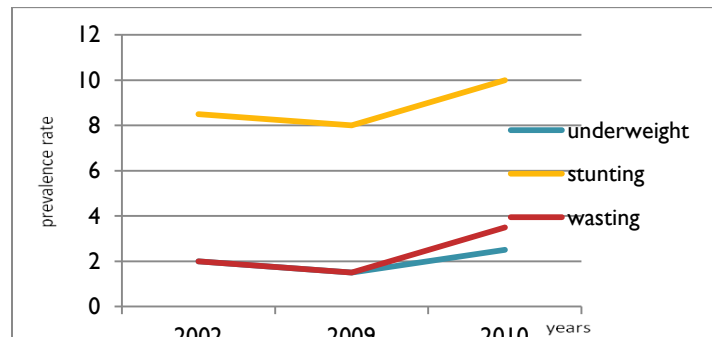
The major health outcomes of interest are the following:

- Malnutrition (stunting, wasting, underweight)
- Growth retardation
- Morbidity rate due to low immunity system
- Intrauterine growth retardation in newborn
- Low birth weight
- Iron deficiency anaemia
- Iodine deficiency disorder
- Disabilities

Nutritional status for children under 5 years old and women at childbearing age

Figure 2 reveals that there is an increasing trend in the prevalence of stunting, underweight and wasting among children under 5 years of age at the national level for the period 2002-2010.

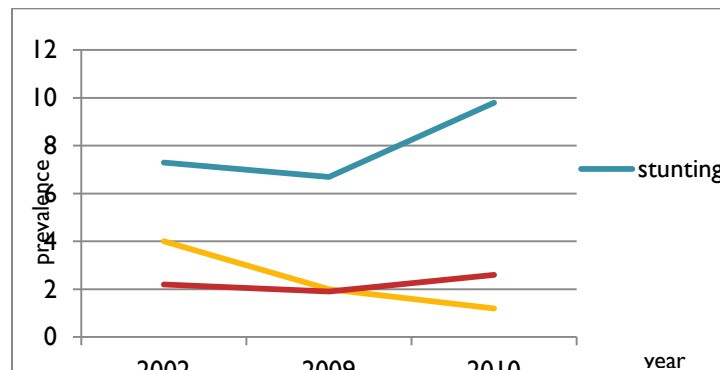
Figure 19 Prevalence of stunting, underweight, and wasting among children < 5 years at the national level



(Source: DHS, MOH 2010)

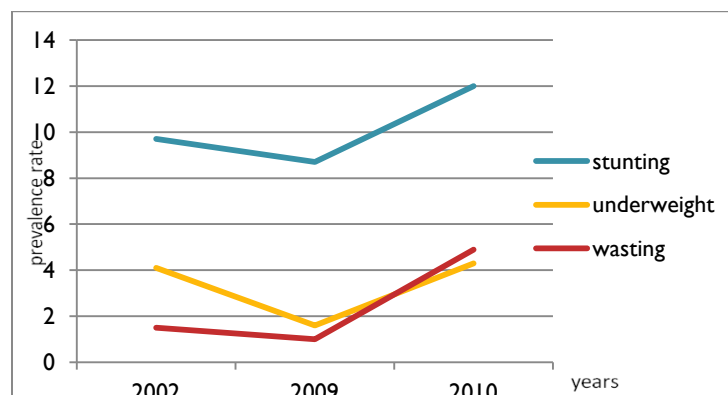
Figure 3 shows an increasing trend in the prevalence of stunting and wasting, and decreasing trend in the prevalence of underweight in the middle region (Amman, (2002-2010)). Whereas, Figures 4 and 5 illustrate an increasing trend in the prevalence of stunting, underweight and wasting among children under 5 years of age during (2002- 2010) in the northern and southern regions.

Figure 20 Prevalence of stunting, underweight, and wasting among children < 5 years in Middle Region (Amman)



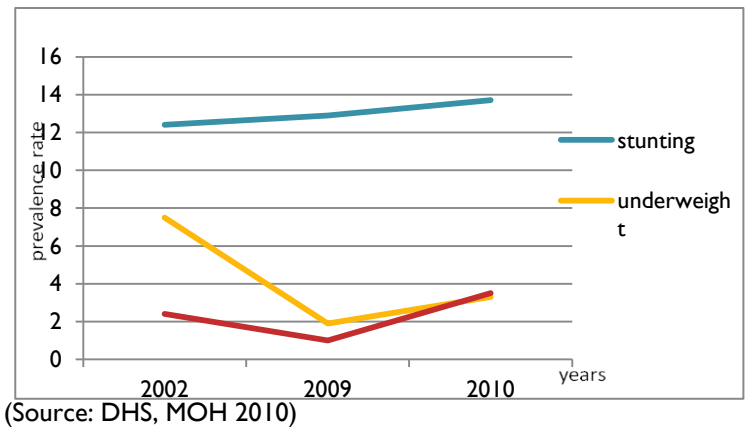
(Source: DHS, MOH 2010)

Figure 21 Prevalence of stunting, underweight, and wasting among children < 5 years in Northern Region



(Source: DHS, MOH 2010)

Figure 22 Prevalence of stunting, underweight, and wasting among children < 5 years in Southern Region



Figures 6, 7, 8, and 9 show an increasing trend in the prevalence of iron deficiency (ID) among women at childbearing age at the national level, Middle, Northern and Southern Regions during (2002-2010).

Figure 23 Prevalence of iron deficiency (ID) among women at childbearing age at the national level

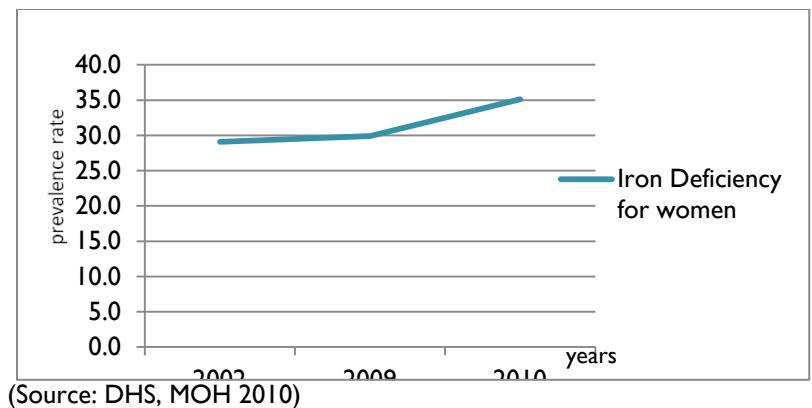


Figure 24 Prevalence of iron deficiency (ID) among women at childbearing age in the Middle Region

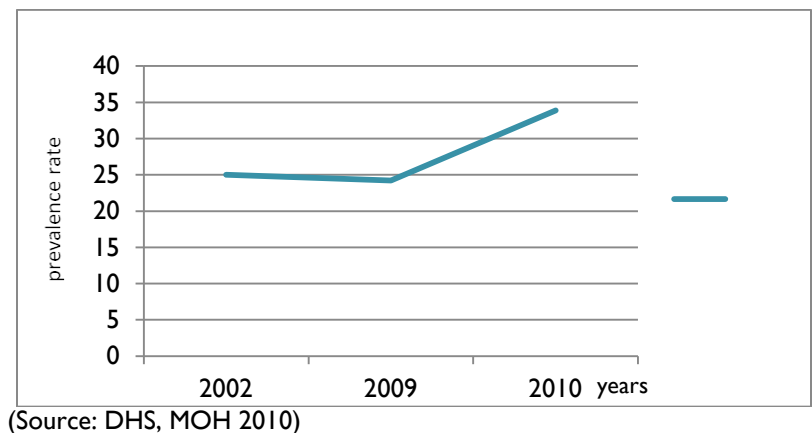
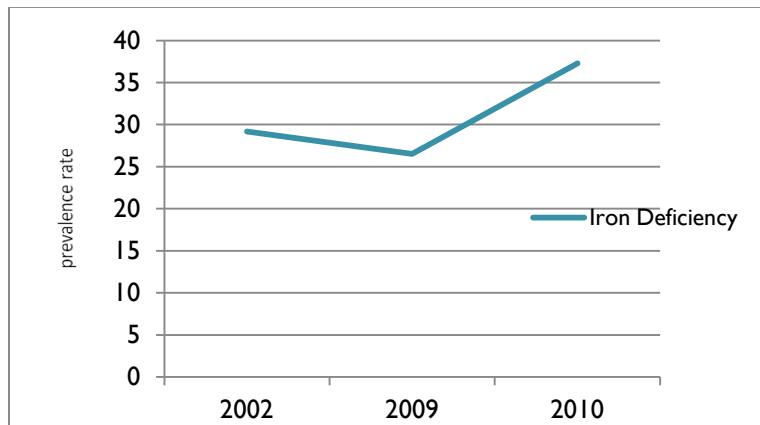
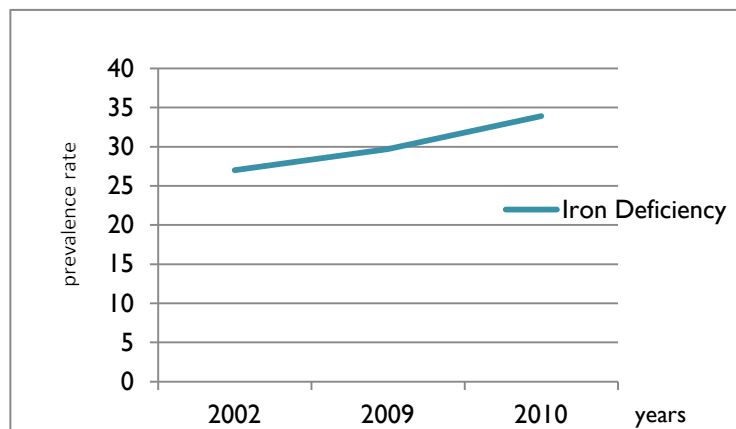


Figure 25 Prevalence of iron deficiency (ID) among women at childbearing age in the Northern Region



(Source: DHS, MOH 2010)

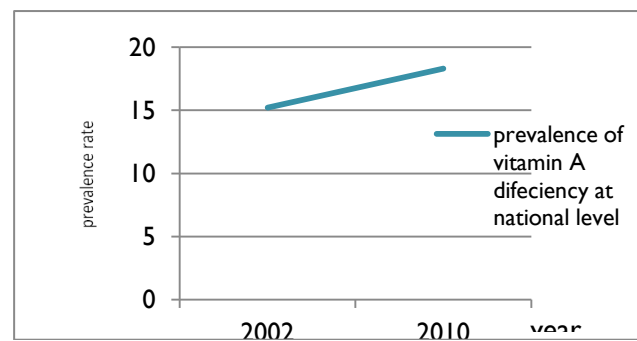
Figure 26 Prevalence of iron deficiency (ID) among women at childbearing age in the Southern Region



(Source: DHS, MOH 2010)

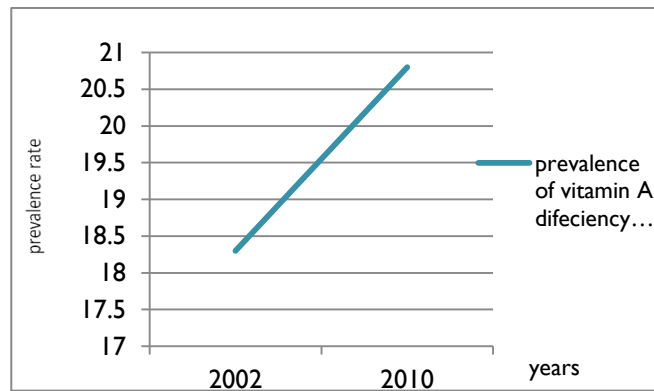
There is an increasing trend in the prevalence of vitamin A deficiency among children under five years old at the national level (moderate public health problem regarding the WHO references for the classification of the severity of vitamin A deficiency) as shown in Figure 10. The same increasing trend is applicable to the Middle Region; whereas in the Northern Region, a sharp increase in the prevalence of vitamin A deficiency is shown in Figure 11 (severe public health problem).

Figure 27 Prevalence of vitamin A deficiency among children under five years old at national level



(Source: DHS, MOH 2010)

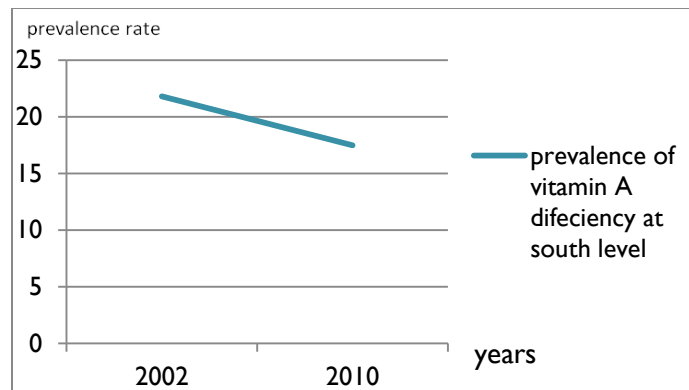
Figure 28 Prevalence of vitamin A deficiency among children under five years old in Northern Region



(Source: DOS)

Figure 12 shows a decreasing trend in the prevalence of vitamin A deficiency among children under 5 years of age at the Southern Region.

Figure 29 Prevalence of vitamin A deficiency among children under five years old in the Southern Region



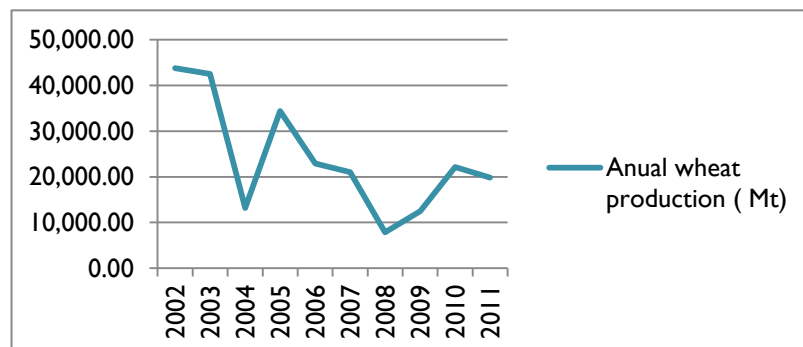
(Source: DOS)

Food Security Indicators

Food Availability

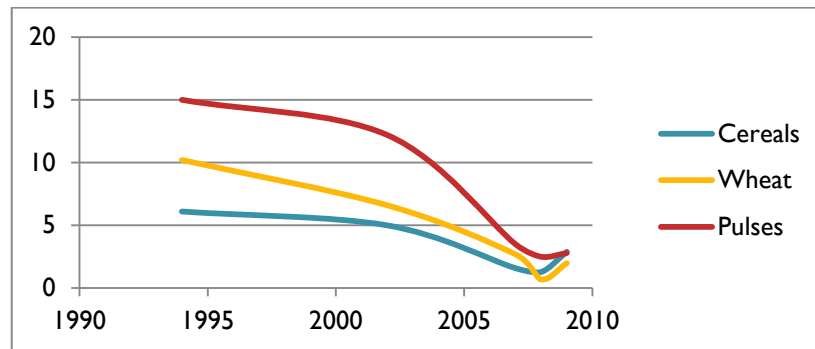
Figure 13 reveals that the trend of annual wheat production (MT) at the national level is decreasing; whereas Figure 14 shows a decreasing trend in SSD for cereals, wheat, and pulses at the national level.

Figure 30 Annual wheat production (Mt: metric tons) at the national level



(Source: DOS)

Figure 31 Self- sufficiency degree for the main food items

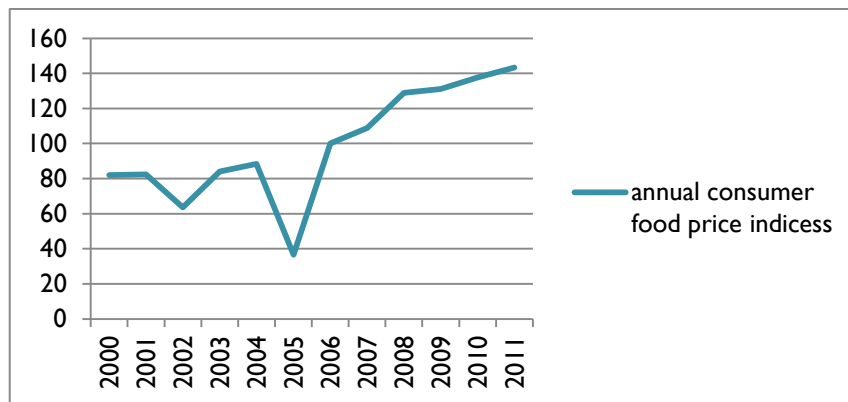


(Source: DOS)

Food Stability

Figure 15 illustrates that there is an increase in annual consumer price indices at the national level.

Figure 32 Annual consumer food price indices

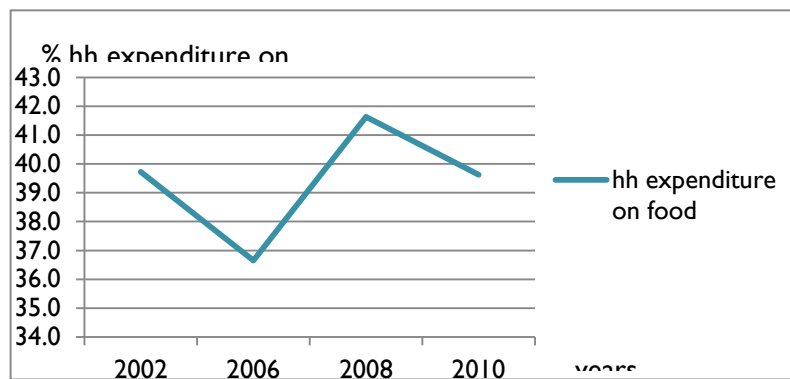


(Source: DOS)

Food Access

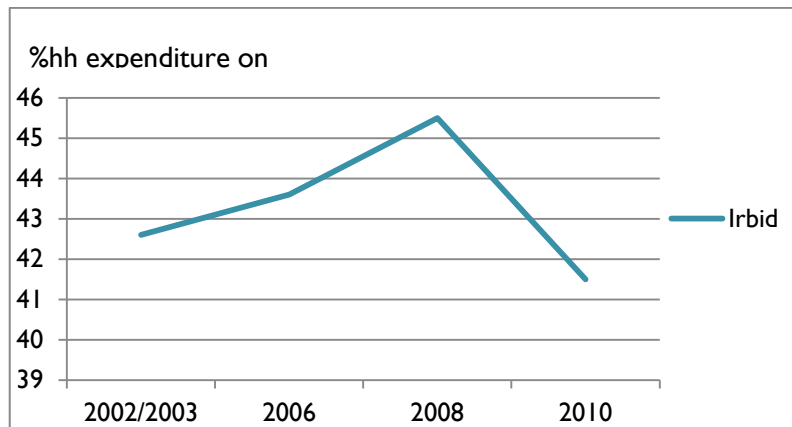
Figures 16, 17, and 18 indicate that since 2008 there is a decreasing trend in household expenditure on food at the national level, Irbid (northern region), and Aqaba (southern region).

Figure 33 Household expenditure on food at the national level



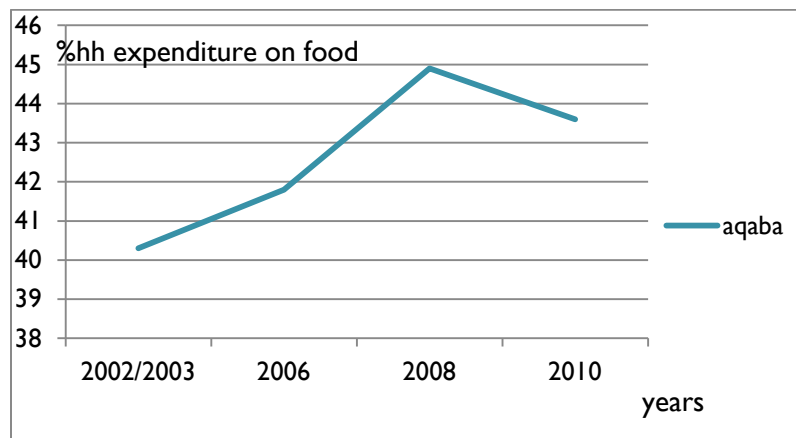
(Source: DOS)

Figure 34 Household expenditure on food in Irbid governorate (northern region)



(Source: DOS)

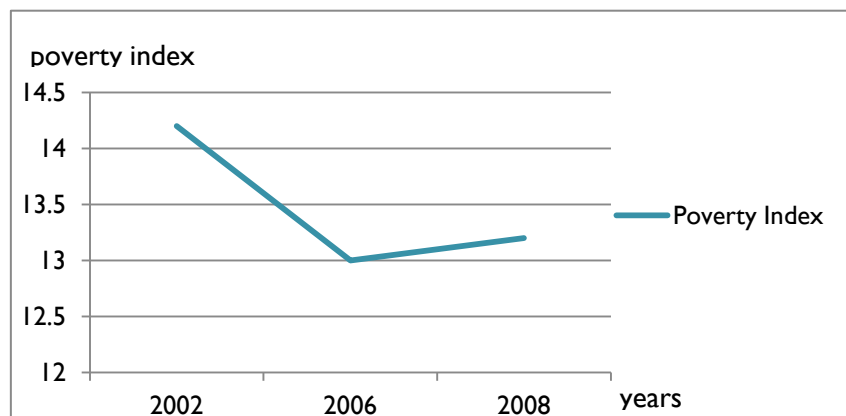
Figure 35 Household expenditure on food in Aqaba governorate (southern region)



(Source: DOS)

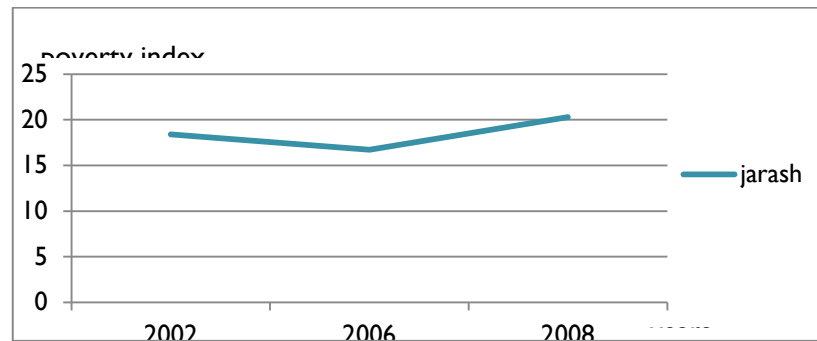
Figures 19, 20, and 21 show that there is an increasing trend in the poverty index since 2006 at the national level, Jerash (northern region), and Tafila (southern region).

Figure 36 Poverty Index at the national level



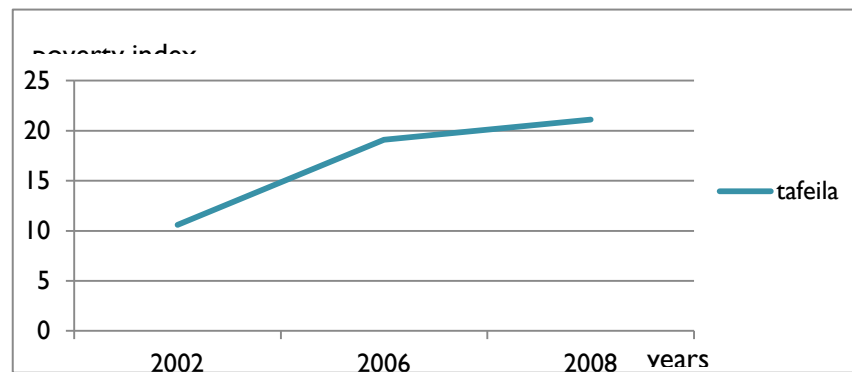
(Source: DOS)

Figure 37 Poverty Index at Jerash governorate (northern region)



(Source: DOS)

Figure 38 Poverty Index at Tafila governorate (southern region)

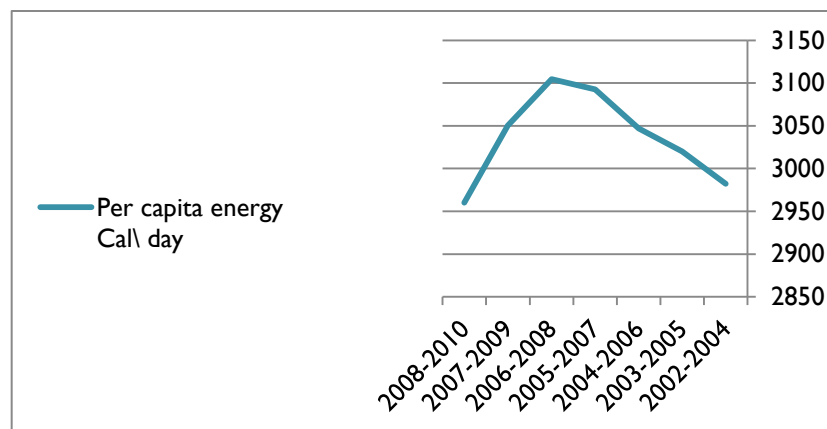


(Source: DOS)

Food Utilization

Figure 22 shows that the Per Capita Energy Utilization (Cal/day) at the national level is decreasing since 2008.

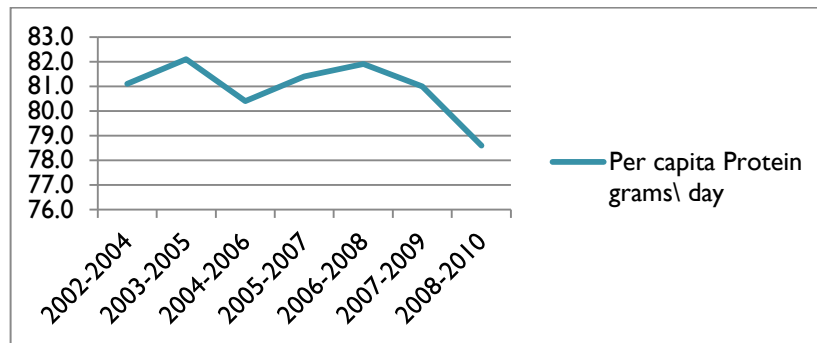
Figure 39 Per Capita Energy Utilization (Cal/day) at the national level



(Source: DOS)

Figure 23 illustrates that the Per Capita Protein Utilization (gram/day) at the national level is decreasing sharply since 2008.

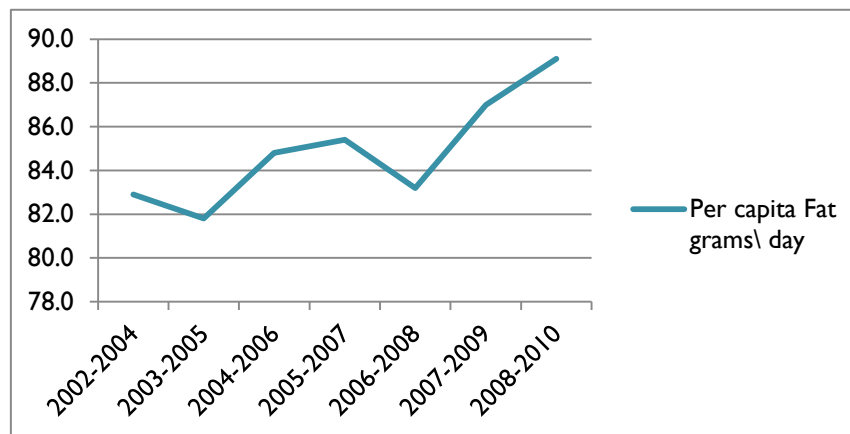
Figure 40 Per Capita Protein Utilization (gram/day) at the national level



(Source: DOS)

Figure 24 illustrates that the Per Capita Fat Utilization (gram/day) at the national level is increasing since 2008.

Figure 41 Per Capita Fat Utilization (gram/day) at the national level



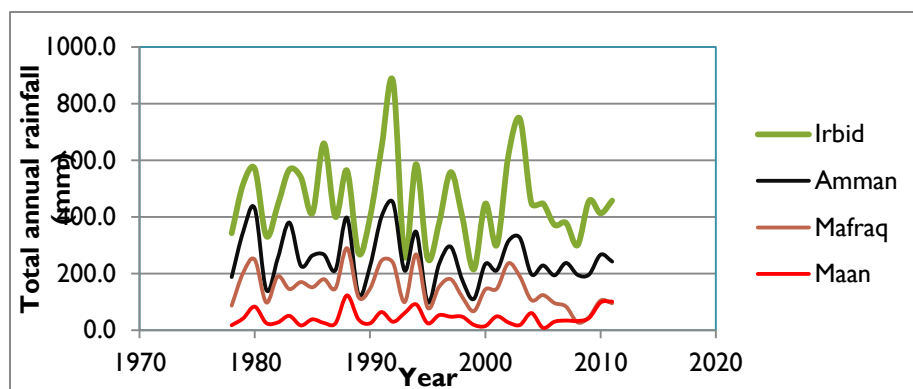
(Source: DOS)

Influencing Factors

Annual Precipitation

Figure 25 indicates that annual precipitation at Mafraq, Amman, Ma'an, and Irbid is decreasing.

Figure 42 Annual precipitation at Mafraq, Amman, Ma'an, and Irbid

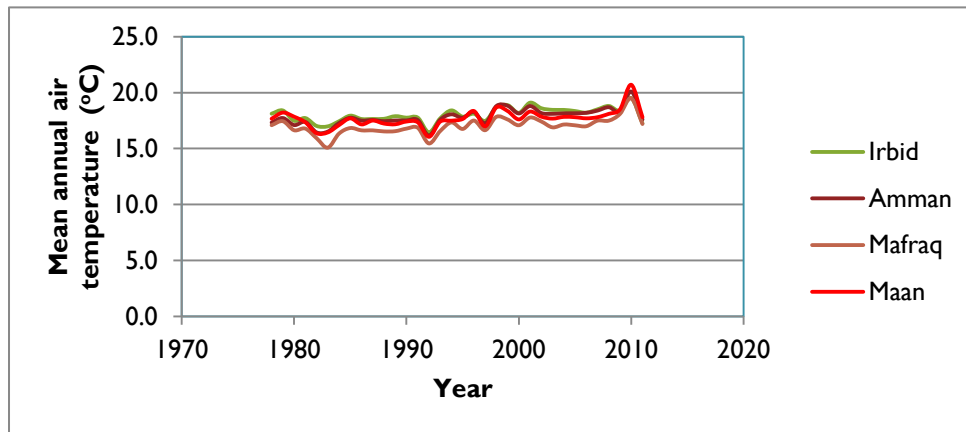


(Source: Al Bakri, et al)

Temperature

Figure 26 indicates that the annual temperature at Mafraq, Amman, Ma'an, and Irbid is increasing.

Figure 43 Annual temperature at Mafraq, Amman, Ma'an, and Irbid



(Source: DOS)

Vulnerability Assessment of Impacts of Climate Change on Nutrition and Food Security

Future Climate Change Projections in Jordan

To assess climate change impacts on nutrition, climatic data for the period 1981-2010 was analyzed by the Meteorological Department. The analysis focused on predicting trends of air temperature, rainfall, heat waves, and dust storms, and the results of the analysis was compared with results of Jordan's SNC to the UNFCCC. Since nutrition programs and surveys are available for the Northern, Middle, and Southern Regions of Jordan, the same geographical dimension is considered in presenting the results.

The results indicate that most of the country's population will suffer from the direct impacts of climate change, particularly heat waves and increased air temperature. The highly populated areas of Amman and Irbid will suffer from increased heat waves relative to other locations. The southern parts of the country will suffer from increased droughts and reduced rainfall when compared to other parts. In addition, severe weather conditions of frost during winter and early spring, in addition to severe dust storms will become more frequent in the southern parts of the country. (Details in Chapter I)

Assessment of Vulnerability and Adaptation in Different Sectors relevant to Nutrition and Food Security

Water Resources and Climate Change

Jordan suffers from a severe water scarcity problem. Jordan's Water Strategy (Water for Life) for the period of 2008-2022 states that Jordan is one of the four driest countries in the world. This strategy was updated in year 2010 and included strategic objectives to increase water use efficiency and reduce losses in different sectors. The issues of climate change were included as well as adaptation within the programs of this strategy. It identifies plans and actions that will be taken to ensure that water is available for people, business, and nature. The bold lines for future scenarios show that water

allocation for irrigation would be reduced significantly by 2022, as it was based on low prioritization of water for agriculture, which would aggravate the problem of food security in Jordan (FAO, 2011). The alternative sources to compensate for this shortage would be treated wastewater and desalinated water. The strategy clearly emphasizes that drought management and adaptation to climate change would be important future challenges that need to be addressed through proper policies and regulations.

Despite the Government efforts in managing the limited water resources and its relentless search for alternative supply, the available water resources per capita are falling as a result of population growth (MWI, 2009).

Water resources depend mainly on the limited precipitations within the country, where 90% of the country receive less than 150 mm annual rainfall. The current share of water is estimated at 146 m³ per capita per year. Because of scarcity, the demands and uses of water are far exceeding renewable supply. The deficit is made up by the unsustainable use of groundwater through overdraw of highland aquifers, resulting in lowered water table in many basins, and declining water quality in some. In addition to that, the deficit is overcome by supply rationing to the domestic and agricultural sectors.

Treated wastewater emanating from twenty-four existing wastewater treatment plants is an important component of Jordan's water resources. About 100 MCM per annum of treated wastewater is primarily used for irrigation, mostly in the Jordan Valley. Wastewater quantity is increasing with the increase in population, increasing water use and development of the sewerage systems. Thus, by the year 2022 about 220 MCM/year of wastewater is expected to be generated.

The effect of climate change on water resources is expected to be significant as a result of decrease in precipitation and projected changes in its spatial and temporal distribution (FAO, 2010a) (<http://faostat.fao.org/default.aspx>). Under climate change scenarios reported in Jordan's SNC (MoEnv, 2009), the change in precipitation and temperature will highly affect the amounts of monthly surface runoff for the main surface water basins in Jordan. Analysis of surface runoff for Zarqa basin under climate change scenarios from the CSIRO MK3 GCM showed that the amount would decrease for the rainy season of October - February. The highest decrease was expected to take place in January (about 25 percent) which was the rainiest month of the year. For Yarmouk basin, WEAP model showed that there would be a slight increase in the surface runoff amount during the rainy season. Incorporating the outputs from HADGEM1 GCM into WEAP showed a major increase in surface runoff values in Yarmouk basin during March, accompanied by a decrease in October and November. While for other months, no change in surface runoff values was observed. Incorporating the outputs from the three GCM models into WEAP showed slight or no change in surface runoff values for January, February, May and October. This could be attributed to the changes in rainy season, which tended to be shortened and concentrated during December-March.

The trends of water demand and supply were analyzed and showed that water share for irrigation would decrease in the future, as more water would be prioritized for the other sectors (FAO, 2011). Under normal trends (no climate change) water deficit would be 257 and 215 MCM in years 2020 and 2030, respectively. Due to climate change, surface water would decrease and water demand would increase. Without adaptation, the expected deficit under these conditions would be 374 MCM and 488 MCM in 2020 and 2030, respectively (FAO, 2011).

Climate Change and Agricultural Sector

Agricultural sector is highly important in providing food security and commodities even though its contribution to the GDP decreased from 30 % in 1954 to 3.9 % in 2009 (FAO, 2011). Linkages between agriculture and overall economy are still strong as the sector is the key stone in food security. Nowadays, more pressure is put on the sector as the prices of cereals, forage and feed resources are getting high. The sector is also important in its social dimension as it provides opportunities to settle people in sparsely populated areas (mainly arid) of the country and in providing socially accepted jobs for local communities.

The agricultural sector of plant production contributes to the production of cereal, fruits, and vegetables while the sector of animal production includes the production of red meat (mainly sheep and goats), milk (from cows, sheep and goats) and the white meat and eggs. Animal production sector depends on the imported forage, browsing of the crop residues of wheat and barley, and to a lesser degree on rangeland forage (15%) (MoEnv, 2009). In terms of vegetables and fruit trees, Jordan is self-sufficient and exports surplus yield. The total rainfed and irrigated areas in Jordan varies from year to year. The country's total yield in 2008 was 212 thousand tons of field crops, 349 thousand tons of fruits, and 1.4 million tons of vegetables.

Agriculture in developing countries is a vulnerable sector to climate change due to the weak financial and technical capacities of farmers to adapt at farm levels (FAO; 2008, 2010b). Agriculture in Jordan is one of the most vulnerable sectors to climate change because the available water and land resources are limited as most of the country's land is arid.

The impact of climate change on rainfed agriculture was investigated in Jordan's SNC (2009) using a Decision Support System for Agrotechnology Transfer (DSSAT) model on wheat and barley (Al-Bakri et al., 2011). For both crops, the reduction of rainfall by 10% to 20% and the increase of air temperature would have negative impacts on yields. The maximum predicted losses of yield were 423 Kg/ha and 523 Kg/ha for wheat and barley, respectively. The impacts of climate change were always adverse on barley, which has more acreage than wheat at the country's level.

Within its efforts to develop the different sectors, the national strategy for agricultural development (NSAD) for the decade 2000-2010 included the dimension of adaptation to climate change through proposed programs focusing on conservation of land, water, natural vegetation, and biodiversity. The NSAD called for improving livestock sector, protecting natural rangelands, organizing grazing and adopting proper land uses according to land capacity. Many of the programs were not achieved due to lack of financial resources and the limited technical capacities of the MOA.

Socio-economic Impacts of Climate Change

There are no published data on socio-economic factors affected by climate change at the country's level. The World Food Program (WFP) identified key risks to food security in Jordan (Hamdan and Karaki, 1998) as lack of job opportunities and low income, decline in economic indicators, agricultural land degradation, and self insufficiency in food products, especially cereals.

During 1988-1989, Jordan faced tightened economic conditions and implemented the "Economic Adjustment and Restructuring Programs (EARPs)." These programs required the privatization of economy, lifting subsidies for both consumers and producers, and elimination of food pricing systems. In 1998, a study conducted to evaluate the impact of the EARPs on food consumption patterns of the poor in Amman indicated that the quantity and structure of food demand of certain social groups, particularly the poor was affected, and resulted in different consumption patterns.

The study of socioeconomic dimension of climate change within the SNC (MoEnv, 2009) relied on the subjective analysis, in general, and on a short field survey of selected areas. The survey was conducted to understand the attitudes of respondents to climate change. The main effect of climate change factors on the respondents (according to their perspective) in the urban areas is shortage of water which affects the sanitary conditions in the households; leading to an increase in some kinds of diseases such as diarrhea and skin and eye diseases and the increase of cost of living. The farmers, mainly rainfed farmers, would be affected by the high temperature and low rain in their farming practices, leading to a decrease in their income (MoEnv, 2009).

Climate Change and Food Security

Food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2010b). Many literatures expected that shifts in farming systems and increased crop water requirements, in addition to the increased incidence of pest attacks would result in reducing crops yields, particularly in mid-latitudes. Its impacts will be short-term, resulting from more frequent and more intense extreme weather events, and long-term, caused by changing temperatures and precipitation patterns.

In terms of food availability, the main impacts of climate change are related to agricultural production, temporal effects on local markets, and the imbalance of food import/export. The expected increase in food prices and loss of farm income will limit food accessibility. The dietary patterns and challenges of food safety will affect food utilization patterns. The combination of the above factors will negatively impact access to food and will lead to greater instability of food supply (FAO, 2010b). This will have direct impacts on human health, livelihood assets, food production and distribution channels, as well as changing purchasing power and market flows.

Evidence for climate change effects on crop yields is strong. Crop models have been validated in 124 sites in 18 countries over a wide range of environments. Major uncertainties relate to the extent this relationship will be maintained over long-term climate change, and in particular, how the world food trade system will adapt to changes in production. The IPCC has concluded with “medium confidence” that climate change would increase the number of hungry and malnourished people in the twenty-first century by 80 to 90 million (McMichael et al., 2003).

Climate change may affect food availability through the broadly negative effects of changes in temperature and precipitation and broadly positive effects of higher CO₂ levels on yields of food crops. The food trade system may be able to absorb these effects at the global level. However, climate change can be expected to have significant effects on food poverty in conjunction with variation in population pressure and economic capacity to cope (McMichael et al., 2003).

Several recent UN agency and other reports concluded that even if practical steps are taken to try to mitigate the effects of climate change, the world would become increasingly food insecure over the next few decades. By year 2050, the number of people suffering from hunger is projected to increase by 10-20% and child malnutrition is anticipated to be 20% higher compared to a scenario of no climate change (IPCC, 2007).

In terms of food security, Jordan is self-sufficient in vegetables, fruit, and white meat. The Security Risk Index of 2011 (http://maplecroft.com/about/news/food_security.html), based on the key elements of food security identified by FAO, Jordan is classified as a medium risk country. In year 2011, an assessment for climate change impacts on food security was carried out through a study submitted to

FAO (FAO, 2011). Results showed that by year 2030, an increase of 1°C in air temperature and a 10% decrease in precipitation would result in yield reduction of 7% for wheat, 18% for barley, 5% for vegetables, apple, and olive. The 2°C increase in air temperature and 20% decrease in precipitation (year 2050) would decrease yield by 21% for wheat, 35% for barley, and 10% for, vegetables, apple, and olive. The average net irrigation requirements for the different crops would also increase by 6 and 12% in years 2030 and 2050, respectively.

Based on the projected water resources, expected reduction in crop yield under climate change, the trends of urbanization and land use change and the population growth, self-sufficiency degree (SSD) of food was assessed at the country's level. Results showed that SSD of many food items will decrease dramatically in the future and will depend on available imports of forage and important food items (FAO, 2011).

Production of field crops will decrease in light of the decline in agricultural resources of arable lands and irrigation water. It will not be possible to maintain the current production levels of these crops as long as the current policies concerning land use remain. Production of sheep and goat meat will decline due to the continued deterioration of the rangeland and the removal of feed subsidies. Local production of milk, poultry, and meat will face severe competition from imports, which will be increasing in quantity, due to trade liberalization. This development may not only affect local production but may lead to termination of some projects (MOH, 2010b).

A recent FAO study (2011) showed that Jordan would suffer from food insecurity under climate change scenarios in the region. With exception for vegetables and fruits, the country is self-insufficient, particularly in items of red meat, cereals, and legumes. With increased inflation and current rates of population growth, the problem of food security will worsen and will put more pressure on the government to improve nutritional status, particularly for the low-income families. The adaptation for climate change would be a challenge under the limited financial resources.

Climate Change and Nutrition Security

Climate change directly affects food and nutrition security of millions of people (FAO, 2008). According to the United Nations Standing Committee on Nutrition (UNSCN, 2010), climate change can affect food and nutrition security through reduction of income from animal production, reduction of yields of food and cash crops, lowered forest productivity, changes in aquatic populations, and increased incidence of infectious disease. Demand for biofuel may divert land away from food cropping and increase risk of harmful production practices and environmental degradation (UNSCN, 2010b).

Jordan has witnessed an increasing trend, in the last four decades, towards the average daily per capita energy and macronutrient supply. Food availability in Jordan has been characterized, over the last three decades, by a considerable increase in cereals (primarily wheat) through imports, and a relative increase in milk, eggs, meat products, sugars, and vegetable oils. Removal of food subsidies, implementation of price liberalization policies, and the economic and social changes may have affected food expenditure and the purchasing power of the lower social segment of the population (MOH, 2010b).

Nutrition security in Jordan is dependent on the domestic food demand of foreign food market supply for food items of strategic value, such as, wheat, sugar, and rice. Jordan exports fruit and vegetables and is self-sufficient in poultry and eggs, though most inputs of poultry industry are imported. Although improvement of this situation is not expected in the near future, it is possible to improve self-sufficiency of particular food items, such as, animal products, legumes, and cereals through rational use

of scarcely available agricultural resources, and implementation of a reasonable food and macro-economic policy. However, wheat production is not expected to improve the self-sufficiency of wheat because it is not competitive (MOH, 2010b). The increasing food demand is mainly seen as the result of a continuously growing population and the changing food consumption patterns of Jordanians. In addition, high-income elasticity of food demand, improved income levels of consumers, moderate food prices, and policies of food price control also contribute to increased food demand (MOH, 2010b).

At the household level, nutrition security is determined by income and food prices. Low-income households have greater food supply insecurity. The lower the income level of the household, the higher is the proportion of its total expenditure on food. In Jordan, households with an annual income below JD 1,200 pay larger share of their income per calorie when compared to households with an annual income of JD 6,000 or more. Furthermore, the poor households have lower quantity and quality of food, calorie, and nutrient intake. Cereals are the main and cheapest source of energy for households with an annual household income of less than JD 1,200 contributing to about 70% of total calorie intake (MOH, 2010b).

Based on the MOH study (MOH, 2010b) and the shared vision of FAO (2008) and the UNSCN, the following represents the major points of emphasis when assessing nutrition security under expected climate change in Jordan:

- Jordan has been classified as “a net food importing developing country” by the WTO Committee on Agriculture.
- Food shortages still occur. This is the result of the limited use of appropriate agricultural technology, over-dependence on rain-fed agriculture, lack of markets and market information, and inefficient marketing plan.
- Jordan exports fruit and vegetables and is self-sufficient in poultry and eggs.
- Marketing and post-harvest operations infrastructures suffer from clear weaknesses, especially in fruit and vegetable sectors. There are no wholesale markets for livestock with appropriate administrative and service structures, including the biggest and most important livestock market in Amman. As for slaughterhouses, there is a central slaughterhouse run by the Amman Municipality and several old slaughterhouses (with limited capacity and poor hygienic conditions) operating in various governorates and districts.
- There is wide marketing margins expressed by large differences between producer and consumer prices. Producer incomes have decreased and consumer prices have increased in favour of middlemen. The small size of the local food market is affected by marketing of regional produce. The local produce appears to have poor quality in terms of specifications, grading, and packaging.
- About twenty pockets are reported to be under the absolute poverty line according to a study funded by the World Bank and conducted by the Ministry of Planning (MoPIC) and the Ministry of Social Welfare (MoSW).
- Contributing factors to chronic under-nutrition and food insecurity include poverty, low productivity in agriculture, and high seasonal and year-to-year variability in food supplies due to unreliable rainfall, insufficient water for crop and livestock production, lack of off-farm employment opportunities, which contribute to low and uncertain incomes in urban and rural areas.

Although food security and nutrition are linked, simply ensuring access to an adequate quantity of food does not guarantee adequate nutrition, particularly adequate intake of essential micronutrients. In

terms of nutrition, this leads to a parallel depletion of micronutrients in the diet and then increased clinical signs of micronutrient deficiencies. Next, underweight in infants and young children increases and maternal undernutrition rates increase. These nutrition insults lead to a lowering of immunity and increased risk of infectious disease morbidity. Then wasting increases (stunting is not affected noticeably in acute shocks) and growth and development are delayed. All of these factors lead to increased early childhood mortality (Darnton and Cogill, 2010).

In countries with low diversity of agricultural crops and limited financial resources, malnutrition is expected to be the main problem resulting from climate change. Malnutrition is directly related to infection as it impairs barrier protection and immune functions (Rodríguez et al., 2011). Once infection occurs, decreased dietary intake and malabsorption will occur and will increase the problem of malnutrition. This cycle is seen as an important link between diseases infection and human nutrition (Brown, 2003).

In summary, under the combined pressure of macroeconomic, social and political factors, the food sector in Jordan moved from a food subsidy, price and import control policy during the 1970s and 1980s to a gradual but progressive liberalization and removal of food subsidy in the early 1990s. Despite some improvement in food production, food imports of essential food commodities such as cereals, animal foods and dairy products remain critical and affect the process of socioeconomic development. Therefore, a sustainable food security strategy is important to ensure adequate food of good quality while helping to stimulate rural economies and to promote the social and environmental aspects of sustainable agricultural development. As an indirect effect, low-income people everywhere will be at risk of food insecurity owing to loss of assets.

Health Sector

In Jordan, the overall susceptibility of population to environmental health concerns has dropped dramatically during the past few years with the improvements in health infrastructure. Referring to the likely changes of climate system, a series of impacts on public health are expected. Therefore, negative impacts of climate change are related to increased food prices, which will cause purchasing power falls and will endanger human health as affected people, especially the poor, are unable to cope.

The indirect impacts of climate change on human health are mainly reducing access to nutritious food, decline in dietary quality and eventually quantity, and increasing micronutrient malnutrition (or hidden hunger). These will lead to poorer health, lower incomes, and reduced physical and intellectual capabilities.

Malnutrition among infants and children

During the 1960s, severe protein energy malnutrition (PEM), whether presented as Kwashiorkor or Marasmus, was not an uncommon observation in pediatric wards of Jordan's government hospitals. Now the problem became much less significant. Until late 1980s, clinical manifestations of moderate to mild PEM were invisible although the problem continued to exist silently at the community level (MOH, 2010b).

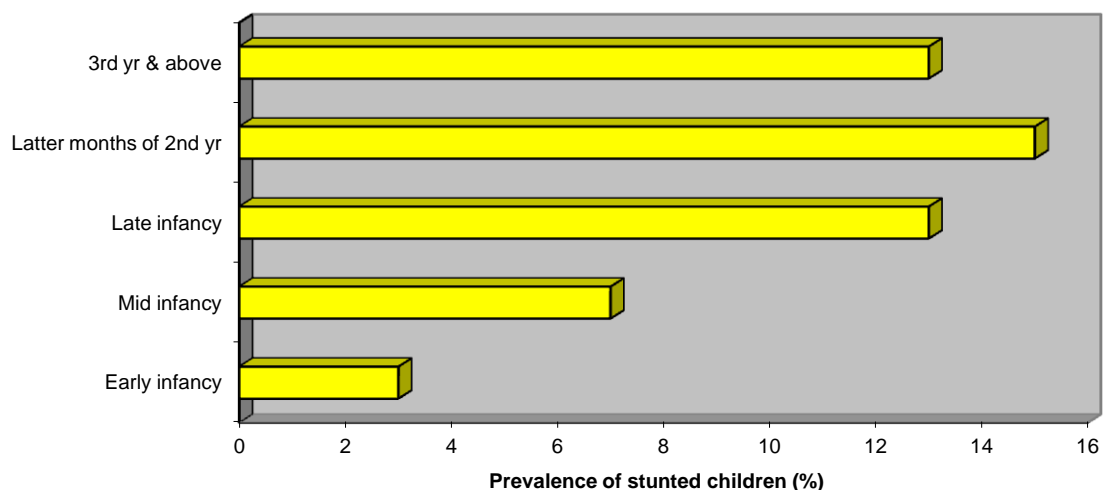
In 1990, the Jordan Population and Family Health Survey (JPFHS) included an assessment of the nutritional status for children under 6 years of age, to measure Weight-for-Height (wasting), which indicates acute nutritional problem, and Height-for-Age (stunting), which reflects chronic under-nutrition and short stature for age, and the Weight-for-Age (underweight), which is a composite of both long and short-term effects. A national representative sample of 6,100 children was measured and

assessed using National Centre for Health Statistics (NCHS) reference charts. Thorough analysis of the nutritional data confirmed a previously reported finding that nutrition-related growth of Jordanian children started to falter only during and after late infancy (MOH, 2010b).

Further data analysis showed that stunting, and not wasting, is the prevalent mode of malnutrition among preschool children. The prevalence of stunting was 16% in both sexes. Only 3.5% of males and about 2.5% of females were wasted. Prevalence of stunting was 25% - the highest - among toddlers 18-24 months with no reported sex related differences. When comparing governorates in the three main geographical regions in Jordan (middle, northern and southern regions), the study reported a stunting prevalence of 14%, 19% and 20% respectively indicating that children are doing better in middle region governorates. Receiving good quality health care during pregnancy and at delivery was found to be associated with future child's growth and nutritional status. Other contributing factors to a child's nutritional status were: birth weight, place of delivery, mother's education level and infant's age at introduction of solid foods and milk-formula-feeds. The areas shown to be most appropriate for effective intervention were: mother's education, and patterns of infant feeding (MoH,2010b).

In 1990, another cross-sectional survey on nutrition was conducted to assess the nutritional status during pre-pubertal life stage in north Jordan. The survey reported that the prevalence of stunting in north Jordan was 3% in early infancy, 7% in mid-infancy, 13% in late infancy, 15% in the latter months of the second year, and 13% during the third year of age and above (Figure 27). The reported prevalence of wasting was about 3% at early infancy, 5% at mid-infancy, and 14% during early months of second year. The prevalence gradually decreased with age until it disappeared around the age of school-entry (Khatib and Hijazi, 1993).

Figure 27 Prevalence (%) of Stunted Children in North Jordan (Source: Khatib and Hijazi, 1993)



The magnitude of stunting, underweight, and wasting was also investigated in a survey conducted by the MOH in 1991 on 8,113 children (0-59 months) in 8 governorates. The differences between governorates showed that nutritional status of children was worst in Mafraq governorate followed by Tafileh and Ma'an (stunting percentage in Mafraq was 33% for males and 24% for females) (MOH, 2010b).

The Jordan Population Family Health Survey (DHS 2002) revealed somewhat similar trends to the previous surveys, with slight improvements. Variations in wasting were seen more likely in the south.

Rural children were more likely to be wasted than urban ones. Higher levels of wasting were observed in children born to young mothers (15-19 years).

The improvements in nutritional status were likely to be associated with promotion of maternal and child health activities (the number of MCH centres increased by 214% from 1990 to 2000), increased vaccination coverage rates, and improvement in education, birth spacing and sanitation. These results showed a dramatic change in the patterns of exclusive breastfeeding. The rate of exclusive breastfeeding of infants 0 - <6 months changed from 11.9% in 1997 to 26.7% in 2002. This has contributed to the fall of infant and under 5 mortality rates in recent years to 22 deaths per 1,000 live births in 2002 (DoS, 2002a).

Data for the 2010 Micronutrient Surveys showed that the anthropometric measurements, taken for children 12 to 59 months revealed that 3.5% of children were wasted (weight-for-height Z-score < -2), 2.5% were underweight (weight-for-age Z-score < -2), and 10.8% were stunted (height-for-age Z-score < -2). Anthropometric measurements also showed that 8.8% of the children were at risk for overweight (BMI-for-age Z-score > 2) and 1.8% at risk for obesity (BMI-for-age Z-score >3). A statistically significant difference was seen across subgroups of underweight, where a higher percentage of children in the North and South were underweight compared to the Central region, and a higher percentage of males were underweight compared to females. No statistically significant differences were observed across subgroups (including sex, age, region, and residence) of wasting, stunting, overweight, or obesity (MOH, 2010a).

Micronutrient Deficiencies (MNDs)

In 1993, Jordan University for Science and Technology (JUST) conducted a survey to assess the nutritional status of children in the north of Jordan. It revealed a 40% prevalence of anaemia in children less than two years of age. Dietary assessment in this survey suggested inadequate zinc and iron intakes during late infancy. The complementary intervention study integrated in the survey confirmed these findings along with additional suggestions on the possibility of multiple deficiencies, including iodine deficiency disorder (IDD) and vitamin A deficiency (VAD). The conclusion led to mounting interest in studying micronutrients, particularly: vitamin A, iodine, and iron (Khatib and Hijazi, 2003).

1. Vitamin A Deficiency (VAD)

Improving vitamin A status of young children leads to significant reductions in mortality rates. VAD is linked to the nature of foods available and feeding practices, rather than to geochemical or other conditions affecting populations at different geographic areas.

The first attempt to prepare for conducting a national survey on vitamin A status took place in 1997 through a pilot project supported by WHO. The results indicated that the prevalence of stunting was 15%, number of subjects with sub-clinical VAD (SRC <200 µg/L) was 4%, whereas those at risk of VAD (SRC >200 but <300 µg/L) were 31% (Khatib and Hijazi, 2003).

The first response to the recommendations of the 1997 pilot survey came from the Ministry of Education (MOE). In 1999, an interventional study with dietary supplements was conducted. A total of 1,023 school children aged 5.5 to 9.9 years were randomly selected from seven semi-rural districts labelled by the government as disadvantaged areas. The study was conducted over a period of nine months. Subjects were provided with a daily mid-morning snack that consisted of iron fortified biscuits, fresh milk and a fruit. Only one 200,000 IU vitamin A capsule supplement was additionally given at the middle of the survey period. The study showed a baseline prevalence of 19.9% for stunting, 18.8% for

anaemia, and 21.8% for sub-clinical VAD. Mean and median serum retinol concentrations were 248 (SD±66) and 242 µg/L, respectively. Moreover, 60% of subjects had serum retinol in the range 200-300 µg/L. Supplementation had a significantly positive impact on serum retinol levels ($p<0.01$) and on anaemia ($p<0.05$) indicators. The study concluded that VAD among school children might be a common health problem, and projected that VAD could also be affecting preschool children as well (Khatib and Hijazi, 2003).

Before the end of year 2001, a new six month dual purpose intervention survey was launched in eight disadvantaged semi-rural districts. Results of the study in eight districts showed that baseline prevalence for stunting, anaemia and non-ocular VAD was 15%, 20% and 33%, respectively. The results of the control group demonstrated no statistically significant difference in serum retinol concentration (SRC) between the test group and the control group. However, when compared to the baseline, only vitamin A status of the test group showed improvement. The study showed that vitamin A supplementation could not alone boost up the SRC, but also fat and VA-rich foods from animal sources influenced mean values of SRC and STC ($p<0.05$) (Khatib and Hijazi, 2003).

Results of the 2002 dual study on poorer young schoolchildren in underprivileged areas supported the results of the previous survey. The findings on anaemia and vitamin A deficiency suggest that these conditions were significant public health problems among schoolchildren in poor areas. The positive impact of supplementation was found to be modulated by dietary fat levels and vitamin A supply from animal sources. Again, VA-rich foods of plant origin seemed to fail compensating the impact of animal-based foods as determinants of serum vitamin A levels. Therefore, it was hypothesized that the explanation may reside in the trace metal-dependant metabolic pathways of beta-carotene conversions.

The findings of surveys in poor areas were taken into consideration when the study of a national representative sample of Jordanian schoolchildren population was launched. This national survey came as a baseline, prior to the implementation of the Royal Philanthropic Gratuity of King Abdulla II, who called for a universal multivitamin/mineral tablet supplementation for all Jordanian schoolchildren in December 2002. Results indicated a prevalence rate of vitamin A deficiency of 47% in all governorates. Analysis by age groups showed that the prevalence of vitamin A deficiency was inversely related to age. Thus, the 10 year-age was identified as the age group at highest risk of vitamin A deficiency. In addition, within this cohort, no inter-sex differences were observed. The results were considered applicable to all students in their childhood years, irrespective of region or governorate (Kharabsheh et al., 2004).

In the year 2004 evaluation of the supplementation programme, results revealed that the students' compliance with the regular use of the multi-vitamin supplement was only 46% (Khatib, 2004).

In 2003, the first national baseline survey was conducted before launching the wheat flour fortification programme. The survey included women of childbearing age along with under-five year old children. The study reported VAD prevalence of 15% among pre-school children, which was linked to the nature of foods available and feeding practices, rather than to geochemical or other conditions affecting populations of geographic areas. Another study also reported that 38% of children consumed fruits and vegetables rich in vitamin A. Consumption of foods rich in vitamin A was increased with age. Children who were not breastfed consumed more foods rich in vitamin A than breastfed children did. Consumption was reported the highest in urban areas and in the central region of Jordan. Mother's education and mother's age were strongly associated with increased intake of foods rich in vitamin A among children (Kharabsheh et al., 2003). According to this survey, the VAD prevalence exceeded the cut-off point of 15% prevalence, which is a new limit proposed lately for assessing sub-clinical VAD in communities.

In summary, vitamin A deficiency constitute a public health problem according to the indicators from local studies. This, in turn, triggered MOH to issue recommendations to supplement children less than 1 year with vitamin A 100,000 IU tablet given to the child along with the measles vaccine.

2. Iodine Deficiency Disorders (IDD)

In 1993, the National Committee on Iodine Deficiency Disorders (NCIDD) was formed by the MOH. A national representative sample of 2,457 young children (cohort 8-10 years) was selected from all governorates. The study concluded that IDD was 37.7% for all grades as indicated by goitre palpation and urinary iodine excretion. Prevalence was highest in Tafileh (south) (76 %), the lowest prevalence was reported in Mafraq (north) (11%). Prevalence was higher among rural children than urban ones (45% vs. 34 %), and was slightly higher in females than in males (39% vs. 36%). The study provided clear evidence that moderate or lower degrees of IDD existed in Jordan. In 1995, a universal salt iodization program was established (MOH, 1993).

In year 2000, the NCIDD conducted another impact evaluation study on the salt iodization programme five years after its implementation. The results of this follow up study showed that there was an improvement in total goitre prevalence and an alleviation of severity of goitre. The number of households consuming iodized salt was 88%. Thus, and according to the differences in the median urinary iodine excretion, the national programme for iodine table salt supplementation (NPITS) proved to be effective (Saraira, 2000).

In 2000, survey results revealed a median value of 15.4µg/100ml for the urinary iodine excretion (MoH, 2000). The value has increased considerably when compared to 4 µg/100 ml in 1993, thereby indicating effective programme implementation (MOH, 2000). Another assessment study was also conducted in 2000 to monitor the progress of the iodization programme in Tafileh governorate, which had the highest goitre prevalence in 1993. The study revealed a reduction in the prevalence from 76.1% in 1993 to 42.5% in 2000 (MOH, 2002).

A national monitoring survey was conducted in October 2010 to assess the effects of iodization program on Jordanian population. The study was conducted on 4600 school children aged 8-10 years and randomly selected from the primary of public, private, and UNRWA school children in 3rd, 4th and 5th grades of 12 governorates. The indicator that was used for this study consists of measurement of the iodine concentration in urine, clinical examination for goiter and proportion of households consuming iodized Salt. The finding of the 12 governorates were pooled into three regions (middle, north, south) of the country for the sake of giving more validity for comparisons, for both clinical and biochemical indicators. There were significant improvements for all regions in the 2010 when compared with 2000 study for the prevalence of goiter. While there was a risk of iodine – induce hyperthyroidism, in the middle and north regions, an optimal intake of iodine in south region was observed (Barham and Masa'd, 2010).

3. Anaemia and Iron Deficiency Anaemia (IDA)

Anaemia in general, and iron deficiency anaemia (IDA) in specific, constitute a major problem worldwide. The most susceptible groups are preschool children, women of childbearing age, and adolescent girls. Anaemia in infants is associated with physical and intellectual growth retardation, and reduced immunity (Mahan and Escott-Stump, 2001). Paediatric and antenatal clinics tend to distribute iron and folic acid supplements to prevent anaemia and IDA.

A study on the incidence of iron deficiency anaemia in infants was conducted in 1999. The study examined the relationship between anaemia during pregnancy and iron deficiency in 232 infants. The iron status of infants born to 107 anaemic mothers and 125 non-anaemic mothers was reviewed at 3, 6, 9 and 12 months. Indicators to define iron deficiency were haemoglobin <11g/dl, and either plasma ferritin (<12 mg/dl), or zinc protoporphyrin (ZPP) (>35mg/dl) of whole blood. The results indicated that anaemia was significantly higher in infants born to anaemic mothers (81%) compared with controls (65%). At 12 months of age, 72% were anaemic, while 57% were identified as iron deficient (Kilbride et al., 1999).

The Jordan National Survey on IDA conducted in 2002 by MOH, WHO, UNICEF and CDC used the WHO standards. The sample included 1,411 females aged 15-49 years, and 1,253 children aged 12-59 months in all governorates. The survey showed that anaemia affected 32% of Jordanian woman in reproductive age, with a prevalence of iron deficiency of 41% and that of iron deficiency anaemia of 22%. The highest prevalence of anaemia was in Aqaba with 58.4% followed by Irbid with 44.7%. the respective prevalence rates for children under five years were 20% for anaemia, 26% for iron deficiency, 10% for iron deficiency anaemia and 15% for vitamin A deficiency (MOH, 2002).

Results from the 2003 national survey on schoolchildren were different for the different age groups studied (10, 13 and 17 year-age group). The statuses of vitamin A and anaemia have been found to be significantly correlated in all categories. Anaemia was found to be at an acceptable level when compared to the reported results by any of the previous surveys. According to this national study, prevalence rates of anaemia in the south, north, and middle regions of Jordan were 13%, 12%, and 5%, respectively. Anaemia prevalence rates in the surveyed three age cohorts (10, 13, and 17 year-age groups) of students were 12%, 8%, and 8%, respectively, indicating that anaemia victimized children (less than 10 year-age group) more than adolescents (13 to 17 years). The prevalence of anaemia in students was 9% in the national sample, which showed that anaemia, in the Jordanian preparatory and secondary schools, was a mild problem (MOH, 2010a).

Many social factors may have contributed to the apparent declination of anaemia prevalence in Jordan, especially following the implementation of the MOH-enforced iron fortification of wheat flour that has been going on since May 2002.

Prevalence of anaemia, iron deficiency, and iron deficiency anaemia for non-pregnant women was 30.6%, 35.1%, and 19.8%, respectively. Older women and married women were more likely than younger unmarried women to have anaemia and iron deficiency anaemia. Women living in south of Jordan were more likely to suffer iron deficiency anaemia than women in north and central Jordan. Prevalence of anaemia, iron deficiency, and iron deficiency anaemia for children were 17.0%, 13.7%, and 4.8%, respectively. Younger children were more likely than older children to have anaemia, iron deficiency, and iron deficiency anaemia. Children living in rural areas were more likely than children in urban areas to have anaemia. Based on the WHO thresholds for defining the severity of anaemia as a problem of public health importance, anaemia is a public health problem of moderate severity in women and a public health problem of mild severity in children (MOH, 2010a).

4. Vitamin D Deficiency

Vitamin D is predominantly derived from exposure of skin to solar ultraviolet radiation. Natural dietary sources of vitamin D are limited, unless fortification or supplementation practices are adopted (Mahan and Escott-Stump, 2001). Jordan is a sunny Middle Eastern country where no vitamin D fortification of milk is undertaken.

Studies on vitamin D deficiency in Jordan are scarce. A small study was conducted to evaluate vitamin D and parathyroid hormone levels among healthy young Jordanian women of childbearing age. Results suggested a prevalence of hypo-vitaminosis D of 62%. Studies to verify these findings are not available (MOH, 2010b).

In 2000, another study was conducted to investigate the prevalence of vitamin D deficiency in 38 children aged 3 to 24 months who were at high risk of developing nutritional rickets. Out of the 38 children selected, 26% were premature babies, 65% were found to have other nutritional problems (such as anaemia), and 71% were breastfed until the age of one year without any reported intake of dietary supplements. Clinical manifestations included bowing of the legs, wide anterior fontanel, developmental delay and convulsions. Children at high risk of developing nutritional rickets were premature babies, babies with prolonged breastfeeding without any dietary supplements, and children with nutritional problems such as anaemia (Al Qaq, 2000).

Additionally, Masri et al. (2005) reported, in a study on osteoporosis, that 87% of the study subjects (821 women aged 15-89) had a low level of serum 25-hydroxy vitamin D.

Vitamin D deficiency was prevalent in 60.3% of non-pregnant women. Deficiency was higher among urban women compared to rural women and higher among women living in Central Jordan compared to North and South Jordan. Deficiency was also higher among unmarried women compared to married women, as well as among women who reported covering their head and their hands when they leave the house or go outside compared to women who reported not covering. Prevalence of vitamin D deficiency among children was 19.8%. Deficiency was higher among females compared to males, among children living in urban areas compared to rural areas, and among children living in the Central and South regions compared to children living in the North region (MOH, 2010a).

In conclusion, data available on vitamin D are scarce and are based on small samples that are not representative of the Jordanian population. Hence, it is difficult to draw firm conclusions on the status of vitamin D deficiency.

5. Vitamin B12 Deficiency

Vitamin B₁₂ deficiency was prevalent in 11.1% of non-pregnant women, and was higher among urban women compared to rural women and among women living in Central and South Jordan compared to women in North Jordan. Red blood cell folate deficiency was prevalent among 13.6% of non-pregnant women. No statistically significant differences in folate deficiency were detected among observed subgroups of age, region, residence, marital status, and education level (MOH, 2010a).

Current Programs and Activities of MOH to Manage Nutrition-related Health Issues

Breast Feeding and Complementary Feeding Practices

In 1997, a national strategy on breastfeeding was included in the MOH National Plan for Nutrition. The MOH recommended that infants should only receive breast milk until the age of six months, and should continue breastfeeding with complementary food until they reach two years of age and beyond. This contributes to optimal physical growth and mental development.

National policies were developed to ban all forms of marketing of breast milk substitutes, especially in the public sector. In 2001, MOH proposed a draft regulation on marketing of breast milk substitutes

and submitted it to the legislative bureau for approval. In 2008, a committee wrote the Jordanian code for promotion and protection of BF, which was signed by the Minister of Health.

The 1997, JPFHS data showed that only about one-third of children in Jordan were breastfed within an hour of birth, and 75% were breastfed in the first 24 hours after delivery. This has improved in recent years as documented by the DHS 2002 study, in which 40% of children were breastfed within the first hour of birth, and 80% were breastfed during the first 24 hours of delivery. The introduction of supplementary foods began early in Jordan, 12.4% of children two to three months of age were given complementary food, and 69.5% of children six to seven months of age were fed solid or mushy food (DoS, 2002).

The baby friendly hospital initiative (BFHI) slowly gained momentum in Jordan. Seven hospitals are currently certified as baby friendly hospitals. . The Mother and Child Health Directorate of MOH launched both initiatives of the “Baby Friendly Mother and Child Centre” and the “Mother to Mother Support Group”. The centres require further assessment. In 2004, MOH established a breastfeeding unit in the Mother and Child Health Directorate to promote breastfeeding.

The government passed a law in 1995 to extend maternity leave from 8 to 12 weeks. In the International Labour Organization (ILO) meeting held in Geneva in June 2000, Jordan endorsed the convention on maternity protection to give mothers the right to have a maternity leave for not less than fourteen weeks, and to have nursing breaks when returning to work. However, this endorsement was not translated into action yet.

Micronutrient Intervention Program

The National Nutrition Taskforce was formed in 2002 to develop a programme for flour fortification in collaboration with WHO and UNICEF. The Cabinet subsequently approved the programme. WHO and UNICEF funded the purchase of premix and ten feeders. The project was launched at the national level in April 2002. The MOH provided seed money to purchase the premix for the second year of the project from the government’s annual budget. Orientation meetings were conducted to millers about IDA. In 2002, a monitoring and evaluation system was established to control the process of iron flour fortification.

In 2006, the National Nutrition Taskforce adopted the initiative to add vitamins A, B1, B2, B3, B6, B12 and zinc to flour in addition to the already added iron and folic acid. The vitamins were also added to biscuits provided in the school lunch meals and served to all students in kindergarten to grade six. The initiative will cover 550,000 schoolchildren.

Salt Iodization Program

In 1993, the National Committee on Iodine Deficiency Disorders (NCIDD) was formed, and in 1995, a universal salt iodization program was established by MOH.

Adaptation Measures to Reduce Vulnerability of Nutrition to Climate Change

Nutrition and food security need to be integrated in the enhanced action on adaptation. This can be achieved through the up-scaling of nutrition-specific interventions and safety nets and the multi-sectoral nutrition-sensitive approach to sustainable and climate-resilient agriculture, health and social protection schemes, risk reduction and risk management plans and climate resilient community-based development (UNSCN, 2010).

The MOH current nutrition-related programs can be upgraded and supported to include the following adaptation measures to reduce vulnerability to climate change:

Reducing the prevalence of VAD among children

- Diversification of dietary consumption of vitamin A rich foods.
- Disseminating vitamin A supplementation programs to target groups through distribution of vitamin A supplementation to infants at the time of measles and MMR vaccination, giving one shot of vitamin A to every case of measles, and mass campaign to cover primary school children in under-privileged areas with two doses of vitamin A.
- Giving postpartum women one dose of vitamin A within six weeks after delivery.
- Developing communication strategy for behaviour change through face-to-face communication, developing IEC materials and mass media programs.
- Eliminating measles to include sustaining very high coverage of measles vaccine, strengthening measles surveillance, and conducting supplementary immunization activities.
- Conducting continuous monitoring and evaluation.

Reducing the prevalence of anaemia among the population

- Diversification consumption of iron rich foods.
- Establishing supplementation programs to high-risk groups e.g. supplements of iron, folic acid and B12 to pregnant women attending health facilities; regular supplements of iron to all less than five years of age, especially for those under two years of age.
- Strengthening surveillance and control programs for diseases like schistosomiasis, malaria, and parasitic infestations.
- Establishing a communication and mass media strategy for behaviour change.
- Expanding the current flour fortification programs to include all flours, and conduct further studies on the causes of nutritional anaemia.
- Strengthening Monitoring and Evaluation (M&E) through capacity building and research.

Eliminating IDD

- Achieve universal salt iodization and strengthen monitoring programmes.
- Establish a communication and mass media strategy for behaviour change.

Reducing chronic malnutrition among the under-five years and young school children in rural and under-privileged areas

- Sustained promotion of exclusive breast feeding and complementary feeding practices.
- Strengthen the assessment of growth and development programs for under 5 years and young school children.
- Strengthen MCH services and promote the implementation of the IMCI programme.

Adaptation Measures

The overall purpose of adaptation is improving the nutritional and health status of the disadvantaged, socio-economically deprived and nutritionally vulnerable groups. Interventions will include poverty alleviation, awareness and education, reviewing and updating relevant laws and legislation, capacity building and monitoring and evaluation. The recommended adaptation measures are shown in Table 2.

Adaptation Measures	Avoidable Health Impact	Steps Needed	Amount of work needed	Total cost
Strengthening surveillance and establishment of highly sensitive alert system by developing health forecast system for acute malnutrition and any climate sensitive disease	<ol style="list-style-type: none"> 1. To characterize the nutritional status of the population for early identification of nutrition health problems and increase the recovery rate 2. To identify and target potentially at risk groups/ areas for appropriate care 3. To monitor trends over time 4. To evaluate interventions to decrease the disease burden cost 5. To build national capacity for monitoring of nutritional status 6. To facilitate information sharing 7. To serve as advocacy tool that aims at raising awareness, gaining commitment, and formulating policy. 	<ol style="list-style-type: none"> 1. Conduct an inventory on the available and needed material resources (measuring equipments, and other needed materials) 2. Decide on the staff teams to be assigned for the surveillance system (their numbers, areas of work, their regional supervisors) 3. Provide the included health centers and staff with all needed equipments and supplements to carry out the required measurements and blood tests at the centers 4. Conduct training courses for staff 	<ol style="list-style-type: none"> 1. Provide 50 MCH centers with accurate (calibrated) weight and height scales (25.000\$) 2. Provide the health centers with all needs for blood test for 3.000 samples (16.000\$) 3. Conduct 6 training workshops (30.000\$) 4. Conduct pilot study (6,000\$) 5. Staff payment (200,000\$) 	277,000\$
Prevention and control of emerging and re-emerging food insecurity and acute malnutrition (hidden hunger)	<ol style="list-style-type: none"> 1. Maximum coverage and access (reaching as many vulnerable people with acute malnutrition as possible) increase the recovery rate 2. Timeliness (early identification and referral before medical complications develop) decrease the mortality rate 3. Appropriate care (outpatient care for vulnerable group with severe acute malnutrition (SAM) without medical complications as long as needed and inpatient care only for those with SAM) decrease the disease burden cost 	<ol style="list-style-type: none"> 1. Demonstrate the community-based approach works which should be integrated into existing health facilities and run as a component of primary health care (PHC) where possible. Linkages can be made to other mother and child health services (e.g., integrated management of childhood illness [IMCI], services, and prevention services). 2. Education and sensitization of the community so that they know how and where to bring their malnourished patients for screening and treatment 3. Conduct training courses 	<ol style="list-style-type: none"> 1. Establish the community based approach works and building capacity in risk group and areas (20 campaigns 400.000\$) 2. Training workshops for TOT (8 workshops 8.000) 3. Printing educational material (20.000) 	428,000\$
Strengthening the existing emergency preparedness and disaster management by implementing recognized surveillance monitoring system	<ol style="list-style-type: none"> 1. Understand local barriers to access and service uptake 2. Explain acute malnutrition and the objectives of the services in readily understandable local terms 3. Community assessment and mobilization 4. Active case-finding to ensure early detection, early presentation and referral 5. Case follow-up 	<ol style="list-style-type: none"> 1. Engage a broad array of local institutions and community outreach systems and initiatives 	<ol style="list-style-type: none"> 1. Assign focal points for nutrition surveillance monitoring system (3) 2. Training courses for data entry and data analysis (6) (10,000\$) 	10,000\$

Supporting and strengthening preventative health nutrition programs (fortification and supplementation) and projects within public health divisions, with emphasis on community involvement projects	<ol style="list-style-type: none"> 1. Easy access promotes high coverage of target population and areas 2. Treat moderate acute malnutrition (MAM) in children 6-59 months and other vulnerable groups, such as malnourished pregnant and women at child bearing age with children under five years and risk groups/areas 3. Decrease the diseases burden cost 	<ol style="list-style-type: none"> 1. Training of trainers (TOT) to increase the health staff for monitoring of the program 	<ol style="list-style-type: none"> 1. Conduct 3 training workshops for focal points (TOT) per year over 5 years (15.000\$) 2. Conduct 3 training workshops for 24 health inspectors per year over 5 years (30.000\$) 3. Purchase the supplementations for 5 years (7.500.000\$) 	7,545,000\$
Capacity building and increasing awareness of the population through regular training workshops on health and nutrition education	<ol style="list-style-type: none"> 1. Improve the nutritional status for population at risk groups/areas 2. Decrease the economic burden of disease 	<ol style="list-style-type: none"> 1. Training courses for skilled health care provider's staff. 2. Training courses for volunteers for substantial efforts to encourage community understanding, mobilization and participation 	<ol style="list-style-type: none"> 1. Conduct 3 training workshops for focal points (TOT) per year over 5 years (15.000\$) 2. Conduct 15 training workshops per 5 years (15.000\$) 	30,000\$
Undertaking research on population and on individual level to provide a solid basis for formulation of adaptation strategies	<ol style="list-style-type: none"> 1. To facilitate information sharing 2. To serve as advocacy tool, that aims at gaining commitment, and formulating policy. 3. To evaluate interventions and formulating the adaptation strategies 	<ol style="list-style-type: none"> 1. Building capacity 2. Training courses 3. Preparedness' for the research(equipment, questioners....etc) 	<ol style="list-style-type: none"> 1. Conduct a 6 training courses for health care providers (12.000\$) 2. Conduct 3 courses for TOT (6.000\$) 3. Purchase all the research needs(150.000\$) 	168,000\$
Improving monitoring systems such as continuous monitoring of drinking water quality, water supply and	<ol style="list-style-type: none"> 1. Adequate access to clean drinking water and safe food, 2. Decrease the incidence infectious disease, which interacts with Under nutrition 3. Decrease the socioeconomic cost 	<ol style="list-style-type: none"> 1. Reviewing and updating relevant laws and legislation 2. Capacity building for monitoring and evaluation quality control lab 	<ol style="list-style-type: none"> 1. Establish a steering committee (meetings training)(4meeting per years over 5 years)15.000\$) 2. Training workshops 15 training 3per year over 5 	90,000 \$

sewerage systems

years) 15.000\$
3. Quality control payments for
water lab testing
(60.000\$)

Table 2 Recommended climate change adaptation measures to lessen food security and nutrition-related health risks

See Chapter 8 for detailed Climate Change Adaptation Strategy and Action Plans to Protect Health.

Early Warning System to Monitor and Assess the Impacts of Climate Change on Nutrition

Climate change can affect food security because of the dependence of food systems on the mean and variability of weather. Understanding the potential implications of climate change for food systems requires evaluation of a complex set of climate, environmental, and socioeconomic factors. The interaction of these factors determines the degree to which families, communities, and nations are food secure (UN SCN News).

Although the links between climate change and undernutrition have been increasingly examined recently, most analysts consider isolated pathways such as those of food insecurity, health, or water. Undernutrition is poorly considered in the Fourth Assessment Reports (AR4) of the IPCC (UNSCN News). As a conclusion, Food Insecurity is likely to increase under climate change, unless early warning systems and development programs are used more effectively (UNSCN News).

Objectives of the EWS

The objective of an Early Warning System is to alert the relevant authorities and a specific population in advance about developing meteorological conditions and related food security issues, and consequently, implement effective measures to reduce adverse outcomes on nutrition and health during and after the event.

Structure of EWS for Nutrition and Food Security

A basic requirement for an early warning system is that the community or region has an adequate public health and social infrastructure, including the political will, to undertake the design and implementation such a system.

The principal components of the EWS include 1- identification and forecasting of the event 2- prediction of the possible health outcomes 3- an effective and timely response plan and 4- an ongoing evaluation of the system and its components.

EWS is based on the assessment of risk and vulnerability. Moreover, early warning should be communicated appropriately and ensure response capability. The system will be developed in collaboration with all relevant stakeholders to ensure that the issues of greatest concern are identified and addressed, thus increasing the likelihood of success. The addition of EWS to surveillance mechanisms, together with effective response capabilities, can reduce current vulnerability and increase resilience to future events.

A committee affiliated to the Nutrition Department at the MOH will be established consisting of relevant stakeholders. This committee will develop the existing surveillance system in order to collect and gather the information needed (quantified indicators) to take actions before and after the events affecting health. There is a lot of scattered information on food security among the various bodies; the system will collect this information and deliver to MOH.

Data on under nutrition indicators (anthropometric measurements) will be collected yearly for the most vulnerable group(s) (children under five years old); blood samples will be collected yearly from women at the national level and tested for iron deficiency.

The EWS indicators

The EWS indicators will be applied to the four areas of food security (availability, stability, access, biological utilization), giving decision-makers enough time to react to the warning with a high degree of reliability.

➤ *Availability of staple foods*

The foods that should be monitored are the staple foods required by the poorest populations (cereals, wheat).

➤ *Stability of supplies*

Forecasts in this area are usually based on the analysis of market trends, taking into account the socio-economic and political situation (price trends as well as changes in quantities available in markets, stocks, inter-regional transfers, etc.). In the commercial area, forecasting is often very difficult and can be unreliable.

➤ *Access to supplies*

Access is linked to the constraints of relative poverty (financial means/price of staple foods) and to physical access to these products. Monitoring indicators of poverty and retail prices are useful for medium- to long-term trend analyses forecasts of the evolution of poverty and physical access to food.

➤ *Biological utilization of foods*

Health or anthropometric indicators are status indicators; they do not indicate changes in the nutritional status of populations and, most importantly, the most vulnerable groups. They provide information on the past nutritional levels of a population, sometimes, current nutritional levels, but never future ones. Therefore, indirect socio-economic indicators (or sets of indicators) are generally used to measure individuals' own perceptions of future nutritional problems. The analysis of coping strategies used by vulnerable individuals or groups in food crises generally gives good indirect indicators for forecasting nutritional problems.

Vulnerable populations

The most vulnerable populations expected to be exposed to malnutrition in Jordan, especially in remote areas, are women of childbearing age and children under five years old.

The involved stakeholders include:

MOIT, MOA, DOS, MD, Jordanian universities (Faculties of Agriculture), mass media, NGOs and International Organizations (e.g. WHO, UNICEF, WFP, UNDP).

Gaps and challenges with respect to response capability

There are many gaps; the most important is the lack of time series data, which will hinder time series forecasting to predict future outcomes. Thus, the following tasks will be adopted as immediate priorities:

- Conduct a detailed survey of gaps and needs with respect to food insecurity and under nutrition and associated vulnerabilities and warning capabilities, particularly in risk areas.
- Develop plans for the systematic strengthening of early warning capabilities.
- Implement monitoring, forecasting, and early warning systems for the most affected areas and vulnerable populations.
- Implement a pilot project on undernutrition monitoring and early warning in every risk area that has suffered significant loss of health from malnutrition in the last 10 years.

Indicators for Early Detection of Nutrition-related Health Risks Posed by Climate Change in Jordan

The indicators to detect the health risks posed by climate change are based on figures and data of numerous surveys and studies conducted by DOS, MOH, DHS, etc., which will illustrate the time

series of the correlation between climate change and food insecurity and malnutrition. The time-series key graphs are:

- Prevalence of stunting, underweight, and wasting among children < 5 years at the national level, and middle, northern and southern regions
- Prevalence of iron deficiency (ID) among women at childbearing age at the national level, and middle, northern and southern regions
- Prevalence of vitamin A deficiency among children under five years old at national level, and middle, northern and southern regions
- Annual wheat production (MT) at the national level
- Wheat self-sufficiency degree (SSD) (%) at the national level
- Self- sufficiency degree (SSD) for the main food items (cereals, wheat, and pulses) at the national level
- Annual consumer food price indices at the national level
- Household Expenditure on food at national level, and middle, northern and southern regions
- Poverty Index at the national level, and middle, northern and southern regions
- Per Capita Energy Utilization (Cal)/ day at the national level
- Per Capita Protein Utilization (gram)/day at the national level
- Per Capita Fat Utilization (gram)/day at the national level
- Annual precipitation
- Annual temperature

Prediction of possible health outcomes

Using the previous forecasting information (indicators), an EWS model for Jordan using weather conditions and its effects on nutritional status and food security can be built. Considering water scarcity in Jordan, which is induced by climate change, there is a decreasing trend in local food production, which leads to a decrease in self-sufficiency degree from local food. In addition, there is a decrease in calories utilization from nutritious food (higher in protein and lower in fat) and a decrease in household expenditure on food and an increase in food crops prices. This trend can be seen obviously in the last years, and it is predicted to continue in the future especially among the most vulnerable groups (children below 5 years old and women of childbearing age) and in the northern and southern regions of Jordan, in particular, in poverty pockets.

The indirect impacts of climate change on nutrition status are mainly:

- Reducing access to nutritious food
- Decline in dietary quality and eventually quantity
- Increasing micronutrient malnutrition (or hidden hunger)

The vulnerability assessment's findings indicate that micronutrient malnutrition is a public health problem in Jordan, particularly with respect to vitamin A and iron deficiencies.

Response Plan

The design and implementation of response activities will be carried out in a transparent manner that includes all stakeholders in the process and reflect the cultural, social, economic, and political context and constraints of the targeted region. The appropriateness of the components, including thresholds of action and the interventions, will be evaluated and modified to maximize response effectiveness for the relevant community or region.

The MOH and the stakeholders will agree on the geographic boundaries of the response plan. The intervention will focus on the risk area, where there is an increasing trend of the identified health

problem. This will include the Northern region represented by Mafraq and the Southern region represented by Ma'an.

The threshold of interventions will be set according to data that will be made available in 2013 from the proposed nutrition survey project.

Decision-makers need accessible and robust information, tools, and guides. It is necessary to make existing knowledge widely available and fill the gaps. Understanding the potential climate change impacts on nutrition and food security is important in directing interventions and implementing the necessary nutrition-related programs. Table 3 shows the Response and Communication Plan, which builds on initial action by the MOH.

Partnerships will be maintained and enhanced with MOH to share information and explore adaptation strategies of mutual benefit. Close coordination and cooperation between all the involved stakeholders should be maintained.

Monitoring and Evaluation Plan

Monitoring and evaluation of the effectiveness of the EWS and specific interventions will be incorporated into the system design so that appropriate corrections can be made to maximize the benefits of the system while minimizing its costs.

There must be an ongoing evaluation of every item of the four components of the early warning system. MOH will establish a special unit for evaluation and monitoring of every step in the system, in order to decide if the collected information is accurate, the indicators forecasted are sufficient and accurate, and the health outcomes prediction is in the right direction.

The evaluation of the components must be done every year by conducting a survey that measures the prevalence rate of the indicators (especially anthropometric measurements, vitamin A deficiency, and iron deficiency among children under five years old and iron deficiency among women of childbearing age) during the five years.

Table 3 Response and Communication Plan

Response and Communication Plan		
Response Action	Activity	Communication Plan
I. Intensifying the Supplementation program of vitamin A	<ul style="list-style-type: none"> - One dose of vitamin A capsule (100,000 IU) that should be routinely given for children attending public and private clinics for measles immunization (at about 10 months of age) and 200,000 IU dose of vitamin A should be given with MMR. - Strengthening monitoring and evaluation (M&E) of vitamin A distribution and provision procedure. - Establishing mobilization units to ensure maximum coverage and access (reaching as many vulnerable people as possible) to increase the recovery rate. - Demonstrate the community-based approach works, which should be integrated into existing health facilities and run as a component of primary health care (PHC). - Education and sensitization of the community (public health education for diversification consumption of vitamin A rich foods during nutrition week or mass campaigns). - Capacity building and development to improve and Scale-up the quality of service(training of the health care providers on the adopted supplementation programs; create community volunteers training, supervision, facilitation, mentoring, on-the job training, etc). 	<ul style="list-style-type: none"> - UNICEF (financial support for purchasing vitamin A) - Nutrition department, MCH directorate for monitoring the provision and distribution - Private health services and local authorities - MOH - MOH - Private sector hospitals - NGOs - MOH - NGOs(UNICEF ,WHO financial and technical support) - Private health services - Mass media - MOH (supervision ,facilitation, monitoring) - NGOs (training) - Private health services - Local authorities community volunteer

<p>2. Develop and maintain operative national Iron supplementation programs for all women at reproductive age</p>	<p>Routine screening for anaemia to be introduced among women at reproductive age who attend public clinics with no cost as a quality indicator for health center performance, and supplements to be given for those screened since iron supplements are offered at no cost (whether or not they are medically insured).</p>	<ul style="list-style-type: none"> - MOH (includes PHC and MCH for routine screening and iron supplement) - UNICEF (financial support allocated fund for purchasing Iron supplement) - Private health services (coordinate and collaborate with MOH for Iron supplement)
<p>3. Strengthening monitoring and evaluation system for the flour fortification program</p>	<ul style="list-style-type: none"> - Capacity building for the health inspectors - Capacity building for the workers inside the mills - Capacity building for laboratory technicians on approved methods of testing wheat flour samples 	<ul style="list-style-type: none"> - MOH (training the focal point for the program from the health inspectors) - Mills (develop the skills of the workers regarding mixing the premix) - MOIT (legislation and regulation and facilitation) - JFDA (legislation and regulation)

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CHAPTER 6 CLIMATE CHANGE AND HEAT WAVES

Introduction

Heat waves, defined by the Jordan Meteorological Department as “prolonged periods of excessive hot air in which the temperature rises 5 degrees or more above the average, and continue for a period of time not less than three successive days”, are projected to increase in number, intensity and duration over most land areas in the 21st century (IPCC, 2007). During such periods of hot weather, not only do daytime temperatures reach high values, but nighttime temperatures and humidity levels may also rise well beyond their long-term mean.

This trend will increase the risk of heat-related mortality and morbidity, especially for the elderly, chronically ill, and very young and socially isolated individuals. More people will be admitted to hospitals and die from heat stress and its complications. Children, the elderly, and those with cardiac and respiratory diseases are most at risk. Those living in urban areas will be particularly affected by heat waves, because of higher levels of air pollution as well as the “heat island effect.” The weather conditions that could result in health risks depend on the sensitivity, acclimatization, and adaptability of the population to extreme heat.

In recent decades, several devastating heat waves have caused large health consequences across the globe. For example, the 1987 heat wave in Athens caused around 2000 deaths¹, the 1995 heat wave in Chicago caused around 700 deaths², and the 2003 heat wave in Europe is estimated to have caused 70,000 deaths³.

Heat waves are relative to the climate of the geographical area. Thus, the same meteorological conditions can constitute a heat wave in one place but not in another. Similarly, at the level of the individual, the health effects of heat are relative due to a range of risk factors.

The direct effects of heat waves are heat stroke, heat cramps, heat exhaustion, dehydration, as well as respiratory illnesses. Higher temperatures and levels of ultraviolet radiation will favor the formation of ground level ozone, increasing sensitivity to allergens. Heat waves have indirect effects as it may potentially alter the geographical and/or seasonal pattern of infectious diseases transmitted through vectors (e.g. mosquitoes, etc.). Droughts and destruction of water infrastructure could increase the reliance on unsafe sources of water, especially among the poor, increasing chances for the spread of water-related diseases, such as typhoid, cholera, salmonellosis, and other infections. Dysenteries that are important causes of mortality in the developing world are expected to increase.

The public health sector’s interventions are fundamental in minimizing the impacts of heat waves induced by climate change on health. They aim to reduce the impact of heat waves by modifying the behavior of individuals or by modifying the environment in which they live. The main categories of interventions are those that provide information about protective behaviors, facilitate access to cooler environments and drinking water, facilitate contact with vulnerable groups, and facilitate timely treatment for those with heat-associated illnesses.

Heat Waves and Climate Change

The fourth report from the Intergovernmental Panel on Climate Change (IPCC), a body recognized as the international authority on climate change, has concluded that there is no doubt global warming is

occurring, and that this is very likely due to increases in atmospheric greenhouse gases concentration caused by human activities.

Over the past 100 years, average global surface temperatures have increased by about 0.74°C, with most of this increase having occurred in the past 50 years. It is considered very likely that this global warming has been responsible for an increased frequency of hot days and nights and of heat waves observed over the past 50 years¹⁹. The IPCC has predicted that hot extremes and heat waves will become more frequent in the future, with average temperatures predicted to rise relative to 1990 by about 1.0°C by 2030, and by up to 3.4°C by 2070.¹⁹ Furthermore, climate models for areas of Europe and North America predict that heat waves will become more intense and longer lasting.¹⁸

Figure 1 shows the causality analysis diagram for the impacts of climate change and heat waves on health.

Health Burden of Extreme Hot Weather

Health burden includes two types of health issues: Morbidity and Mortality.

Heat-related illnesses (Morbidity)

This term refers to a spectrum of disorders caused by exposure to excessive environmental heat including sunburn and fatigue, heat rash, heat cramps, heat syncope, heat exhaustion, and heat stroke. The most serious of these are heat exhaustion and heat stroke, which can lead to death. In addition, exposure to hot weather may exacerbate existing chronic conditions. For instance, it is suggested that the requirements for an increased cardiac output to support increased cutaneous blood flow during thermoregulation may worsen cardiac failure and heat-induced alterations in blood composition may promote thromboses in already narrowed coronary or cerebral arteries.

Few studies have investigated the effects of extreme hot weather on population morbidity. Those that have been published include analyses of hospital emergency department presentations, hospital admissions, ambulance calls, and survival rates of heat-stroke patients.

Studies of patients admitted to hospitals during heat waves for treatment of heatstroke have shown this illness to be associated with a poor short and long-term outcome. It is more likely to occur in people with underlying chronic medical conditions, who are taking medications, and who become ill at home. The in-hospital mortality of heat-stroke patients in Chicago hospitals during the 1995 heat wave was 21%.⁴ In France during the heat wave in 2003, 63% of heatstroke patients admitted to intensive care units died, with a mean survival time of just 13 days.⁵

Total emergency hospital admissions are reported to have increased by 11% during a heat wave in Chicago in 1995,⁴ and not at all during a heat wave of the same year in Greater London.⁶ In marked contrast, the excess mortality reported for the same periods in these cities was considerably higher: 147% for Chicago⁷ and 16% for Greater London⁶. While this discrepancy could be due to chance or measurement bias, one explanation proposed is that many people dying during heat waves have a rapid decline in health leading to their death before they are able to reach a hospital, or before they are noticed by others.⁶

A study from Adelaide found that emergency hospital admissions were on average 7% higher during heat waves than non-heat wave periods over a 13-year period. In addition, ambulance transports increased by 4% in Adelaide on heat wave days.⁸

Heat-related deaths (Mortality)

Most studies of the impact of extreme hot weather on human health have assessed the effect on mortality, since mortality data is often readily available. However, many deaths occurring during heat waves are not clinically apparent as being due to heat, with high ambient temperature playing an indirect role by precipitating failure of already compromised body systems. For this reason, it is likely that heat-related deaths are underestimated. In one study, a heat wave in Chicago was found to have contributed to 182 more deaths than had been defined as heat-related⁷. Therefore, to avoid underestimation, the measure 'excess deaths' is often used to quantify mortality associated with heat wave events.

Excess mortality associated with heat waves has been observed to occur predominately in the elderly,⁹ and frequently, but not always, to be greater for women than for men⁷. The age group for which vulnerability to heat-related death is reported to be most pronounced varies and is most commonly ≥ 65 years or ≥ 75 years⁹. In addition, a predominance of excess deaths amongst those of low education levels and low socioeconomic status has been observed in two large Italian cities. Analyses of cause-specific mortality have revealed that not all²³, and sometimes very few of the excess deaths occurring in heat waves are directly attributable to the effects of excessive heat, but rather are due to the consequences of other illnesses. Cerebrovascular disease, cardiovascular disease³¹, and respiratory disease have frequently been reported to be predominant causes of death in heat waves.

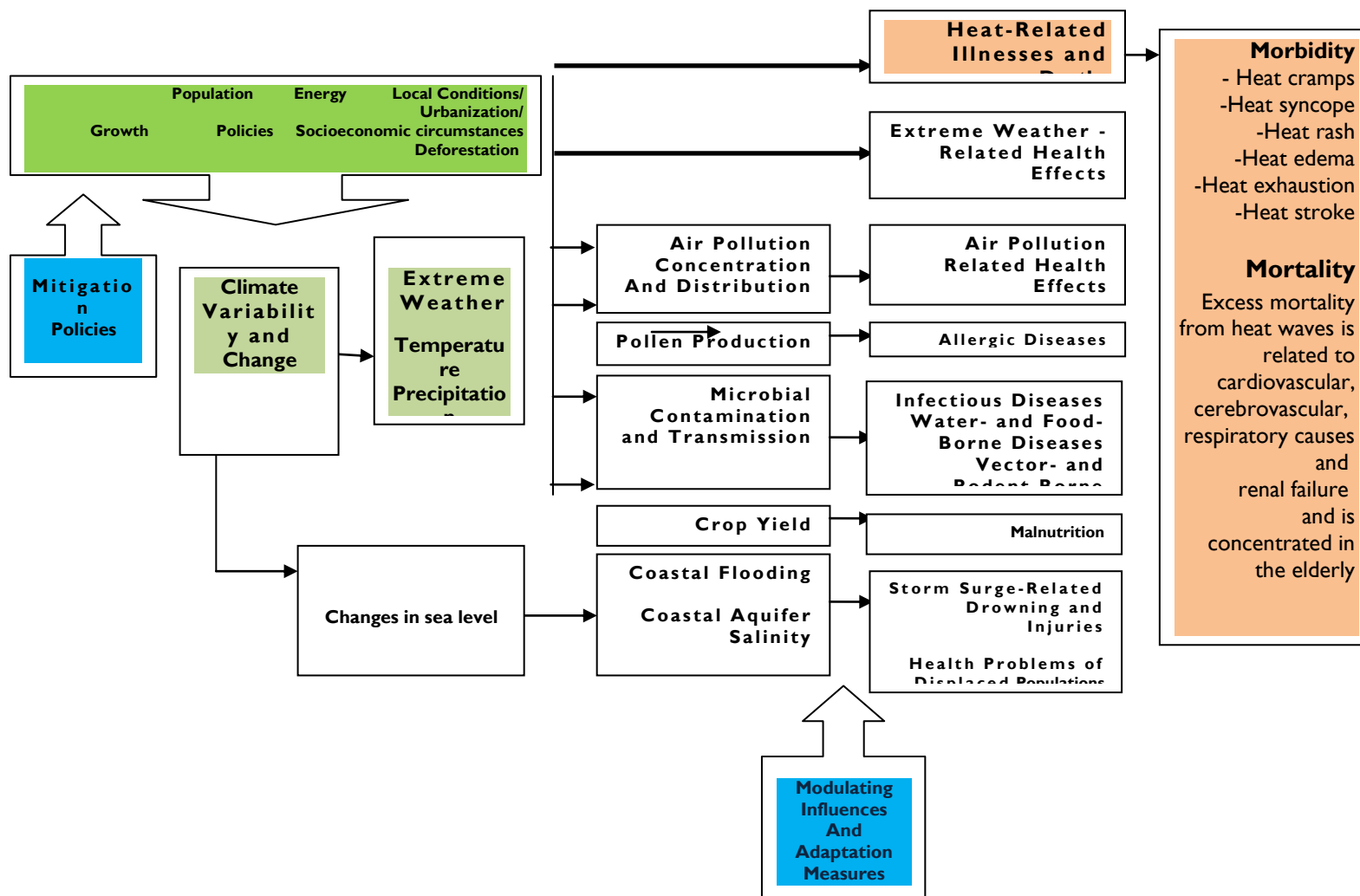
During the 2003 heat wave in France, accidental falls as a cause of death increased by 130% for those aged 75 years and over. For the 2003 heat wave in Europe, diseases "directly linked to heat" were found to account for the largest proportion of the excess deaths in those aged 75 years and over in France³³, while in the Netherlands only four deaths were attributed to exposure to "excessive natural heat". The lack of a standard definition of heat-related death makes it difficult to compare results of these studies.

Lag times of 1-2 days, 1-3 days and up to 4 days have been observed between the onset of a heat wave and the rise in mortality, suggesting that people give in quickly to the effects of extreme heat. An analysis of excess mortality by place of death in southern England during the 2003 heat wave found a disproportionately large fraction of excess deaths occurred in hospitals and nursing homes.¹⁰

Similarly, a marked increase in deaths of the elderly in nursing homes was found in the Netherlands,¹¹ France, and Italy¹⁰, during the heat wave of the same year, when air-conditioning was uncommon in these facilities.

Studies of heat waves in England in 1995 and 2003 reported the largest proportion of excess deaths to occur in the London area.¹⁰ This has been attributed to higher nighttime minimum temperatures associated with the heat-retaining properties of the city environment (the 'urban heat island' effect), higher levels of air pollution, and poor housing conditions¹⁰.

Figure 44 Causality Analysis diagram for climate change and heat waves



Risk Factors for Heat Wave-associated Illness and Death

Factors that increase the risk of illness and death during heat waves include characteristics of the heat wave event itself, as well as characteristics of the exposed individuals, and the environment in which they live.

1. Characteristics of heat wave event

Characteristics of heat waves found to be important regarding health outcomes of exposed populations are the extent to which temperatures deviate from the usual summer temperatures for that area ³⁷, duration, intensity, and timing of the heat wave within the summer season. Thus, episodes of hot weather posing the greatest threat to exposed populations are those characterized by several days of temperatures much hotter than usual for that location, with hot nights, and occurring early in the summer period.

2. Characteristics of exposed individuals

Descriptive studies of heat wave events have consistently shown the elderly to be predominant amongst those dying or becoming ill during heat waves. A meta-analysis of case-control studies has identified being confined to bed, not leaving home daily, and being unable to care for one-self to be characteristics of those at greatest risk³⁸. The characteristics of individuals found to increase susceptibility to poor health outcomes during heat waves are:

➤ Age

Most studies of mortality associated with heat waves and hot weather have shown that the excess mortality is most pronounced in the elderly. It is unclear if there is a difference in risk between the young old (65 to 74 years), old (75 to 84 years) and very old (85 years and over). It would seem reasonable to speculate that the risk increases with each age grouping. Young children, especially those younger than 4 years old, are also regarded as being at increased risk of dehydration and heat stroke. During the period 1979 – 2002, 6% of all heat-related deaths attributed to weather occurred among children aged less than 15 years of age, with a number of these deaths occurring in locked cars. However, time-series and episode analyses have shown little evidence of excess mortality amongst children during heat waves. ³³

➤ Social isolation

Living alone, not leaving home each day, being a widow or widower, and not having social contacts are all strongly associated with an increased risk of death during heat waves. For instance, in one study, the complete absence of social contacts multiplied the risk of death six-fold ³⁸.

➤ Being dependent on others for care

Indicators of dependence found to be associated with an increased risk of death include being confined to bed ³⁸, being unable to care for ones-self, receiving assistance in the home, and the loss of at least one activity of daily living. Being confined to bed has consistently been found to be a major risk factor, with one study finding this multiplied the risk of death during heat waves more than seven times ⁴⁰.

➤ Pre-existing illness

Numerous studies have identified having a chronic illness or pre-existing illness at the time of a heat wave as being a risk factor for heat-associated mortality ⁴⁰ and morbidity. Preexisting illnesses found to be most strongly associated with dying during a heat wave are cardiovascular diseases, psychiatric illnesses, cognitive impairment, and neurological disease ³⁸. Also found to increase risk are respiratory disease, diabetes, cancer, and obesity ⁴⁰. It is reported that most excess deaths

occurring during heat waves are attributed to exacerbation of existing illness³³. These illnesses, and medications used in their treatment, may increase vulnerability through compromising thermoregulation, mobility, awareness of a hot environment, or the ability to adopt protective behaviors. Increased blood viscosity and cholesterol concentration, due to haemoconcentration, resulting from increased loss of water and electrolytes in sweat, is thought to be the underlying mechanism explaining the increased mortality due to coronary and cerebral thrombosis observed in hot weather.

Pre-existing cardiac failure may be worsened by cutaneous vasodilatation accompanying the thermoregulatory response to excessive heat⁴¹, and there is evidence that impaired autonomic nervous system function can compromise thermoregulation through altered control of cutaneous vasodilatation, and diminished ability to sweat in those with diabetes⁴².

Dementia and other neurological conditions leading to cognitive impairment may lead to difficulties caring for one self, obtaining drinks, asking for help, and using an air conditioner. There are a number of reports of people with psychiatric illnesses being at greater risk of heat-related illness and death, including a meta-analysis, which found that a pre-existing psychiatric illness tripled the risk of death³⁸.

➤ *Lower socioeconomic status*

Increased risk of death during heat waves has been reported for people of lower socioeconomic status^{31, 40}. Lower socioeconomic status may increase vulnerability to heat wave associated mortality because of reduced access to adequate housing, inability to purchase air-conditioning, inability to pay for electricity needed to operate air-conditioners, lack of transportation to cooler locations and medical assistance, and associated behaviors such as alcoholism and drug abuse.

➤ *Homelessness*

Excess deaths and morbidity have been reported for homeless individuals in association with heat waves in Arizona⁴⁴ and Adelaide⁴⁵. Fourteen of the 18 heat-associated deaths that occurred during a heat wave in Phoenix in 2005 were of homeless people. Factors contributing to the increased vulnerability of individuals with insecure housing include lack of access to shade, drinking water, and air-conditioned shelter, little access to sources of information about the heat wave such as television, radio, newspaper, or internet, as well as associated psychiatric disorders, drug and alcohol abuse, and chronic illness⁴².

Vulnerability of the elderly to extreme hot weather

A combination of factors diminishes the capacity of the elderly to maintain a normal body temperature and adequate hydration during extremely hot weather, thus making them vulnerable to heat-related illness. These include:

Effects of ageing:

- Thermoregulation: Compared with younger adults, older individuals have been found to have reduced sweat gland output, decreased skin blood flow, reduced cardiac output and smaller redistribution of blood flow from spleen and kidneys to skin, during heat stress⁴⁹.
- Thirst mechanism: It has been found that people over 65 years of age do not drink as much in response to dehydration as do younger subjects. Although the sensation of thirst is thought to be as intense, satiation of the thirst sensation occurs earlier for a smaller volume of ingested water. This is thought to be caused by age-related alterations in the part of the brain responsible for the sensation of thirst⁵¹.
- Renal function: Age-related changes in renal function cause a diminished ability to conserve water and salt through the production of concentrated urine, thus accentuating the effects of dehydration. In addition, decreased responsiveness of the renal hormonal systems to

electrolyte imbalance is postulated to contribute to cardiac arrhythmias and increase the risk of thrombo-embolic disease. Diseases such as diabetes and hypertension, more common in the elderly, have been found to accelerate the process of renal ageing ⁴⁴.

- Reduced fitness: Level of fitness, as measured by maximum oxygen uptake, has been found to be an important factor influencing the response to heat stress of individuals placed in warm, humid environments ⁷⁴. For a given heat stress, fitter subjects have been found to have a more efficient sweating response, with more efficient skin cooling and smaller elevations in heart rate. Fitness in healthy, sedentary individuals is reported to decline by about 10% per decade after the age of 20 years ⁵². A low level of fitness, due to reduced levels of physical activity, is regarded as an important factor increasing the vulnerability of the elderly to harm during hot weather ³⁹.

Effects of chronic illness and disability:

- A number of chronic illnesses that are associated with an increased risk of death during heat waves are also more prevalent amongst those aged 65 years and over. For instance, data from the Australian Bureau of Statistics reveal that in Australia, cardiovascular disease ⁴⁹, cancer ⁵³, diabetes, and dementia are all more prevalent in the older age groups. Rates of disability requiring assistance with activities of daily living also increase with increasing age, particularly for those aged over 80 years ⁵⁴.
- As previously explained, these chronic health problems in conjunction with medications used in their treatment, may increase vulnerability to hot weather through compromising thermoregulation, mobility, awareness of a hot environment, or the ability to adopt protective behaviors.

Effects of prescribed medications:

- Medications that can contribute to adverse health outcomes during heat waves include diuretics, which promote fluid loss and may exacerbate dehydration in hot weather, anti-cholinergic agents (e.g., tricyclic antidepressants, antihistamines, some anti-parkinsonian drugs) that reduce the ability to sweat, anti psychotic drugs, which act on the central nervous system to alter the thermoregulatory set-point, and tranquilizers, which may alter the usual behavioral response to heat ⁴³. These categories of medication are commonly prescribed for management of illnesses in the elderly.

Effects of social factors:

- Social isolation has been strongly associated with an increased risk of dying during a heat wave; a large proportion of elderly people live alone. The Australian Bureau of Statistics has estimated that there will be between 2.8 million and 3.7million lone person households in Australia by 2026. Between one-quarter to one-third of all people living alone (between 844,000 and 962,000 people) will be aged 75 years and older, with three-quarters of these people being women ⁵⁵. Risk factors for social isolation include loss of partner, poor health, mental illness, living in an isolated rural area, not speaking English as a first language, being fearful of assault, and lacking access to suitable public transport ⁵⁶.

3. Characteristics of environments in which people live

Characteristics of environments in which people live that have been found to increase vulnerability to poor health and death associated with heat waves are:

➤ Geographic location

Those residing in geographic locations with variable weather patterns, and cooler climates, have little opportunity to acclimatize to high temperatures and are therefore vulnerable to the adverse health effects of heat waves ⁴⁶.

➤ Cities

A number of studies have reported excess mortality to be greater in cities than for surrounding areas. This is attributed to the 'urban heat island effect', and the effect of concurrent air pollution. The combination of dark coloured heat-absorbing road and building materials, lack of cooling vegetation, reduced airflow between closely built buildings, and the generation of heat by cars and factories contribute to the development of urban heat islands in which daytime and night-time temperatures are higher than surrounding rural areas. Higher temperatures persisting for longer periods of time, due to the diminished opportunity for night-time cooling, leave residents more vulnerable to adverse health effects of heat waves ⁴⁷.

➤ *Housing*

Living on the top story of a multi-story building, and having a bedroom directly under the roof of a house have both been found to be significant risk factors for heat-related illness and death, as has residing in older buildings without insulation ⁴⁰.

Factors that decrease the risk of death and illness associated with heat waves

Factors found to be most strongly associated with a reduced risk of dying during a heat wave are having a working air conditioner in the home, visiting other air-conditioned locations, and participating in social activities ³⁸. In addition, having a pet in the home, having access to transport, dressing lightly, and taking extra baths or showers during a heat wave have been reported to be protective ⁴⁰. Two studies have reported that while use of air-conditioners was protective, use of electric fans was not. Fans move air past the skin, and can induce heat loss by facilitating convection and evaporation of sweat. However, as the ambient temperature rises, airflow becomes a less efficient way of promoting heat loss through convection since the temperature gradient between skin and air decreases ⁴⁸. In addition, cooling through evaporation becomes less efficient as air humidity rises. Therefore, fans are not considered to be protective against heat-stroke when ambient temperature reaches 32.2°C, and humidity exceeds 35% ⁴³.

Assessment of Current Vulnerability and Preparedness for Heat Waves in Jordan

There is no data about morbidity attributed to heat waves in Jordan in the reviewed literature and no studies about this subject. A study investigated the number of heat waves that occurred in Jordan during the period 1960-2000, and indicated that there were about 135 heat waves during this period (41 years) with an average of 3.3 per year. Distribution of heat waves by month of occurrence shows that May was most affected with 35 heat waves and October with 34 heat waves. The study did not assess the burden of these heat waves on human health; rather, it investigated what people felt during heat waves to identify if they were comfortable or not ³⁶.

Heat Waves in Jordan

Heat waves data provided by the MD show some differences in decadal averages long-term averages results for whole Jordan in comparison to station and region long-term averages. It indicates the following:

- Trend decadal averages of the number of heat waves is similar to the long-term trend of the period 1981-2010.
- No significant change between the results in the analysis of the period 1981-2010 for whole Jordan and the analysis of station by station for the same period.
- The monthly distribution of heat waves occurring during 1980-2010 in the selected stations shows that the maximum number of heat waves occurs in May with 15.3 heat waves as

monthly average number, with a minimum number of 8 heat waves in Rewashed and Ma'an, and a maximum number of 21 heat waves in Tafiela. This can be explained due to transitional period from spring to summer and due to instability and khamasinic conditions.

- October is considered the second month when heat waves occur with 8.2 heat waves as monthly average number.
- There is an increasing trend in the number of heat waves in all regions, as indicated by Table 1, Figure 2 (Jordan Valley, Mountainous, North and Eastern desert regions) during the period 1980-2010.
- There is an increasing trend in the number of heat waves in Jordan Valley during the periods 1981-1990, 1991-2000, and 2001-2010 as shown in Figures 3 and 4.
- Increasing trend in the number of heat waves in the Mountainous region during the periods 1981-1990, 1991-2000 and 2001-2010, as shown in Figures 5 and 6.
- There is an increasing trend in the number of heat waves in North and Eastern deserts during the periods 1981-1990, 1991-2000, and 2001-2010, as shown in Figures 7 and 8.
- The maximum number of heat waves was found in year 2010 in all regions with 5.1 events as yearly average.
- The Maximum number of heat waves, from Figure 9, was 9 and occurred in 2010 at Shoubak (Mountainous region); whereas, Al Jafer, Wadi Dhulail, Mafraq, and Amman witnessed 7 heat waves during 2010 with recorded maximum temperature of 39.4°C on 12-7-2010, which exceeded the normal minimum temperature by 11.5°C.

Figure 2 Number of heat waves in all regions during the period 1981-2010

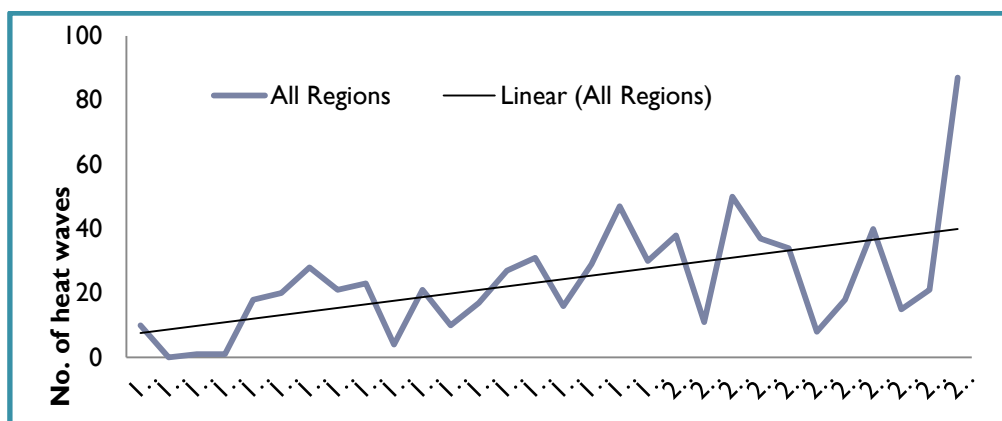


Table I Heat waves distribution for the period (1981- 2010) by year and station

Region	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Sum	
Jordan valley	Baqura	0	0	0	0	1	1	1	2	0	1	0	1	3	1	0	2	3	3	2	1	3	3	0	1	1	2	0	2	5	40	
	Aqaba	0	0	0	0	0	1	1	1	0	2	0	1	0	0	0	1	3	1	0	0	2	3	2	0	0	1	0	1	1	22	
	Deir Alla	0	0	0	0	0	0	1	1	2	0	0	0	1	1	0	1	3	2	2	1	3	2	0	0	1	2	0	3	4	30	
	Wadi El-rayyan	0	0	0	0	0	1	1	1	2	0	1	0	1	3	1	0	2	3	3	0	1	3	2	0	0	1	2	0	2	4	34
	Ghor Safi	0	0	0	0	0	0	0	1	1	0	0	0	0	1	1	0	0	1	1	0	0	1	2	0	0	0	2	0	0	0	11
Mountainous	Ras Muneef	0	0	0	1	3	2	3	2	2	0	1	1	2	5	2	2	2	2	2	2	1	4	3	3	1	1	3	1	1	5	57
	Irbed	0	0	0	0	1	1	1	2	2	0	0	1	1	4	1	1	2	3	3	1	1	4	2	2	1	1	3	0	2	4	44
	Amman	0	0	0	0	2	2	3	2	1	0	1	1	2	1	2	1	2	2	2	3	0	4	3	3	1	2	3	2	1	7	53
	Er Rabbah	2	0	0	0	1	2	1	2	2	0	1	1	1	1	4	2	2	4	4	3	1	4	2	5	2	2	4	0	1	6	60
	Shoubak	3	0	0	0	2	2	2	2	1	0	4	1	2	1	2	2	1	3	2	2	2	4	3	3	1	1	3	1	1	9	60
	Tafileh	0	0	1	0	2	2	3	1	3	0	1	2	2	2	3	2	3	2	2	3	1	3	3	3	0	1	2	1	1	5	54
North desert region and Estern desert region	Mafrq	3	0	0	0	2	2	4	2	2	1	2	1	3	2	2	1	3	2	2	5	1	4	3	2	0	1	3	2	1	7	63
	Wadi Dhulall	0	0	0	0	2	2	4	2	2	1	2	2	1	1	3	1	3	2	1	3	1	3	2	2	0	1	3	3	1	7	55
	Rwaished	1	0	0	0	0	0	1	0	0	1	0	0	0	0	2	1	2	4	1	2	0	2	1	1	0	1	1	1	1	6	29
	Ma'an	0	0	0	0	1	1	1	0	0	0	3	0	0	0	2	1	0	3	0	2	0	0	0	3	0	1	1	1	1	5	26
	Al Jafer	0	0	0	0	0	1	0	0	0	0	1	0	0	0	2	1	1	3	0	5	0	3	1	2	0	2	2	1	1	7	33
	Safawi (H5)	1	0	0	0	1	0	1	1	0	1	1	0	0	2	2	1	2	4	1	3	0	3	2	3	1	1	3	2	1	5	42
Yearly Average	0.6	0.0	0.1	0.1	1.1	1.2	1.6	1.2	1.4	0.2	1.2	0.6	1.0	1.6	1.8	0.9	1.7	2.8	1.8	2.2	0.6	2.9	2.2	2.0	0.5	1.1	2.4	0.9	1.2	5.1	41.9	

Figure 3 Number of heat waves in Jordan Valley during the period 1981-2010

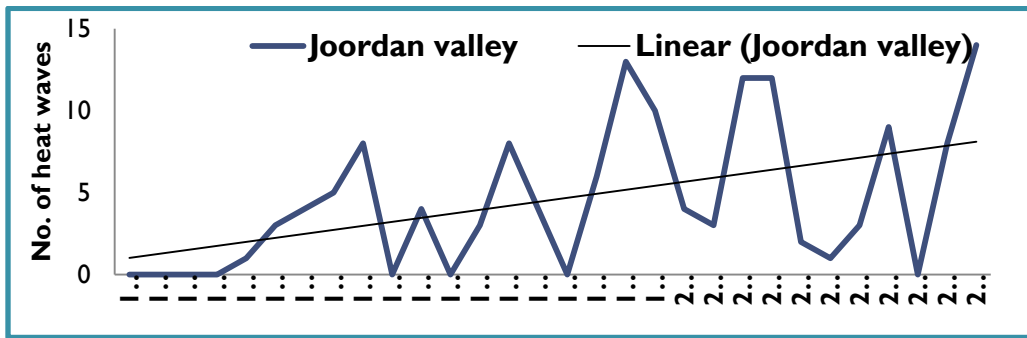


Figure 4 Number of heat waves in Jordan Valley by location during the period 1981-2010

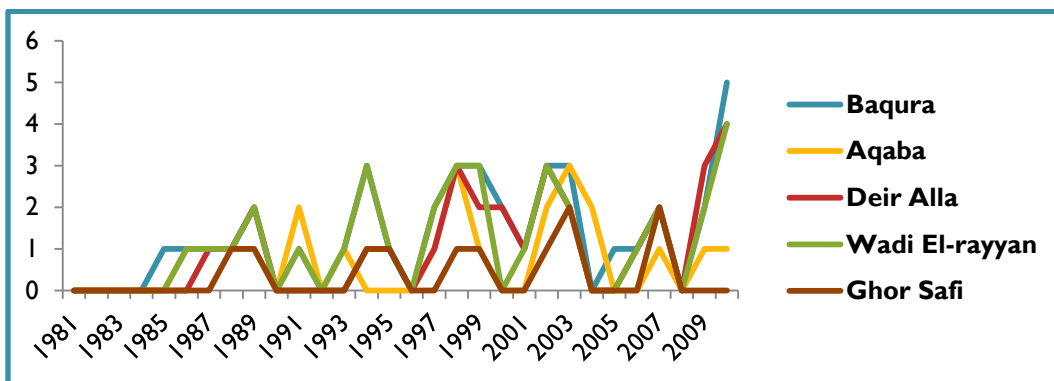


Figure 5 Number of heat waves in Mountainous during the period 1981-2010

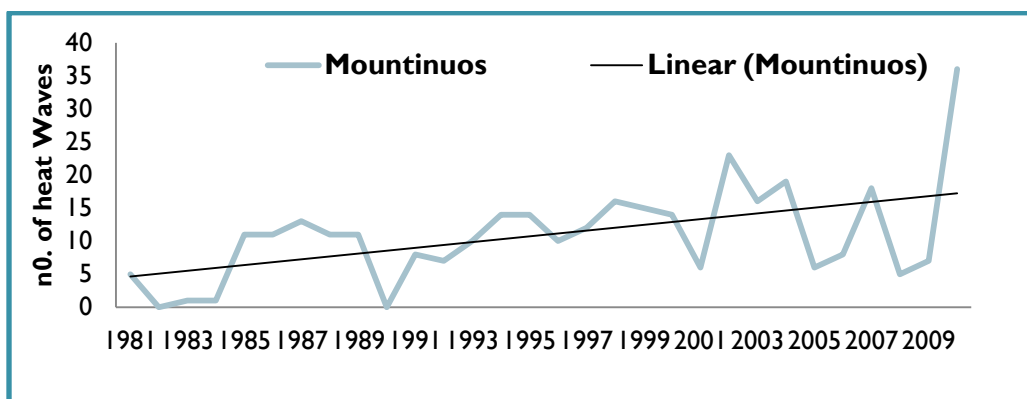


Figure 6 Number of heat waves in Mountainous region during 1981-2010

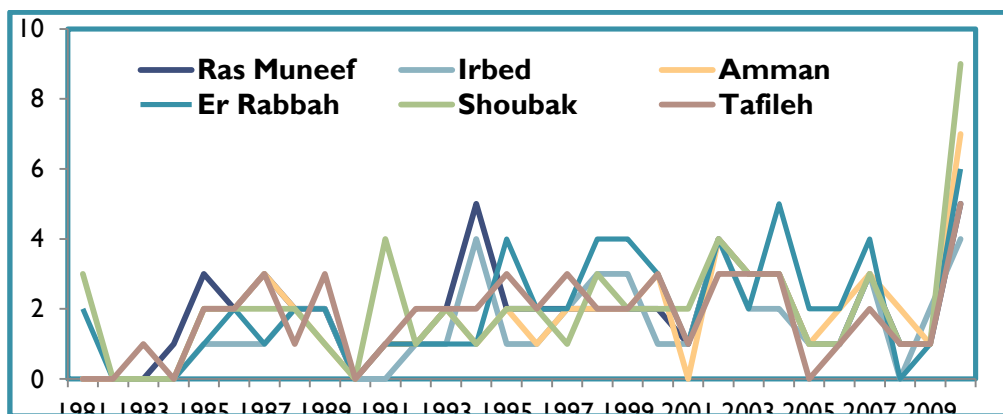


Figure 7 Number of heat waves in North and Eastern Desert during 1980-2010

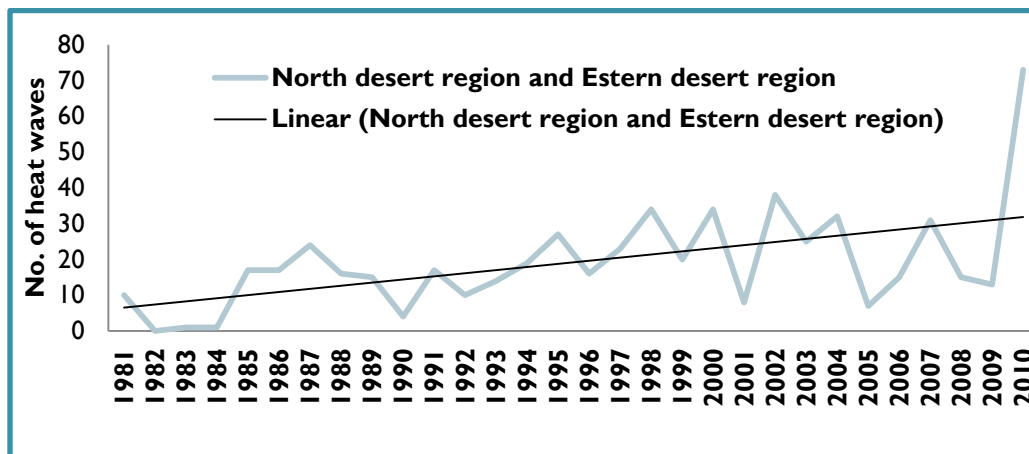


Figure 8 Number of heat waves by area in North and Eastern Deserts, 1980-2010

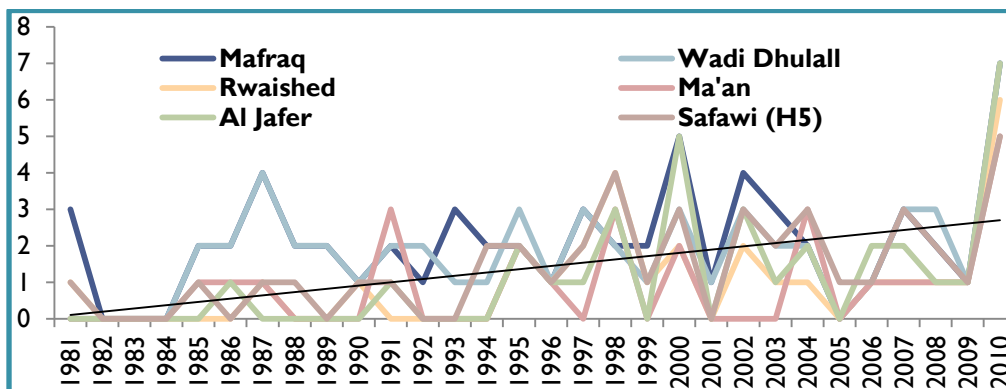
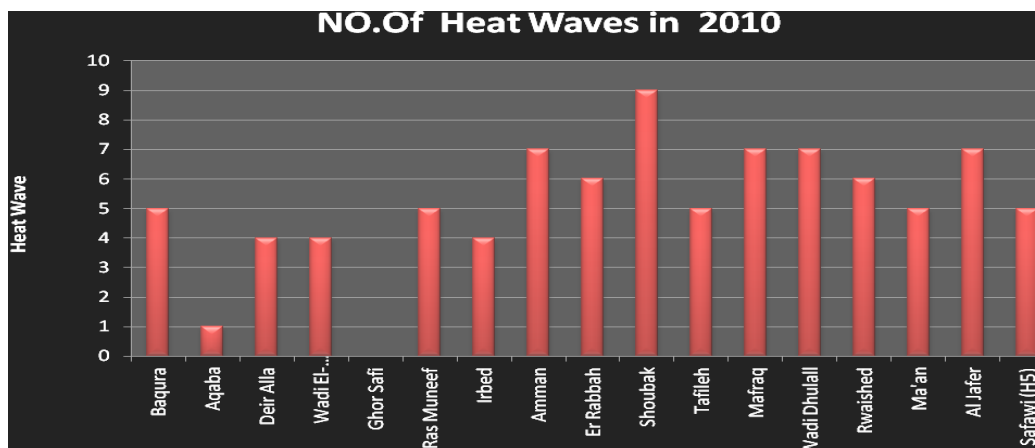


Figure 9 Number of heat waves in all stations 2010



Analysis of heat waves data for the years 1994, 2000, and 2004, respectively show that 5 heat waves events occurred at Ras muneef, Ma'fraq and Er Rabbah, respectively. In addition, it demonstrated that:

- The maximum temperature recorded at Ras muneef was 34.0 °C on 13-9-1994, exceeding the normal by 8.5 °C;
- Ma'fraq recorded a maximum temperature of 38.8 °C on 13-9-1994, while Er Rabbah recorded a maximum temperature of 34.8 °C on 26-5-1994, which exceeded the normal by 6.9 °C;

- Wadi El-rayyan recorded the highest maximum temperature equal to 48.8 C° on 20-8-2010, which exceeded the normal by 10.3°C.

The Current Burden of Heat Waves in Jordan

A number of governmental hospitals, university hospitals and some private hospitals were visited and questionnaires were filled out to collect data on the current burden of heat waves, identify the vulnerable regions and to determine the health impact of heat waves in Jordan. The questionnaire included issues on preparedness, admissions during heat waves, the availability of medical records, curative interventions, and existing plan of action or programs that deal with heat waves. Data on morbidity and mortality during the period from 2007-2010 was also collected via the same questionnaire.

Findings from Field visits and Data Collection Tools

The collected information from most hospitals was homogeneous in terms of preparedness and plans of action to encounter high temperatures and heat waves. The results are summarized as follows:

- Even though all hospitals were found to have a general Emergency Plan, no specific plan for climate change or heat waves was identified.
- In all hospitals, no guidelines on the management of health effects of heat waves or any educational materials for the public were identified.
- No training programs for the emergency staff dealing with heat wave management were identified in all hospitals.
- In all hospitals, symptoms related to exposure to high temperature are managed as cases belonging to the internal medicine; or according to other accompanying symptoms such as cardiovascular disease, diabetes or respiratory disease ...etc and are recorded in hospital records accordingly.
- All hospitals are equipped with new and suitable equipment to treat and to deal with expected emergency cases admitted to emergency rooms, but there is no specialized emergency room for heat waves illnesses.
- There is scarce data about heat stroke and heat related illnesses in most of the hospitals, particularly in the emergency departments.
- The average number of available ambulances in most hospitals ranged between 2 to 4 ambulances. It is obvious that the total number of ambulances is not enough to face disasters, epidemiological situations, or severe events such as heat waves.
- Data on admission and deaths was collected from internal medicine departments, by region and month, as most of the patients are admitted to these departments if they complain of symptoms related to chronic disease or fever, etc. In addition, data was collected from pediatric departments, as children constitute an important vulnerable group when considering the health impacts of heat waves.
- Additional data on mortality was obtained from the Civil Register as well as the Civil Defense Directorate.

Analysis of Data

The period extending from May to October, which is the period of high temperatures and heat waves in Jordan, is used in the analysis of data to identify any obvious or abnormal results as indicators for mortality or morbidity.

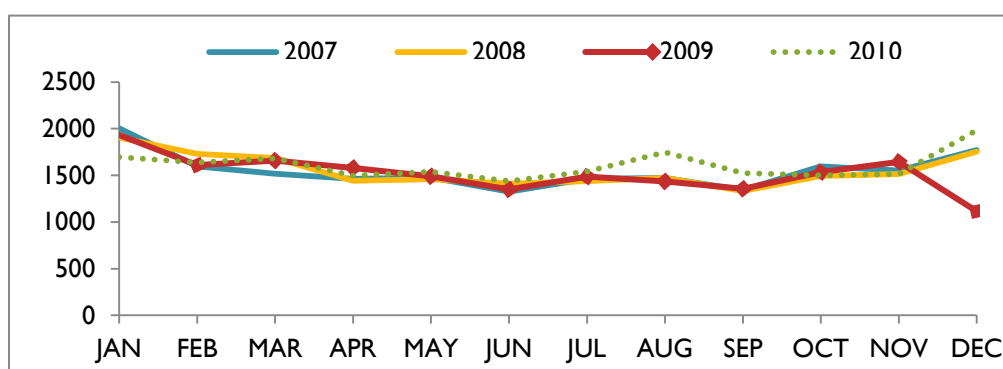
Mortality Data

There is no obvious increase in the number of deaths registered by the Civil Status Department in Jordan during the summer months (May to October) of the years 2007 to 2010. On the other hand, the number of registered deaths increased in January during the same years (Table 2 and Figure 10).

Table 2 Deaths from Civil Status Department in Jordan 2007-2010

Month	2007	2008	2009	2010
January	2005	1,905	1,933	1,695
February	1595	1,729	1,611	1,638
March	1518	1,684	1,659	1,683
April	1464	1,442	1,581	1,498
May	1475	1,460	1,489	1,539
June	1326	1,410	1,350	1,439
July	1462	1,440	1,486	1,540
August	1474	1,474	1,434	1,746
September	1343	1,334	1,357	1,526
October	1596	1,494	1,536	1,501
November	1553	1,514	1,644	1,513
December	1770	1,754	1,115	1,984
Total	18581	18,640	18,195	19,302

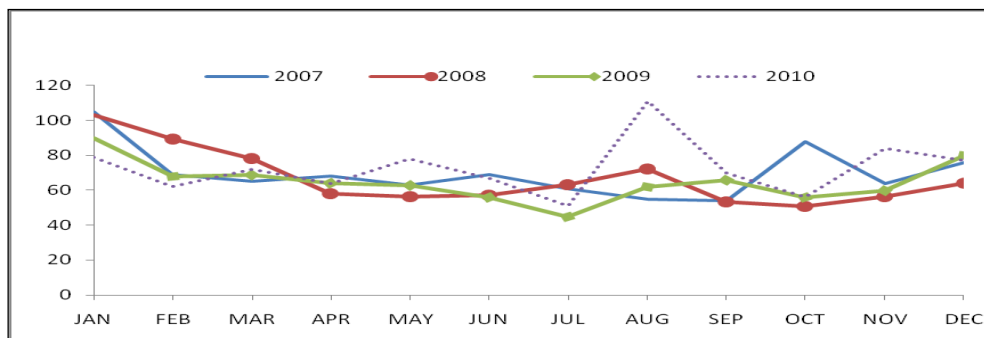
Figure 10 Distribution of deaths in Jordan from Civil Status, 2007-2010



Deaths Registered in some Public Hospitals

Figure 11 shows that there is an obvious increase in the number of deaths registered in August 2010. The distribution of deaths in Internal Medicine Departments in Al Aghwar hospitals shows there is an increase in the number of deaths registered during May 2009 and October 2010. In Mafraq Governorate hospitals, data indicated an increase in the number of deaths registered in October 2007, July and September 2008, and May and August 2010.

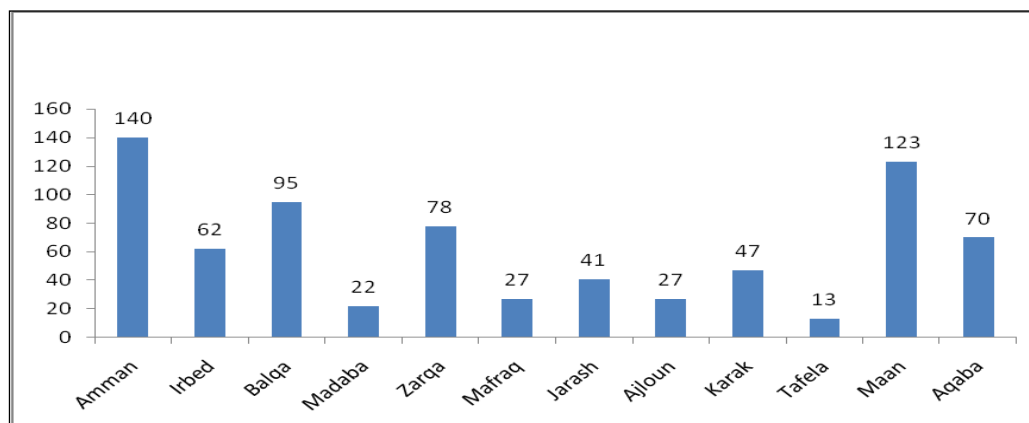
Figure 11 Distribution of deaths in Internal Medicine Departments in Al-Basheer Hospital and Jordan University Hospital, 2007-2010



Hospital Admission Data

According to the data provided by the Civil Defense Directorate on the registered cases related to the health impact of heat waves, only heatstroke cases were registered during the period from 2000-2010, and transferred by ambulances to hospitals. The total number of these transferred cases ranged from 37 cases in 2002 to 116 cases in 2008. Figure 12 shows that Amman governorate had the largest number of cases (140 cases), followed by Maan governorate (123) cases, Balqa governorate (95) cases, and Zarqa governorate (78) cases. The most affected age groups were 16-30 years with 342 cases and age group 31-50 years with 202 cases.

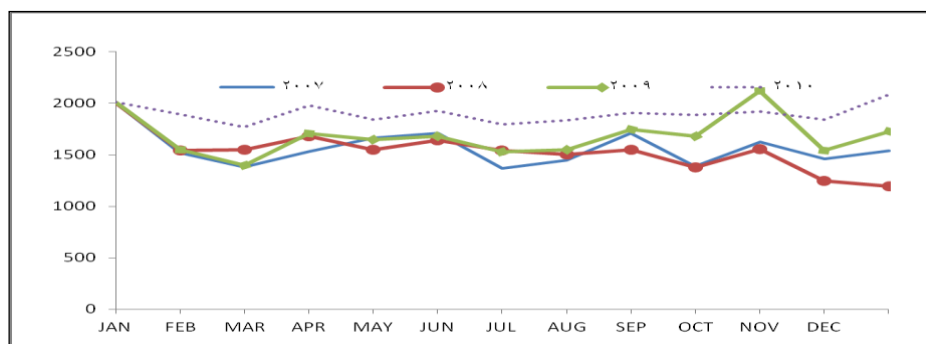
Figure 12 Distribution of heat stroke cases transported by Civil Defense ambulances by governorate during 2000-2010



Distribution of admissions to Internal Medicine Department from Prince Hamza Hospital, Al-Basheer Hospital and JUH (Middle Region) for the period 2007-2010 shows slight increase in the number of admissions to Internal Medicine Departments registered during the summer months of the years 2007, 2008, and 2010 (May to October) as shown in Figure 13.

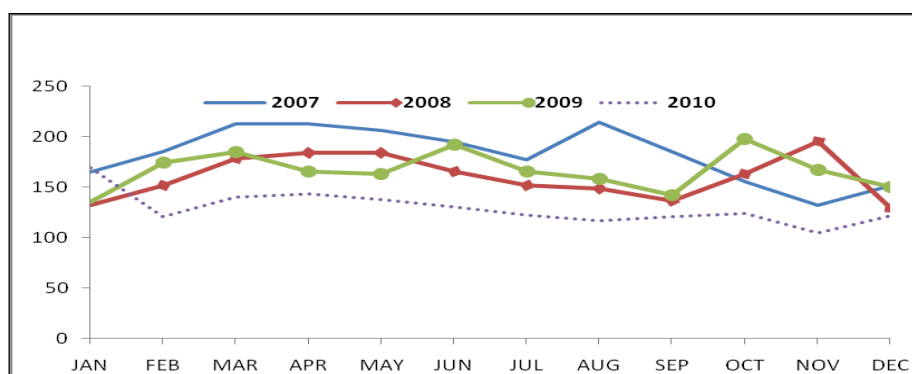
Data shows that there has been an increase in the number of cases admitted to the Internal Medicine Department in Zarqa Hospital (Middle Region) during August 2008, 2009 and 2010. However, no cases were admitted in August 2007. In addition, data indicated an increase in the number of cases admitted to Internal Medicine Department in Irbid Governorate (North region) during summer months (July 2007 and 2010) compared to 2009 and 2008. Distribution of admissions to Mafraq Governorate hospitals (North Region) shows an increase in the number of cases during the summer months in 2007, 2008, and 2010, as well as during March 2009 and October 2010. The number of cases admitted to Internal Medicine Department in Karak Governorate (South Region) increased during July of 2007 to 2010.

Figure 13 Distribution of admitted cases in Internal Medicine Department in Al-Basheer Hospital, Prince Hamza Hospital, and Jordan University Hospital during 2007-2010



There is an increase in the number of cases admitted in Al-Aghwar during the summer months in August 2007, October in 2009, and in November 2008. There was no increase in admitted cases in 2010 during the summer months (May to October), as indicated by Figure 14.

Figure 14 Distribution of admission cases in Internal Medicine Department 2007-2010, AL-Aghwar



Conclusion

In the summer months during the period 2007-2010, the number of hospital admissions and deaths increased. Nevertheless, these increments were not attributable to the high temperatures registered during this period because the increased admissions covered all causes of illnesses irrespective of heat waves or even high temperatures.

Furthermore, in the Emergency Departments, there are no specific records for cases related to heat waves, no plans or programs or case definition of heat waves to be registered regularly. Consequently, the results could not be linked to the effects of heat waves, or excessive high temperature, as Jordan's weather usually witnesses rising of temperature during summer season. Besides, the non-specific causes of disease admission or mortality (e.g. cardiovascular disease or diabetes) make it difficult to link the increment in the death rates or admissions to the rising temperatures in summer. On the other hand, considering these increments, more specific ICD 10 coding system, and detailed analysis such as time series analysis are needed to link between the effect of heat waves and admissions and mortality; also, detailed dates of heat waves and detailed causes of admissions and deaths at the same time are needed.

Vulnerable Regions and Populations to Heat Waves

Vulnerable Population

Many factors determine the health vulnerability of populations, such as:

- Demographic factors: age (proportion of children and old age), sex, population density. Infants and children < 5, elderly age > 65 years and pregnant women, are the most vulnerable groups.
- Health Status: undernourished populations, populations with infectious and chronic diseases, mentally or physically disabled people, are more vulnerable.
- Culture and life conditions: poor, nomadic, and semi-nomadic peoples, indentured laborers, subsistence farmers, and fisher folk are more vulnerable.
- Socioeconomic status: (poverty) poor populations are more vulnerable.
- Work place: such as, outdoor workers

Vulnerable Regions

- Unplanned urban housing
- Drought risk zones
- Water-stressed zones
- Food-insecure zones
- Urban, remote, and rural areas.

The following areas in Jordan are identified as vulnerable regions with vulnerable populations:

Mafraq

The population of Mafraq Governorate is 287300, which constitutes (4.7%) of the total population of Jordan, of which 148900 are males. The population density is 10.8 inhabitants/km². Children <5 years old are 41658 (14.5%); people > 65 years are 10917 (3.8%), while women in childbearing age account for 68040 (23.6%) of the governorate's population. There are 11 poverty pockets in Mafraq Governorate, and it is considered as the most drought-risk zone in Jordan.

Tafileh

The population of Tafileh Governorate is 85600 (1.4%); of which 43600 are males. The population density is 38.7 inhabitants/ km²; children < 5 years old children are 11898 (13.9%); people > 65 years are 3167 (3.7%), while women in childbearing age are 21966 (25.6%). There is one poverty pocket in Tafileh.

Aqaba

The population of Aqaba Governorate is 133200 (2.2%), of which 74100 are males. The population density is 19.3 inhabitants/ km². Children < 5 years are 20739 (15.7%), people > 65 years are 3196 (2.4%), while women in childbearing age are 30788 (23%). There are three poverty pockets, and it is mostly a drought-risk zone.

Amman

The population of Amman Governorate is 2367000, of which 1217000 are males. The population density is 312.3 inhabitants/ km². Children < 5 years are 298242 (12.3%), people > 65 years are 99414 (4.6%); while women in childbearing age are 603200 (25.7%). There are two poverty pockets in Amman. It is mostly a drought-risk zone, compared to other areas.

Zarqa

The population of Zarqa Governorate is 910800, of which 471300 are males. The population density is 191.3 inhabitants/ km². Children < 5 years are 117493 (12.9%); people > 65 years are 35521 (3.9%); while women in childbearing age are 223259 (24.5%). There are two poverty pockets, and it is mostly a drought-risk zone compared to other areas.

Maan

The population of Maan Governorate is 116200, of which 60900 are males. The population density is 3.5 inhabitants/ km². Children <5 years are 16849 (14.5%), people > 65 years are 3486 (3%), while women in childbearing age are 29140 (25.1%). There are four poverty pockets, and it is mostly a drought-risk zone compared to other areas.

Karak

The population of Karak Governorate is 238400, of which 120700 are males. The population density is 68.2 inhabitants/ km². Children < 5 years are 31230 (13.1%), people > 65 years are 9059 (3.8%), while women in childbearing age are 66027(27.7%). There is one poverty pocket, and it is mostly a drought-risk zone compared to other areas.

Jordan valley

The Jordan Valley includes three poverty pockets.

Time Trends and Changes in the Burden of Heat Waves

Jordan's current population and epidemiological profiles are a result of both the demographic and epidemiological transitions. Drastic declines in death rates and continued high birth rates along with the shifting composition of illness away from infectious diseases to non-communicable diseases shape Jordan's population and epidemiological circumstances.

Most of the available evidence indicates that time trends and the burden of heat waves will increase in the coming decades as the following factors and indicators may contribute to the burden of heat waves:

Demographic Patterns and Trends: Advanced age represents one of the most significant risk factors for heat-related deaths. In Jordan, Life Expectancy at Birth (years) is 73.8, (71.6) years for males and (74.4) for females. The population aged 65+ years accounts for 4.2% of the population (256746 inhabitants), becoming an increasingly larger proportion of Jordan's population. Over the next 40 years, the prevalence of vulnerabilities to extreme heat will increase. The population aged less than 15 years constitute 37.3% of the population of Jordan.

Key Economic Trends Indicators: Jordan is a small lower-middle income country with limited natural resources and scarce fresh water supplies (one of the world's 10 most water stressed countries). Jordan's economy is among the smallest in the Middle East, with insufficient supplies of water, oil, and other natural resources, underlying the government's heavy reliance on foreign assistance. Other economic challenges for the government include chronic high rates of poverty, inflation, and a large budget deficit.

Poverty Indicators: According to the DOS Statistics Report (2008), poverty in Jordan constitutes about 13.3%, and unemployment (proportion of unemployed persons (15-24) years of age) is 50.1%. Poverty is significantly higher in rural areas, where 37% are poor compared to 29% in the urban areas. However, since 82.6% of the population lives in urban areas, the number of the urban poor is three times the number of the rural poor. Lower socioeconomic groups are more likely to live in warmer neighborhoods and, not only have greater exposure to heat stress, but also lack resources to cope with it.

Health Indicators- Increasing prevalence of chronic diseases: Major progress was achieved in lowering infant and child mortality rates, as well as the maternal mortality rates. Currently, Jordan is one of the countries with the lowest infant and maternal mortality rates in the region (23 per 1000 live birth and 19.1 / 100,000 live births). Jordan, like other middle-income countries, is

witnessing an epidemiological transition, which is characterized by an increase of non-communicable diseases, where approximately 34% of Jordanian families have at least one member of them complaining of chronic disease. The major cardiovascular diseases are coronary heart disease, stroke and hypertension (more than 26% (662,527 persons who are 18 years and above) having hypertension, and more than 16% (414080 persons of 18 years and above) having diabetes and chronic respiratory conditions).

Environmental Health Indicators: The fresh water supplies of Jordan are scarce and strategically critical. With an average per capita annual share of 170 cubic meters, Jordan ranks as one of the World's 10 most water stressed countries. The average share is 156 liters/citizen/day, one of the lowest in the Middle East. In addition, water supply is intermittent. With urban population constituting 82.6% of the population (50% of Jordan's population lives in Greater Amman) compared to 17.4% rural population, the urban heat island effect is considered an important factor that will undoubtedly amplify both the health effects of heat and the vulnerability of urban populations to heat-related death.

Current Programs and Activities to Manage Heat Waves

There are no specific curative or preventive intervention programs for the management of heat waves implemented by the MOH although it is responsible for all health matters in Jordan according to Public Health Law No 47/2008. MOH is the major single institution financer and provider of health care services and is the largest in terms of the size of its operation and utilization as compared to the Royal Medical Services (RMS), Jordan University Hospital, King Abdullah Hospital (KAH) in Irbid, or other private sectors' establishments. MOH maintains public health by offering preventive, treatment, and health control services.

Management of heat waves is considered a new issue not previously identified as a public health problem. The public health authority needs to take curative and preventive interventions in collaboration with all responsible sectors including governmental, non-governmental, and private sector in order to improve its resilience to heat waves, adaptation, and preparedness.

Interventions by Other Sectors

- There are no specific programs or interventions for heat waves, except for certain actions taken by some organizations, such as the Ministry of Education (e.g. cancelation of sports activities in the days of increased high temperature or students stay at home).
- There are scattered initiatives such as production of leaflets, pamphlets and some educational materials about protection of people in hot weather prepared and produced by the Jordan Environment Society (JES) (NGO).
- Instructors from the Civil Defense Directorate give lectures and small-scale training to their staff on the management of high temperature as well as sending awareness messages to the public on how to protect themselves against high temperature by radio or television.
- The MOH broadcasts random awareness messages to the public on how to protect themselves from high temperatures on radio, television, or newspapers.
- Great Amman Municipality builds public parks in the different parts of Amman, some of them have water fountains; these are not intended as an adaptation measure with heat waves.

Assessment of Climate Change Impacts on Heat Waves

Recently, there is a sense among many that there is an increase in air temperature in Jordan. It is often assumed that since the Middle East region has very scarce water resources and an arid climate, the impact of climate change would be negligible (IPCC-WGII 1996).

All available evidences and studies indicate that an increase in temperature of less than 2°C by the year 2050 is expected. In addition, warming was found to be stronger during the warm months of the year while less warming is projected to occur in the cold months of the year (Details in Chapter 1).

Taking into consideration the absence of current or planned programs and activities to cope with preventing heat waves health burden, heat waves will become common and severe, especially in urban areas, with increased mortality among the elderly, infants, and those in ill health, and increased morbidity.

However, as noted earlier, water resources in the region are under a heavy and increasing stress. Any alteration in climatic patterns that would increase temperatures and reduce rainfall would greatly worsen the existing difficulties.

Previous local studies investigated the weather records showed an increase in the magnitude and frequency of extreme temperatures. Higher temperature and lower precipitation are expected because of climate change. Water resources, environment, and other related issues such as rangeland, and livestock are most likely to be vulnerable to climate change.

Jordan Meteorological Department projected that, for the next 20 years, temperature will increase by 1-2 C°, while distribution of heat waves by months and regions could not be determined. The available data for the occurrence of heat waves during the period of 1980 – 2010 and the expected increase of temperature for the coming two decades by 1-2 C°, lead to the projection of increased occurrence of heat waves in the country.

Adaptation Measures to Reduce Vulnerability and Enhance Preparedness against the Potential Negative Impacts of Climate Change on Heat Waves

Public Health Interventions

A lot of evidence indicated that Global climate change is projected to further increase in the frequency, intensity, and duration of heat waves and attributable deaths. The adverse health effects of heat waves are largely preventable through the development and implementation of *Heat-Health Action Plans* at the national and regional levels. These plans aim to prevent, react to, and contain heat-related risks to health and include measures for long-term prevention, medium-term preparation and short-term emergency measures.

Recommended Elements of Heat-Health Action Plans

- Establishment of collaborative mechanisms between relevant agencies, with a lead body to coordinate responses.
- Develop an accurate and timely alert system.
- Develop heat-related health information system.
- Develop strategies to reduce individual and community exposure to heat.
- Improve urban planning, transport policies, and building design to reduce energy consumption and ultimately reduce heat exposure.

- Provision of particular care for vulnerable population groups.
- Provision of health care, social services, and infrastructure to prevent heat related illnesses. Emergency departments of hospitals should be alerted to heat waves in order to manage an increase in admissions.
- Incorporation of real-time surveillance, evaluation, and monitoring into the planning process.

Interventions by Other Sectors

Interventions by sectors other than health are needed to face the health effects of heat waves, as follows:

1. Meteorological Department:
 - Provide accurate and timely meteorological forecasts
 - Collaborate in establishing an Early Heat Warning system (short-term responses before and during heat wave events; can be useful for decision-makers)
2. Water Authority:
 - Protection of groundwater resources and catchment areas
 - Improve management and maintenance of existing water supply systems
 - Groundwater and rainwater harvesting and desalination
3. Municipalities:
 - Develop building design and infrastructure codes and standards to deal with climate change and heat waves
 - Planting trees in the streets and building public parks with water fountains
 - Build covered external shades at bus stop stations to protect people from the sun.
4. Ministry of Environment:
 - Develop educational programs and awareness materials
 - Develop projects to decrease the effects of Urban Heat Island.
5. Civil Defense:
 - Train staff on dealing with health effects of heat waves.
 - Increase the number of ambulances.
6. Ministry of Education:
 - Integrate heat waves health effects in the students' curriculum.
 - Train the teachers on proper first aid measures for heat waves.
 - Prevent outside activities in days of high temperature
 - Close schools when it is necessary during heat waves.
7. Ministry of Social Affairs:
 - Decrease the poverty rate among the population through financial support of the poor and decreasing the rate of unemployment to cope with heat waves.
8. NGOs:
 - Participate in health education/ awareness programs for the community on climate change including health effects of heat waves, treatment, and prevention.
 - Train their members on the risks of and appropriate responses to extreme weather events and heat waves.
 - Prepare and print education materials on climate change and health effects of heat waves.
9. Ministry of Transportation:
 - Decrease the distance between bus stop stations to decrease exposure to high temperature.
 - Maintain and repair the public transport buses and provide them with air conditioners.

10. Electricity Company:

- Provide and maintain electricity for all, especially during summer time when the temperature is high.

11. Media:

- Raise community awareness on how to minimize the health risks during heat waves.

Cost-benefit Analysis of Heat Waves Adaptation Measures

The success of adaptation plans and/or measures will depend heavily on the competence and capacity of individuals, communities, and local governments, and available financial and other social resources. While adaptation to heat waves will come at a cost that will likely reduce resources available to cope with other societal burdens, the potential for adaptation through technological and institutional development and behavioral changes is considerable, especially where such options meet other sustainable development needs. With scarce resource, adaptation options with co-benefits that help improve other issues, or where they can easily add climate concerns to existing response plans should be considered. The focus on all-hazards response within MOH can simply add heat waves impacts to its list of hazards for which to prepare. This will likely improve the response plans to events such as heat waves that happen in a variable climate, whether or not they increase in frequency or intensity with a changing climate.

Qualitative cost-benefit analysis of adaptation measures

Table 3 below shows a qualitative analysis of some adaptation measures with the expected benefits of the measure indicated as avoidable health impact. Quantitative analysis cannot be conducted due to unavailability of required data. Table 4 includes the activities, steps, and cost of implementing the adaptation measures.

The criteria for the selection and prioritization of the urgent adaptation interventions were developed during stakeholder consultation workshops. The five criteria are:

- Resilience of the adaptation intervention
- Sustainability of the intervention
- The potential to have multiplier effects (co-benefits)
- Extent of reliability of the intervention; and
- Feasibility of the whole intervention.

Table 3 Qualitative cost-benefit analysis of heat waves adaptation measures

	Adaptation Measure (Cost)	Avoidable Health Impact (Benefit)
1	Building Capacity of Emergency Room Physicians and health care workers to detect symptoms of heat – related illness (heat stroke , heat stress , heat cramps) Preparation and printing of guidelines for management of health effects of heat waves	- Decreased number of heat related deaths - Increased productivity of workers
2	Developing Heat-Health Warning Systems: Media announcements, opening of cooling centers, home visits or telephone calls to vulnerable people, website bulletins, automated calls to every home with a school child when school is delayed for heat waves	- Reduced excess morbidity and mortality
3	Improve infrastructure: - Prepare and equip emergency room in hospitals with air-conditioners - Equip hospitals with extra number of ambulances	- Decreased morbidity and mortality
4	Heat-related health information strategies: - Preparation and printing of health education materials for people - Preparing and broadcasting health information through the media - Conduct education campaigns regarding heat-related illnesses	- Increased level of knowledge and awareness among people - Number of heat waves-related health cases decreased
5	Mapping of vulnerable populations: to visualize risk to certain populations within a community, both potential exposure to heat, as indicated by land cover and air conditioning availability, and potential individual susceptibilities, as indicated by age and chronic health conditions, can be inputs into a vulnerability map.	- Decreased vulnerability of risk groups - Reduced heat waves related mortality
6	Increase the use of air conditioning by individuals	- Reduced heat-related mortality and illness - Reduced air-pollution-related mortality by filtering air
7	Increase planting trees Increasing the canopy cover may also reduce air temperature by 1–3° C. Green roofs, or plantings on roofs, may also decrease building energy use. Increasing albedo and vegetation may also reduce ground level ozone and lower energy costs associated with air conditioning use	- Reduced air-pollution and air-polluted related illnesses - Reduced air temperature by 1–3° C - Reduced heat-related mortality and illness - Decreased urban heat island effect
8	Developing good public transportation: Expand the network of buses and stations by increasing the number of working buses, shortening the time interval between buses.	- Reduced excess morbidity and mortality
9	Developing Real-time Surveillance, Evaluation and Monitoring System: Preparation and printing of Surveillance Guideline and reporting forms for health effects of heat waves e.g. heat stroke, heat rash, heat exhaustion	- Decreased number of heat related illnesses - Better monitoring of heat-related illnesses

Table 4 Activities, steps and cost of implementing adaptation measure

Activity	Steps Needed	Volume of Work Needed	Estimated Cost (JD)
Building capacity for health care workers - Training courses	<ul style="list-style-type: none"> - Preparing training materials - Training equipments and facilities 	<ul style="list-style-type: none"> - 10 training courses each for 2 days yearly - 3 preparatory meetings 	20000 5000
Preparing and printing National Guidelines on management of health effects of heat waves	<ul style="list-style-type: none"> - Literature review and review of country experiences - Formulating National committee to prepare the guidelines - Printing and distribution of the guidelines 	<ul style="list-style-type: none"> - Meetings - Production of the national guidelines 	5000
Develop Heat Waves Warning System	<ul style="list-style-type: none"> - No equipment needed - Training of service providers - Meeting to develop communication plan 	<ul style="list-style-type: none"> - 2 Training courses for service providers from MD and MOH 	5000 3500
Preparing Emergency Rooms in public hospitals (air-conditions other suitable equipment for heat waves)	<ul style="list-style-type: none"> - Conducting situation analysis of the emergency rooms in public hospitals - Procurement of 60 split AC - Distribution of AC to public hospitals 	<ul style="list-style-type: none"> - 60 split air conditioner units (AC) 	48000
Health education for vulnerable groups (campaigns)	<ul style="list-style-type: none"> - Mapping of vulnerable groups - Design, prepare and distribute leaflets - Preparing educational materials 	<ul style="list-style-type: none"> - 5 Campaigns in different sites yearly 	15000 10000
Improve housing design to adapt to heat waves	<ul style="list-style-type: none"> - Meeting with authorized bodies to advocate for endorsing greener building codes 	<ul style="list-style-type: none"> - One Meeting 	500
Increase planting trees	<ul style="list-style-type: none"> - Campaign to increase awareness about planting trees 	<ul style="list-style-type: none"> - 3 campaigns – across Jordan 	4500
Strengthening tele-communication system before and during heat waves	<ul style="list-style-type: none"> - Facilitate free call center and train persons to reply 	<ul style="list-style-type: none"> - One free call center - One person 	2500 1500
Real time surveillance , evaluation , monitoring system during May-Sept.	<ul style="list-style-type: none"> - Prepare and print Guidelines, report forms - Procure computers and equipment - Train all concerned on surveillance system: - Data gathering of the number of deaths according to sex and age - Daily monitoring of the number of calls to the emergency medical services and hotline - Relevant meteorological data 	<ul style="list-style-type: none"> - Surveillance system developed 	15000
Total Cost (JD)			140,500

Needed Resources

The most common barriers to the efficient implementation of heat waves prevention and adaptation activities are the lack of funding and expertise in certain fields. Thus, there is a need to allocate resources for the following:

- Building capacity of Emergency Room Physicians and health care workers:
 - Training courses- Preparing training material
 - Training equipments and facilities
 - Preparation and printing guidelines for management of health effects of heat waves for Physicians and Nurses
- Preparing and printing National Guidelines on management of health effects of heat waves:
 - Prepare and equip emergency rooms in hospitals with air-conditioning units
 - Equip hospitals with extra number of ambulances
- Develop Real-time Surveillance, Evaluation and Monitoring System:
 - Preparation and printing of Surveillance Guidelines and reporting forms for health effects of heat waves e.g. heat stroke, heat rash, heat exhaustion
 - Preparation and printing of health education materials for the public
 - Conduct educational campaigns on heat –related illnesses
 - Procurement of computers and related equipment
 - Training of all concerned staff on surveillance system
- Develop Mapping of vulnerable populations to visualize risk to certain populations within a community, both potential exposure to heat, as indicated by land cover and air conditioning availability, and potential individual susceptibilities, as indicated by age and chronic health conditions.
- Develop effective public transportation:
 - Expand the network of buses and stations by increasing the number of working buses, shortening the time interval between buses.
- Develop and improve Heat Waves Warning system:
 - Training courses for service providers from the MD, MOH, Civil Defense Directorate, Media, and other relevant sectors.
- Improve infrastructure:
 - Preparing Emergency Rooms in public hospitals (air-conditioning units, other suitable equipment for heat waves)
 - Equip hospitals with extra number of ambulances.
- Develop and implement health education for vulnerable groups (campaigns):
 - Campaigns in different sites yearly
 - Preparing educational materials
 - Strengthening telecommunication system before and during heat waves
- Develop heat-related health information materials:
 - Preparation and printing of health education materials for people
 - Preparing and broadcasting health information through different media
 - Carry out education campaigns regarding heat–related illnesses

See Chapter 8 for detailed Climate Change Adaptation Strategy and Action Plans to Protect Health.

Heat Wave Early Warning System

It is obvious that extreme weather events such as droughts, hurricanes, and heat waves are increasing in frequency and intensity. Negative health effects of exposure to heat waves includes cramps, fainting, heat exhaustion, heatstroke, dehydration, disease exacerbations, combined effect of medications on thermoregulation and ultimately mortality.

After several devastating heat wave events in many countries such as in Europe 2003, many of those countries highlighted the need to develop plans to effectively cope with heat waves with response plans are an approach to reducing the human health consequences of heat waves.

Meteorological data on temperature and heat waves from all the meteorological station distributed all over Jordan indicates that there is increasing trend in the number of heat waves in all regions (Jordan valley, Mountainous Region, North and Eastern desert region) during the period 1980-2010. From the analysis of the mean maximum and minimum temperatures over the last thirty-year, there is a marked trend towards annual increase, as well as during the summer period.

All available evidences and scenarios based on results of the study implemented to asses of heat waves in the future 2005-2050, indicated that an increase in temperature is around 2°C by the year 2050. Taking into consideration that there are no existing or planned programs and activities to cope with the prevention of the health effects of heat waves, heat waves will become more common and severe, especially in urban areas, with increased mortality among elderly people, infants, and those in ill health, because of direct or indirect effects.

The whole of Jordan will be under the effect of climate changes/ heat waves. The trend decadal averages of the number of heat waves showed similarity to the long-term trend of the period 1981-2010 and that no significant change between the results in the analysis of heat waves for the whole country and the analysis by station for the same period exists.

Efforts should be concentrated towards the preventive and curative measures to minimize the risks and dangerous health impacts of heat waves on the Jordanian population.

Based on these facts, the development of Heat Wave Early Warning Systems (HHWS) or (HEWS) is considered an important risk reduction approach to reduce the adverse health consequences of heat waves. In addition, it provides information and knowledge, regarding possible health outcomes, triggering effective and timely response activities, targeting vulnerable populations, notification of heat wave events, communication of prevention responses and evaluation and revision of systems.

The heat-health warning system (HHWS) (ALERT system for heat waves) is a tool for promptly informing all the participants in the system of upcoming heat waves, so that they may implement the appropriate measures and activities immediately. This system uses the weather forecast to predict situations that could lead to an increase in mortality and morbidity because of heat waves.

Objectives of HHWS

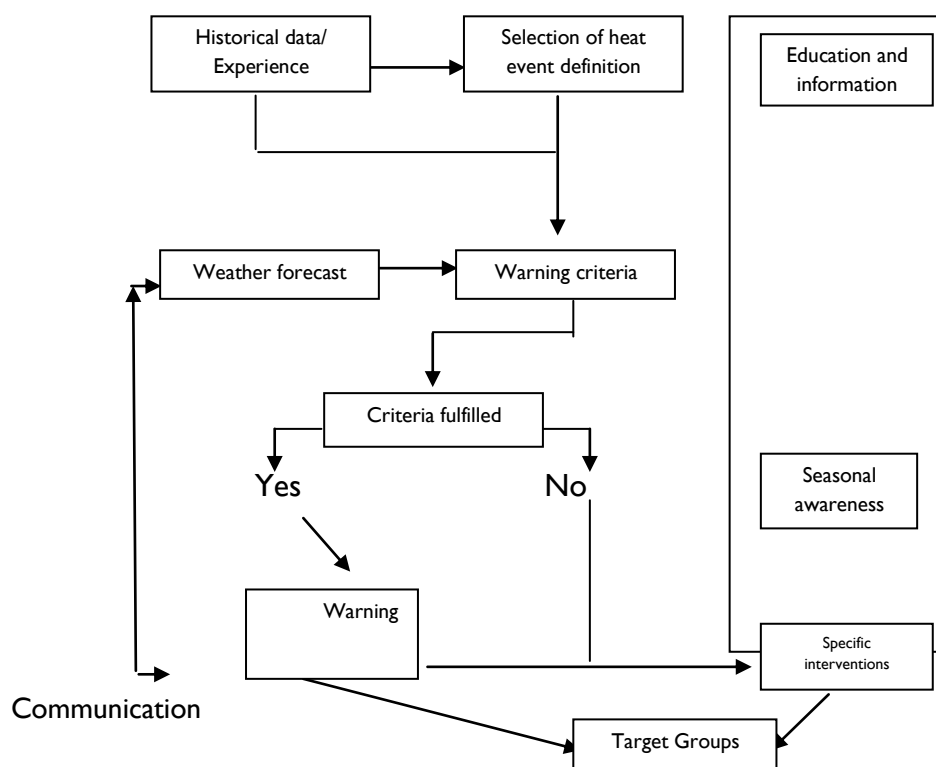
- To maximize the number of people who take appropriate and timely actions for the safety of their lives and protection of property.
- To alert decision makers and the general public of imminent dangerous hot weather
- To serve as a source of advice on how to avoid negative health outcomes associated with hot weather extremes. (WHO/WMO/UNEP, 1996)

Structure of HHWS

Operation of HHWS

Figure 15 demonstrate the development and operation of HHWS. It begins with the establishment of certain thresholds of human health tolerance to the extreme weather. If these thresholds are exceeded, this will trigger the issuance of a warning or alert. The MOH in collaboration with the MD is responsible for warning the community on imminent heat waves. Forecasts issued by the MD are used as the primary input into the HHWS. If the expected negative impact of the heat wave is above a predefined level, or if a situation is identified that has been associated with negative health outcomes, the MOH and MD issue a warning or alert, as the thresholds are determined beyond which expected human health problems increase. Beyond that point, information is disseminated to various stakeholders so action can be taken.

Figure 15 The operation of HHWS



Source: *heat waves and health: guidance on warning system development*. World Meteorological Organization and the World Health Organization.

The main steps are:

- Accurate weather forecasting,
- Dissemination of the watch/warning,
- Identification of vulnerable population groups,
- Interaction with stakeholders,
- Communication of prevention responses, evaluation, and revision of systems.

The following points are very important in developing the HHWS:

- The system should consider local meteorology, demographics, and urban structure ^{67,68}
- The system should be developed in collaboration with all relevant stakeholders to ensure that the issues of greatest concern are identified and addressed.

- The systems should be based upon thresholds that are related to actual heat/health outcomes. HHWS trigger mechanisms should be geared to the point when human health actually deteriorates. This threshold varies greatly from place to place and depends upon the scope of the system.
- The HHWS nomenclature should be clearly understood by the public, local stakeholders, and decision makers.
- The system should be paired with a quality notification and response program.
- The system should be evaluated to determine its effectiveness. The evaluations need to incorporate the effectiveness of mitigation activities, as well as the appropriateness of the warning determinant itself.
- Warnings start with the detection of a hazard and end with getting the people out of harm's way.
- An integrated warning system for weather-related hazards includes: Observing networks, Prediction systems, Mechanisms for dissemination and communication with end users.
- Establishment of Climate Change Unit within the MOH to deal with the implementation of the activities of (HHWS). Suggested site is in the Primary Health Care Administration (PHC).
- Establishment of Steering Committee, consisting of MD, MoEnv, MOT, MoEdu, Universities, RMS, Private hospitals and clinics, UNRWA, Crisis Management Centre; Municipalities; CDD, Jordanian Electrical Company; Media; Non-governmental sector.
- Sentinel sites for HHWS reporting: Seven hospitals will be included in the HHWS in Jordan representing the country for reporting mortality data, one hospital from the northern, southern, and middle regions; one university hospital; one military hospital; two private hospitals

Determining thresholds of HHWS

Mortality data, unlike all other information on morbidity, is the most regularly collected and standardized; Unlike hospital admissions (which can vary in reporting based on severity and may depend on the health system), it is binary in nature, and is available for the longest period. In Jordan, there is scarce data on the relation between temperatures and admission or mortality data. On the other hand, the civil registry for registration of deaths and the deaths reported and registered by hospitals are available.

The temperature threshold, which will be used, is the threshold of temperature and heat waves, which has been defined and determined by the MD as follows: *when the temperature exceeds its normal "long-term average" by 5°C or more for a period of 3 consecutive days.*

Regions and populations included in (HHWS)

All regions of Jordan will be included in the HHWS, and the whole population of Jordan with specific attention directed towards the vulnerable groups defined earlier.

Data handling

Surveillance for notification to provide information on mortality data on regular daily basis from the sentinel hospitals and the Civil Status Department will be handled by a telephone service, fax, or electronically to the Central Climate Change Unit at the MOH. Analysis of data and interpretation on weekly basis by surveillance unit will be passed to steering committee.

HHWS Indicators

Analysis of data on daily deaths and daily temperatures in Amman city and the dates of heat waves during 2010 show there is increase in deaths in both January and December 2010 (winter months)

and during summer months as shown Figures 16 and 17. The green lines show that there is apparent increase in deaths during the heat wave days 1-3 and 16-18 August and 1-3, 14-20 October, which could be due to the effects of heat waves.

Figure 18 shows the relation between temperature and deaths plotted as scattered graph indicating increase in deaths during heat wave periods and increase in deaths during low temperature.

A plot of threshold of daily temperature is needed, as it is a good indicator for rise in temperature, as well as daily deaths by civil registration.

Figure 16 Relation between temperature, heat waves events, and mortality for the year 2010

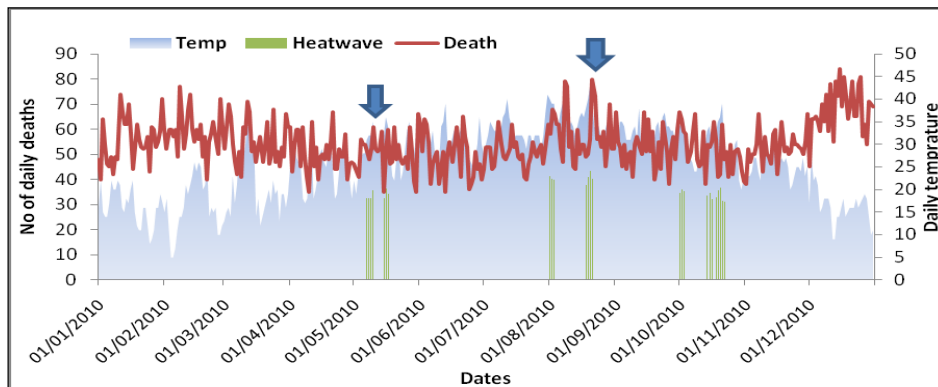


Figure 17 Distribution of deaths during heat waves in July-Oct 2010

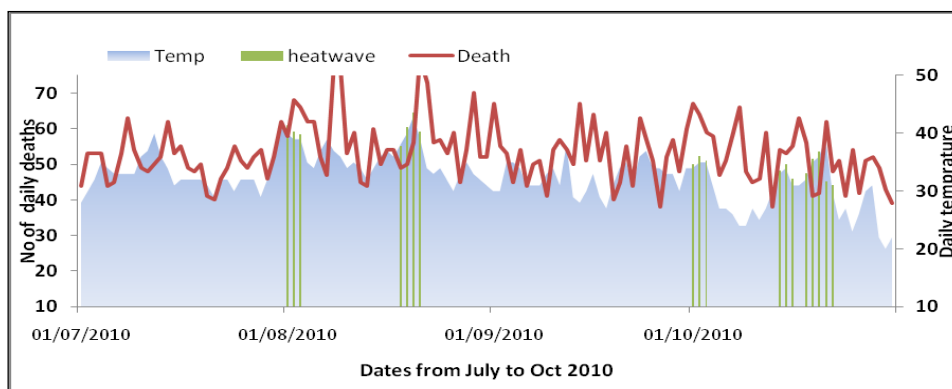
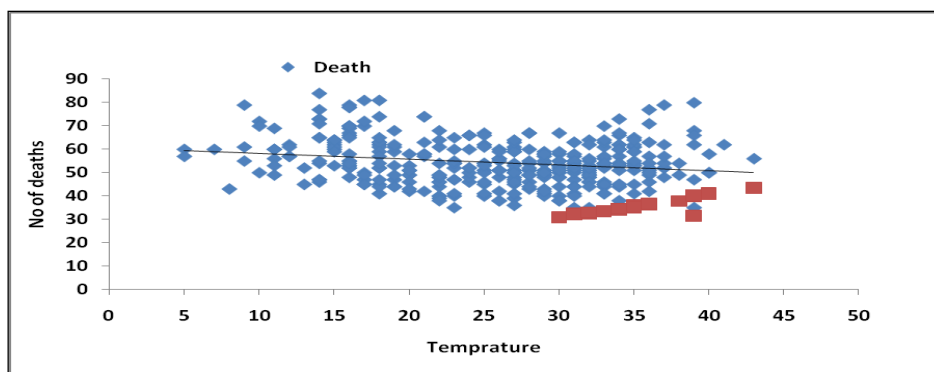


Figure 18 Relation between temperature and mortality in Amman 2010



Periodicity of Reporting

The HHWS will be active between May and October and dormant throughout the rest of the year. However, the active period may need to be reassessed with time, as climate change may create less predictable seasonal effects.

The need to warn

The public expects to be warned of any natural phenomenon that endangers life and property. In the case of excess heat, communicating the risks of hot weather and heat waves, and what to do, are recommended elements of a summer and heat wave prevention strategy. Warning in proper time allows proper action to be taken, depending on the type and severity of the warning. Weather warnings concerning heat incorporate a high degree of urgency and severity of expected conditions.

Content of a warning

The actual content of a warning message that is delivered to members of the public is of critical importance in guiding what people think and in leading them to take appropriate action to protect themselves from the hazard. The warnings must be clear, simple, uses plain language, personalized (targeted) and describes the actions required, and includes a statement of recommended action. Warnings must be disseminated rapidly to the public and responsible stakeholders, or the effectiveness of the HHWS is greatly diminished (WMO, 1999).

Phases of HHWS

The Euro HEAT, 2007 Phases have been adopted, as shown in Tables below:

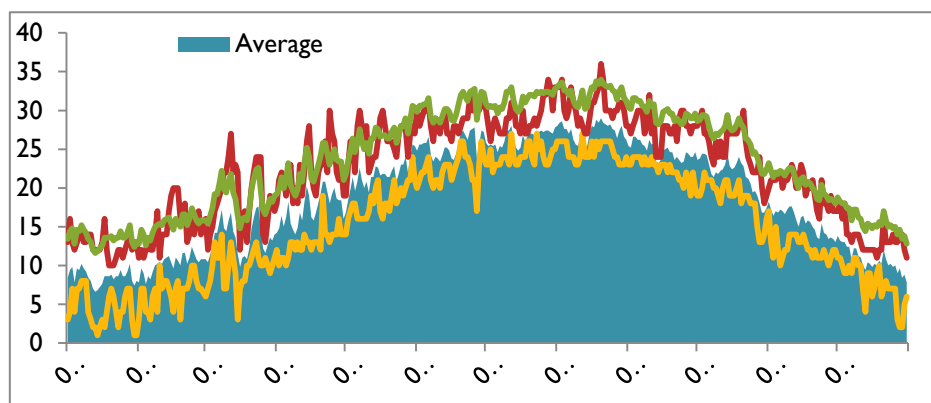
PHASE 0- GREEN- VIGILANCE: In this phase, temperatures are within the safe limits. This phase is activated from 1 May each year with preparedness of the institutions responsible for implementing the recommendations and measures for heat-wave response. The heat-wave warning system is active.

PHASE 1- YELLOW- ALERT/ PREPAREDNESS: This phase becomes active after the threshold for emergency and dangerous temperatures exceed 25.6 °C.

PHASE 2- ORANGE- HEAT WAVES: This phase becomes active after the threshold for emergency temperature exceeds the maximum temperature 28°C.

PHASE 3 – RED- EMERGENCIES: This phase becomes active after the threshold for heat waves temperatures exceeds 35.6°C for each day from May to October in Amman city (Figure 19).

Figure 19 Maximum, minimum, average temperature and heat waves (average temperature +5) during Jan-Dec (2006-2010)



Actions By Phase		
Phase	Actions	Responsible institutions
PREPARATORY PERIOD 01.04 – 30.04	Action no 1: Checking the functionality of the web site of MOH ,www.moh.gov.jo	<ul style="list-style-type: none"> • MOH • PHC • Heat waves and climate unit in NCD
	Action no 2: Printing educational material aimed at the general population, vulnerable groups, GPs, family doctors, managers of health and social institutions.	<ul style="list-style-type: none"> • MOH • PHC • Heat waves and climate unit in NCD
	Action no 3: Development of plan for distribution of the educational materials aimed at the general population, vulnerable groups , GPs, family doctors, managers of health and social institutions and workers	<ul style="list-style-type: none"> • MOH steering committee for Monitoring Heat-health Consequences
	Action no 4: a) Preparation of letters to all public and private health institutions, educational institutions and geriatric institutions, setting out actions that need to be taken during hot weather to guarantee adequate support for elderly and vulnerable people b) Preparation of letter for general practitioners in hospitals and clinics regarding the measures and activities they need to take to reduce their patients' heat risks c) Preparation of letter for the emergency departments and emergency telephone responsible unit , regarding measures that will be implemented so that they can activate their control mechanisms d) Preparation of letter for the Emergency Medical Services to start the process of collecting information on the number of telephone calls and deaths on a daily basis, checking their internet connections and making technical preparations for the forthcoming summer Action no 5: Sending information to the Amman municipality and other municipalities all over the country for putting public fountains and springs into operation. Action no 6: Defining and confirming methods of getting in contact with the most vulnerable populations. Planning for a proactive approach for elderly people, the local authorities and the Centers for Social Care	<ul style="list-style-type: none"> • MoH steering committee for Monitoring Heat-health Consequences • Civil defense • MOH steering committee for Monitoring Heat-health Consequences • MOH steering committee for Monitoring Heat-health Consequences.

PHASE	ACTIONS	RESPONSIBLE INSTITUTIONS
<p style="text-align: center;">PHASE 0 GREEN LEVEL - VIGILANCE 01.05 – 30.09 Heat-wave warning system is active. Every time the threshold for green level is exceeded, the responsible institutions receive sms and e-mail.</p>	ACTION NO 1: Activation of the heat-wave warning system (ALERT) by MOH, and the meteorological department .	<ul style="list-style-type: none"> • Meteorological Department • MOH/PHC
	ACTION NO 2: Distribution of educational materials for the general population, GPs , family doctors, managers of health and NGOs sectors	<ul style="list-style-type: none"> • Ministry of Health PHC In cooperation with the, NGOs
	ACTION NO 3: Announcement to the public to inform them about the upcoming activities for protecting health from heat-waves, reminding them of general protection measures as well as the operation of the telephone line emergency call.	<ul style="list-style-type: none"> • MoH steering committee for Monitoring Heat-health Consequences
	ACTION NO 4: Information on the protection of health from heat waves made available on the web sites of the responsible institutions, to remind and raise awareness of the necessary measures.	<ul style="list-style-type: none"> • Ministry of Health • PHC Centers for Public Health • NGOs Local Authorities • Media
	ACTION NO 5: During the period May–October, initiate the process of: a) Data gathering of the number of deaths according to sex and age b) Daily monitoring of the number of calls to the emergency medical services according to syndromes c) Relevant meteorological data	<ul style="list-style-type: none"> • PHC Emergency medical services • Meteorological Department • Centre for Crisis Management
	ACTION NO 6: Delivery of the letters prepared in the preparatory phase (around 15 May each year): a) Delivery of letters to all public and private health institutions, educational institutions, and geriatric institutions setting out actions that need to be taken during hot weather to guarantee adequate support for elderly and vulnerable people b) Delivery of letters to general practitioners regarding the measures and activities they need to take to reduce their patients' heat risks c) Delivery of letters to the occupational health services and the occupational health inspectorate regarding measures to safeguard workers' health d) Delivery of letter to the State Sanitary and Health Inspectorate regarding measures that will be implemented so that they can activate their control mechanisms e) Delivery of letters to the Emergency Medical Services to start the process of collecting information on the number of telephone calls on a daily basis, checking their internet connections and making technical preparations for the forthcoming summer	<ul style="list-style-type: none"> • Ministry of Health PHC In cooperation with the Ministry of Labor and Social Policy and ten Regional climate unit

PHASE	ACTIONS	RESPONSIBLE INSTITUTIONS
<p>PHASE I YELLOW LEVEL - ALERT/PREPAREDNESS 15.06 – 31.08 This phase is active when the temperature thresholds for yellow level are exceeded</p>	<p>ACTION NO 1: Announce recommendations to the public via the media, with special focus on the most vulnerable groups</p>	<p>At National Level:</p> <ul style="list-style-type: none"> • Ministry of Health/ steering committee for Monitoring Heat-health Consequences <p>At Local Level:</p> <ul style="list-style-type: none"> • Health directorate
	<p>ACTION NO 2: Warrant for activating general and specific measures delivered to the health, educational and social institutions to reduce the risks from the prolonged heat for the most vulnerable population groups</p>	<ul style="list-style-type: none"> • Ministry of Health/PHC • Ministry of Labor
	<p>ACTION NO 3: Proactive approach intended for lonely elderly people, socially isolated and homeless people, with home visits with support of the Red Cross and the social care centers, in accordance with the planning in the preparatory phase</p>	<ul style="list-style-type: none"> • NGOs • Local Authorities • Social Policy
	<p>ACTION NO 4: Telephone information SOS line that will provide information and advice to the public brought into operation</p>	<ul style="list-style-type: none"> • NGOs

PHASE	ACTIONS	RESPONSIBLE INSTITUTIONS
<p>PHASE 2 Orange - VIGILANCE 01.05 – 30.10 Heat-wave warning system is active. Every time the threshold for orange level is exceeded, the responsible institutions receive sms and e-mail.</p>	ACTION NO 1: Constant announcements through the public media regarding the alert level	<ul style="list-style-type: none"> • Ministry of Health/ steering committee for Monitoring Heat-health Consequences • Meteorological Department At local Level: <ul style="list-style-type: none"> • Centres for Public Health
	ACTION NO 2: Implementation of the specific action plans for times of crisis for health institutions, by MINISTRY OF HEALTH , and educational institutions	<ul style="list-style-type: none"> • Ministry of Health/ PHC • Ministry of Labour • Ministry of Education • Crisis Management Centre
	ACTION NO 4: Activating protection measures for vulnerable populations, in accordance with the planning in the preparatory phase	<ul style="list-style-type: none"> • NGOs • Local Authorities • Ministry of Labor • PHC
	ACTION NO 5: Recommendation for use of public centres with air-conditioned premises by the most vulnerable groups.	<ul style="list-style-type: none"> • Ministry of Health • Ministry of Labor
	ACTION NO 6: Extending operational hours of telephone information line, to provide continuous information and counseling to citizens.	<ul style="list-style-type: none"> • NGOs
	Action No 7: Distribution of drinking water in busy public places	<ul style="list-style-type: none"> • NGOs
	ACTION NO 8: Proposing additional measures for consideration by the Government in terms of working hours, for certain sectors where the production process is not affected on the context of people’s health, including releasing the most vulnerable population groups from work responsibilities (pregnant women, people over 60, etc.). These measures will be considered separately and specifically for those areas with dangerous and catastrophic heat waves.	<ul style="list-style-type: none"> • Ministry of Health • Government

PHASE	ACTIONS	RESPONSIBLE INSTITUTIONS
PHASE 3 Red LEVEL - VIGILANCE 01.05 – 30.10 Heat-wave warning system is active. Every time the threshold for red level is exceeded, the responsible institutions receive sms and e-mail.	ACTION NO 1: Constant announcements and press conferences for the heat-wave state of emergency	<ul style="list-style-type: none"> • Ministry of Health • Meteorological Department
	ACTION NO 2: Implementation of the specific action plans for times of crisis for health institutions, by public institutions, retirement homes and educational institutions	<ul style="list-style-type: none"> • Ministry of Health • Ministry of Labor • Ministry of Education • Crisis Management Centre • PHC
	ACTION NO 3: Intensifying advice on protection measures for workers who are occupationally exposed to heat (i.e. construction workers, public transport, workers, farmers, etc), if necessary, in consultation with governmental bodies, stopping the working process during this phase	<ul style="list-style-type: none"> • Ministry of Health • Crisis Management Centre • Ministry of Labor Occupational Health department
	ACTION NO 4: Intensifying the measures for protection of vulnerable populations, in accordance with the planning in the preparatory phase	<ul style="list-style-type: none"> • Ministry of Labor
	ACTION NO 5: Relocating, in residential centers and institutions, the most vulnerable groups in air-conditioned rooms	<ul style="list-style-type: none"> • Ministry of Health • Ministry of Labor
	ACTION NO 6: Operating the information telephone line 24 hours a day to provide information and advice to the public	<ul style="list-style-type: none"> • NGOs
	Action No 7: Proposing additional measures for consideration by the Government in terms of working hours, for certain sectors where the production process is not affected in the context of people's health, including releasing the most vulnerable population groups from work responsibilities (pregnant women, people over 60, etc.). These measures will be considered separately and specifically for those areas with dangerous and catastrophic heat-waves	<ul style="list-style-type: none"> • Ministry of Health • Occupational Health Department
	ACTION NO 8: Procedure for declaring a state of emergency	<ul style="list-style-type: none"> • MOH

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CHAPTER 7 CLIMATE CHANGE AND OCCUPATIONAL HEALTH

Introduction

Climate change is happening due to the increase in emission and accumulation of greenhouse gases. Therefore, warmer climate is expected. The impact of climate change on several climate-sensitive issues has been studied and researched extensively. Yet, the impact of climate change on the health of workers and occupational health has been neglected. Very few references and studies cover this climate-sensitive issue.

One reason for not giving enough attention to the impacts of climate change on occupational health is that this is considered mostly a problem in low and middle-income tropical countries, where air conditioning is not widely available in the workplace (Tord Kjellstrom et al., *Global Health Action*, 2009).

Occupational safety and health (OSH) is a cross-disciplinary area concerned with protecting the safety, health and welfare of workers in all occupations. The goal of occupational safety and health programs is to foster a safe and healthy work environment and maintain the well-being of workers. In addition, OSH leads to reducing medical care, sick leaves, and disability benefit costs.

Occupational health focuses on the identification and control of the risks arising from physical, chemical, and other workplace hazards. These hazards may include chemical agents, such as toxic or carcinogenic substances; physical agents such as heat, loud noise, or vibration; and physical hazards such as electricity or dangerous machinery.

The temperature increases during the hot season, as well as the increase in the occurrence of heat waves can have a health toll on the population, in general, and the workers, in particular. Weather data obtained from the MD and climate change scenarios presented in the SNC predict increases in maximum temperatures and the frequency and intensity of extreme heat events in the future.

Climate Change and Occupational Health

The reviewed literature concludes that there are potential occupational health risks and that the productivity of the workers will be reduced as a result of exposure to increased heat due to climate change, unless effective adaptation measures are taken. The increased exposure to heat will create unhealthy working environments for workers, which is expected to have an impact on economic conditions.

The average temperatures and heat exposures are increasing due to climate change in most parts of the world (1). This demonstrates the need to know and understand the direct and indirect impacts of climate change on health.

If the body temperature exceeds 38°C over several hours, heat exhaustion and reduced productivity occur. If the air temperature exceeds 35°C, then the human body maintains the core temperature by sweating and evaporation, which are influenced by humidity, wind speed, and clothing. (2)

A study conducted in Central America (Kjellstorm & Crowe, 2011, 270-280), which is a tropical region with generally hot/humid weather, concluded that workers are at particular risk of heat stress because

of the intra-body metabolism and production of heat. Many direct and indirect health effects of climate change have been reported or predicted.

An analysis for the WHO concluded that an excess mortality due to climate change (1990–2000) already occurred as a result of acute effects of heat and weather extremes (heat waves, storms, floods, and droughts). The health effects included cardiovascular diseases, injuries, drowning, malnutrition, infectious diseases, and vector-borne diseases (1). The effects on heat stress (conditions under which the body is unable to cool itself sufficiently) can result in a range of outcomes. It may first be experienced as discomfort and sweating, which is common to people working or exercising and may affect performance but does not damage health. If work continues beyond safe exposure limits, workers may experience outcomes including diminished physical work capacity, diminished mental task capacity, increased accident risk, and potentially, death from heat stroke.

Occupational heat exposure is commonly measured by Wet Bulb Globe Temperature (WBGT), which integrates temperature, humidity, wind speed, and heat radiation (often from the sun). The WBGT threshold limit values for risks to health (and reduced productivity) is 28°C. The International Standards Organization recommends 26°C (ISO Standard 7243. Geneva: International Standards Organization, 1989).

To protect workers from excessive heat, WBGT is used to illustrate the proportion of a working hour during which a worker can sustain work and the proportion of that same working hour that (s)he needs to rest to cool the body down and maintain core body temperature below 38° C. Using this proportion, a “work capacity” estimate is calculated for selected heat exposure levels and work intensity levels. Studies have shown that work capacity rapidly reduces as the WBGT exceeds 26-30°C and this can be used to estimate the impact of increasing heat exposure as a result of climate change in tropical countries. (5)

Kjellstrom et al (2009) presented the WBGT levels that require no hourly rest, or rest to the extent of 25, 50, and 75% (rest/work ratios) during the working hour, as shown in Table I. (5)

Table9 Reference values for WBGT (C) at different work intensity levels (in Watts=W(, light clothing

Metabolic rate class ^a (work intensity)	0 (rest)	1 (light work)	2 (medium work)	3 (intense work)	4 (very intense work)
Approximate metabolic rate, M (W)	100	200	300	400	500
WBGT reference values ^b (°C)	33	30	28	25	23

^aThe metabolic rate classes are: 0 =resting, M < 117 W; 1 =light work, 117 < M < 234 W; 2 =sustained medium level work, 234 < M < 360 W; 3 =intense work, 360 < M < 468 W; 4 =very intense work, M > 468 W.

^bThe ISO standard (18) says: ‘If these values are exceeded, it is necessary either to reduce the direct heat stress at the workplace, or to carry out a detailed analysis of exposure and prevention.’... ‘These values represent the mean effect’, so short peak exposures may be acceptable. However, the values are set to avoid over-heating (>38°C) in ‘almost all individuals’. Thus, some people would be more sensitive and risk over-heating.

Note: Based on recommendations from the United States National Institute of Occupational Safety and Health (NIOSH) (16) and the International Standards Organization (ISO) (18), if the worker uses heavier clothing or protective clothing, these values need to be reduced, see ISO (18).

Two methods were used in the abovementioned study conducted in Central America (Kjellstrom & Crowe, 2011, 270-280), namely, a brief review of the available literature on the effects of occupational heat stress with a focus on Central America, and an analysis of occupational heat exposure based on weather station data. The study concluded that workers who work outdoors are exposed to solar radiation, particularly in agriculture, construction, professional or domestic services (such as gardening), land transport, mining, garbage collection, and fishing sectors.

The International Labor Organization (ILO) has identified heat exposure as an occupational health threat in sectors, such as rice and sugarcane production in Central America. In Nicaragua, one intervention study on hydration (1) for sugar harvesters has been published, reporting that hydration programs improved productivity. In Costa Rica, some of the road-repair workers, particularly those working in the northern region, were at risk of excess water loss due to a high sweat rate.

Additionally, researchers found significant differences between the heat stress index WBGT measure at the abdominal level and ankle level for asphalt workers due to heat radiation from asphalt (1). Chronic renal diseases are prevalent among the farmers in El Salvador (12.5%); also in Nicaragua, the same health problem is encountered due to decreased hydration. Above the threshold of 26°C, the increasing need for rest period can be approximated by straight line. The study concluded that the eventual increased risk would depend on the preventive measures that will be implemented (1).

The design of a study conducted in New Zealand by Tord Kjellstrom et al. included a brief review of basic thermal physiology mechanisms, occupational heat exposure guidelines and heat exposure changes in selected cities. In countries with very hot seasons, workers are already affected by working environments hotter than physiological mechanisms can cope. The study concluded that climate change reduced the working capacity in heat-exposed jobs and that it would be difficult to achieve economic and social development in countries if the impact of climate change remains neglected. (5)

Benjawan Tawatsupa et al carried out a national cohort study on 40,913 Thai workers in 2010. The study began with 20-page questionnaire covering the socio-demography of fulltime workers. Overall, 56% were females. More than half the cohort was young, aged between 15 and 29 years (52%). Nearly 20% of the workplaces were located in Bangkok, 41% were in other urban areas (outside Bangkok), and 39% were in rural areas; 19% of classifiable jobs were physical and 81% were based in an office. Compared with males, females were younger, worked in Bangkok (22 vs. 17%). The prevalence of heat stress varied considerably among subgroups, and were notably high for those with other complaints regarding hazards at work. Nearly 5% of workers reported poor overall health; this figure rose to 9% for those reporting often being troubled by three to five other work hazards. Psychological distress was more common; overall, it affected 8% of workers and was reported by 20% of those with three to five other work hazards. In almost all instances, the potential confounders shown in (sex, age group, education, income, job type, job location, and other work hazard complaints) were significantly associated with both the exposure of interest (heat stress) and the two outcomes (overall health and psychological distress).

The study examined the effect of heat stress on overall health and psychological distress. It revealed a positive association between heat stress and poor health or psychological distress stratified by age group and sex. This analysis was restricted to the 24,907 workers who did not complain of multiple work hazards and whose job types were known. In addition, it indicated that the association between overall health, psychological distress, and occupational heat stress are substantial, revealing no consistent pattern with age. Generally, the adverse effects of heat stress on poor health were worse for females; the opposite association was noted for heat stress and psychological distress, which was especially bad for males aged between 15 and 29 years. The heat stress effects are increased for workers aged more than 45 and educated and for work located in rural areas. (3)

Kalpana Balarishna et al carried out a case study in India in different industrial sectors by the same investigators concerning heat stress related perception. The companies that were selected for the assessment were those working in automobile assembly, automobile parts manufacturing, heavy truck manufacturing, heavy vehicle (lorry) manufacturing, automobile parts (wheels), leather, glass

manufacturing, textiles, fertilizers, and electricity (power) generation. The results indicated that the existing level of controls may not be sufficient for managing work-related heat stress in any of the sectors studied, with wide variations in perceived risks.(4)

A cross-sectional study carried out in Thailand included four sites, namely, pottery industry, power plant, knife industry, and construction site, as well as one agricultural site. Among the five workplaces, the outdoor WBGT was found to be highest at 34.68°C during 12:00 and 1:00 PM at the agricultural site. It was found that four out of five study sites had heat indices in the 'extreme caution,' where heat cramp and exhaustion may be possible and one site showed a value of 41°C that falls into the category of 'danger,' where sunstroke and heat exhaustion are likely and prolonged exposure may lead to heatstroke. Productivity as perceived by the workers revealed that only the construction and pottery industry workers had a loss of productivity ranged from 10 to 60 %. Climate conditions in Thailand potentially affect both the health and productivity in occupational settings. The management of heat stress at the work place requires efforts from all stakeholders, the employer, and the government. The relevant governmental office mentioned that there is lack of awareness with regard to policy concerning maximum heat exposure at work. Moreover, the impact of heat on workers' health has not been considered as a priority issue. (6)

In a study conducted by Olivia M. et al. about climate change impacts on working people, the maps show the WBGT within selected hot regions of the world during the three hottest months in 1975 and 2000: Australia, South Asia, Southern Africa, Central America, and southern US. (7)

Between 1975 and 2000, a WBGT increase of 0.5-1.8°C was common and the maps show clear decreases in some places. The time trends fit with the development of global climate change. The high WBGT values (particularly in South Asia) already cause excessive occupational heat exposures during the three hottest months. The maps identify areas where occupational heat stress in non-cooled workplaces will be extreme. The mapping method provides a rapid visual impression of occupational heat exposures in large regions of the world. The local changes in WBGT between 1975 and 2000 fit with the global climate change trends. Future increases of WBGT may create extreme heat exposure situations in large areas of the world (7).

Heat exposure in the working environment is an often overlooked but important part of occupational health. It can cause several potential negative health outcomes such as death from heat stroke, damage to major organs, and physiological functions. (7) Impacts on health and productivity at an individual level have been studied and published by physiologists and ergonomists for decades. In high income countries in temperate parts of the world, the focus on heat and health research has been on clinical health effects during 'heat waves' as it is assumed that most of the year the temperatures are not hot enough to cause heat-related health effects. However, in tropical and hot parts of subtropical countries heat stress is occurring during large parts of each year (in some places almost every day), and cultural practices (e.g. siesta, reduced work intensity, large hats) have provided effective ways to adapt to the hot environment.

In South Africa gold mines, more than 200,000 underground miners worked in extreme hot and humid conditions. About 3.3 deaths/year/1000 miners occur due to fatal heat stroke when WBGT exceeds 34°C; 0.7 deaths/year/1000/miners occur when WBGT was between 31- 33° C. Acclimatization to heat before going underground reduced the risk (2).

Agricultural workers in El Salvador and Nicaragua cutting sugar cane have a high rate of kidney diseases due to daily dehydration (2). In south India, assembly workers in car and truck factories need heat

protection due to rise in temperature such as increasing the rest hours, which, accordingly reduces the productivity (2). The increasing need for rest at higher heat exposure would reduce workers' productivity and well-being incurring loss of income and experience of exhaustion. If the rest period is not taken into account, serious health issues will developed.

Angela Mathee et al (9) conducted a qualitative study utilizing focus group discussions in two sites; Johannesburg, which has a temperate climate, and Upington located in the hottest part in South Africa. The range of jobs included gravediggers, street sweepers, road side construction workers, and sewage and sanitary workers. Workers reported a wide range of heat related effects, including sunburns, sleeplessness, irritability, and exhaustion leading to difficulty in maintaining work levels and output during hot weather. The study concluded that workers working in sun-exposed conditions in hot parts of South Africa experience heat-related health effects (9).

The outdoor occupations most at risk of heat fatigue and heatstroke include construction, refining, surface mining, agriculture workers as well as those workers required to wear semi permeable or impermeable protective clothing; personal protective equipment [PPE], gloves, and half-face, powered air-purifying respirators. There also are possible heat implications for indoor workers such as those workers in greenhouses, glass, or rubber manufacturing plants, and for those who work in buildings without air conditioning or proper ventilation systems. (12)

A study was conducted in Tuscany (central Italy) to investigate the relationship between work-related accidents and hot weather conditions. The findings showed that hot weather is a risk factor for work related accidents in Italy during summer, in particular, in early warming days during June. Workers may change their behavior when heat stress increases. The results suggested that days with an average daytime apparent temperature value ranging between 24.8°C and 27.5°C were at highest risk of work related accidents. (11)

To be able characterize the relationship between climate change and occupational health and safety it is useful to develop a framework for identifying the effects of climate change on the workplace, workers, occupational morbidity, mortality, and injury. Schulte & Chun (2009) developed such a framework that includes climatic effects, their interaction with occupational hazards, and their manifestation in the working population based on a review of scientific literature. (12) The review indicates that there is no evidence of unique or previously unknown hazards; though this possibility should not be excluded. It also indicates that climate change may result in increasing the prevalence, distribution, and severity of known occupational hazards.

Schulte & Chun (2009) developed the conceptual framework shown in Figure 1 below. It was derived from two models used by the WHO for assessing the relationship between environmental health and policy actions or interventions, namely, DPSEEA (driving forces, pressures, state of the environment, exposure, health effects, actions) and MEME (multiple exposures-multiple effects).

The framework indicates that other contextual factors, such as population growth, energy policies, and increasing urbanization and deforestation affect the impact of climate change on the health of workers; and that these factors, along with climate change, may lead to an increase in the severity and magnitude of known occupational hazards and the numbers of exposed workers.

The hazards identified by Schulte & Chun (2009) in the contextual framework are categorized in seven categories, namely increased ambient temperature; air pollution; ultraviolet (UV) radiation; extreme weather; expanded vector habitats; industrial transitions and emerging industries; and changes in the built environment. Figure 2 shows the Causality Analysis Framework.

Figure 45 Conceptual framework of the relationship between climate change and occupational safety and health

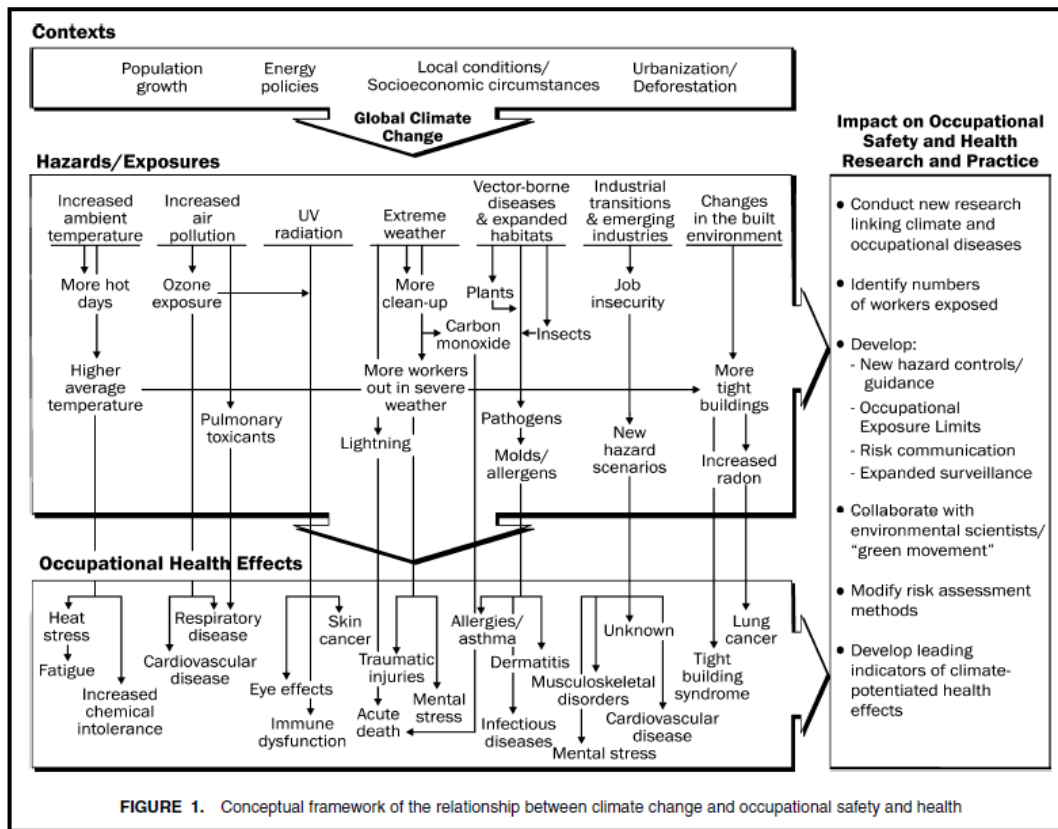
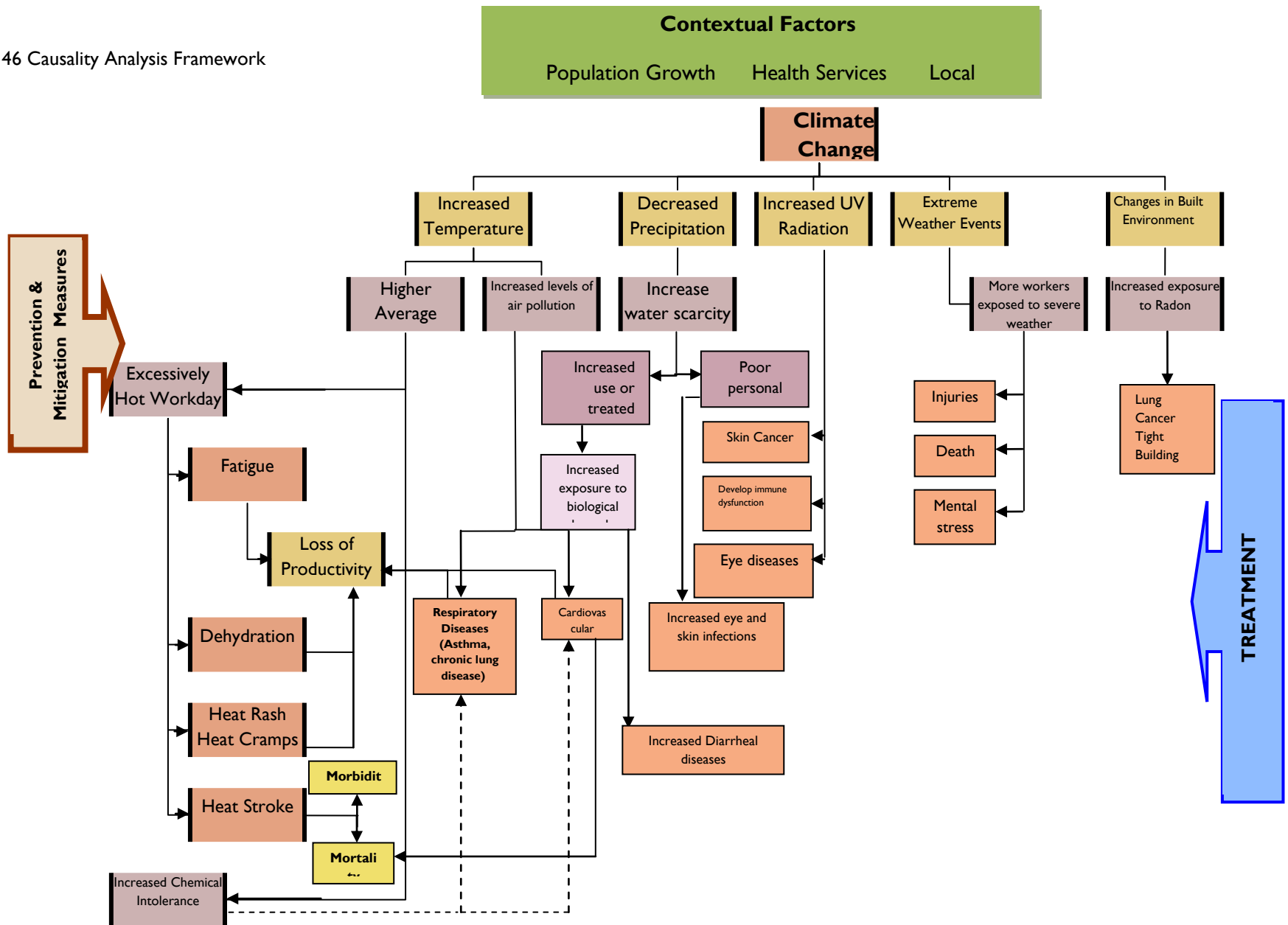


Figure 46 Causality Analysis Framework



Assessment of Current Vulnerability and Preparedness of Occupational Health in Jordan

Current Status and Burden of Occupational Health

Data on work-related accidents and injuries from the SSC, which is the main official source of such data, was reviewed. It covers only 55-60% of the total labor force in Jordan. In addition, the data may not reflect the actual work accidents, as many go unreported by employers to avoid the consequences. Table 2 shows that the highest percentage of work accidents and injuries is encountered in the manufacturing industries (41.1%), followed by the construction sector (12.2%).

Table 10 Number of work accidents by economic activity in 2009

Economic Activity	Percentage of Total (%)	Grand Total
Agriculture, Hunting, Forestry	1.3	216
Mining & Quarrying	1.7	292
Manufacturing	41.1	7088
Electricity, Gas & Water Supply	42	719
Construction	12.2	2112
Wholesale & Retail Trade	11.1	1912
Tourism	7.8	1339
Transport, Storage & Communications	2.5	427
Financial Intermediation	0.9	162
Real Estate & Renting Activities	1.4	235
Public Administration, Defense & Social Security	8.1	1399
Education	2.7	464
Health & Social Work	4.4	765
Community Service Activities	0.6	96
Extra-Territorial Organizations & Bodies	0.2	35
Grand Total	100.0	17261

Source: The Annual Report, 2009, Social Security Corporation. Available at: http://www.ssc.gov.jo/uploads/arabic_ar_2009.pdf

Data indicated that most of the accidents lead to bruises (32.9%) followed by wounds (27.8%). Symptoms that workers may have such as intense thirst, heavy sweating, muscle cramps, anxiety, headache, dizziness, fatigue, nausea, and vomiting, which are symptoms of heat exhaustion, either go unnoticed or are linked to other causes and illnesses, and therefore are not reported as a work-related accident. If untreated, heat exhaustion can lead to heat stroke and death.

The monthly number of work-related accidents could not be obtained. Such data can be useful in analyzing the relationship between the number of accidents and hot weather conditions, as it is a risk factor for work-related accidents. The outcome of the work-related accidents ranged from total recovery to death

Data from the SSC indicate that there is an improvement in the work accident index (*Occupational Health and Safety in Jordan, Jordanian Labor Observatory*). The value of the index fell from 2.5 accidents per thousand workers in 2006, to reach 2.0 accidents per thousand workers in 2010, as shown in Table 3. Yet, the MOL refers to the increase in total accidents and work-related injuries

in 2010 to reach approximately 20000 injured, resulting in 100 deaths and 1500 cases of total disability, costing the national economy around 80 million dinars annually.

Table 3 Work accident index according to data from the Social Security Corporation

Year	2006	2007	2008	2009	2010
No of Social Security Subscribers	662000	724000	788000	825000	880000
No of work accidents	16640	17385	18383	16606	17261
Work Accident Index per 1000 workers	2.5	2.4	2.3	2.0	2.0

The main causes of accidents is falling of persons (28.5%), followed by falling of objects (14.8%), manual working tools (11.6%), and industrial machines and equipment (11.4%). Exposure of workers to high temperatures or heat, e.g. working under the sun for long hours during hot weather, is not listed in the causes of work accidents.

Rapid Vulnerability Assessment

Due to the lack of relevant detailed data on occupational health and its current vulnerability, a team composed of four experts from MOH/ OHD and a National Expert conducted a rapid assessment using a questionnaire designed for this purpose, side-by-side with field visits. This is the first assessment carried out in Jordan on this issue. A convenient sample was chosen, which included four types of outside workers.

The target groups were mainly outdoor workers, namely, farmers, construction workers, surface miners, and municipality workers who spent most of their time working under the sun, and it included workers in both temperate and hot regions, as follows:

1. South Jordan Valley (The Ghor), which is a hot region, and where most of the farmers are found.
2. Amman City (the Capital of Jordan), which has a temperate climate. The construction workers and Municipality workers were selected from Amman City.
3. Al-Hassa/ Ma'an Governorate (the southern region), which is a hot region, and where the temperature degrees jump to over 40°C in summer. The workers in the surface mining of Phosphates were selected.

The field visits to fill out the questionnaire and collect the required data, were as follows:

- Al-Hassa/ Ma'an: (These workers are surface miners so they are considered as construction workers) The team met with the manager of the Phosphate Company and the heads of the units to explain the scope and objectives of the assessment and to introduce briefly the concept of climate change. The team explained how the questionnaire is to be completed. The manager informed the team about the precautionary measures the company follows when the temperature rises above 40°C. For example, during the very hot days of last year (2011), work was stopped for eight days; and sometimes, the manager ordered closing the mines after 11:00 am, when the temperature rose in the middle of the day. The questionnaires were completed by either direct interview carried out by the team or through the heads of the units.
- The team visited the Contractors' Association, and they were referred to the largest contracting company (Suadi Ojeh). The team met the manager, introduced the concept of climate change and its impact on the health of the workers. The team met with the site engineers and explained the objectives of the assessment, the concept of climate change, and questionnaire. A sample questionnaire was completed as an example, and later, the engineers supervised filling out the rest of the questionnaires.

- The team visited the individual farmers who work in the Jordan Valley several times because some of them are illiterate and the questionnaires had to be completed directly by the team members.
- Regarding the farming companies in the South Jordan valley, the team trained two employees of the Institute of Occupational Health and Safety on how to complete the questionnaire. These employees visited the manager and explained the purpose of the questionnaire and the health impacts of climate change. The manager mentioned that there are several precautions taken by the companies, such as start working early in the morning and before sunset; supplying cold water to the workers during the working hours; installing fans in the workers rooms. The farmers completed the questionnaire with assistance provided by the two employees.
- The team visited the heads of units in Greater Amman Municipality and explained the objectives of the assessment and the questionnaire. The Municipality engineers conducted the interviews with workers and filled out the questionnaires.
- The collected data from the questionnaires was analyzed using the EPINFO program.

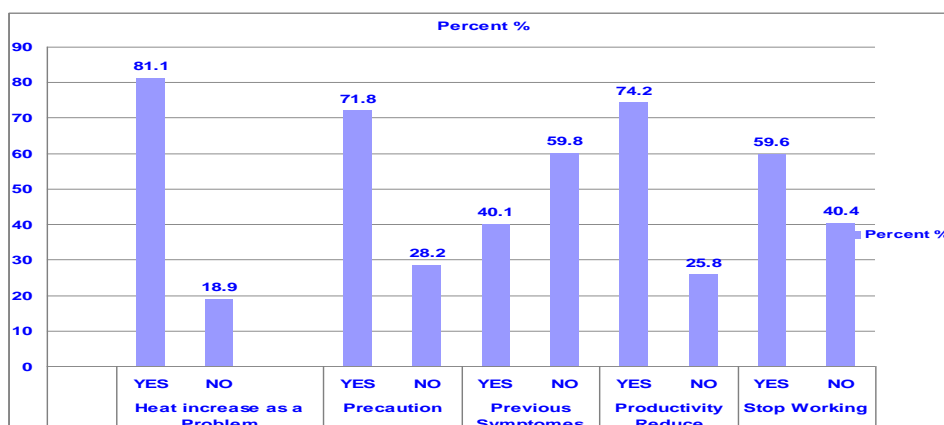
Data Analysis

The responses to the five main questions of the selected groups of workers are shown in Table 4 and Figure 3 below. The majority of workers interviewed (81.1%), (74.2%), (71.8%) and (59.6%) consider the increase in temperature as a problem, feel that their productivity decreases with increased temperatures, take special precautions, and stop working when there is high temperature, respectively. Only (40.1%) of the interviewed outdoor workers could identify symptoms resulting from exposure to heat or high temperatures.

Table 4 Data obtained from the questionnaire and interviews with outdoor workers

Work Type	Heat increase is seen as a Problem		Precautions		Previous Symptoms		Reduction in Productivity		Stop Working	
	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
Construction (and surface miners)	311	153	339	125	172	292	326	138	60	404
Farmers	276	38	243	71	181	132	288	26	243	71
Municipality Workers	1048	191	866	373	456	782	882	357	899	340
Total No.	1635	382	1448	569	809	1206	1496	521	1496	815
Percentage %	81.1	18.9	71.8	28.2	40.1	59.8	74.2	25.8	59.6	40.4

Figure 47 Data collected from the questionnaire and interviews with outdoor workers

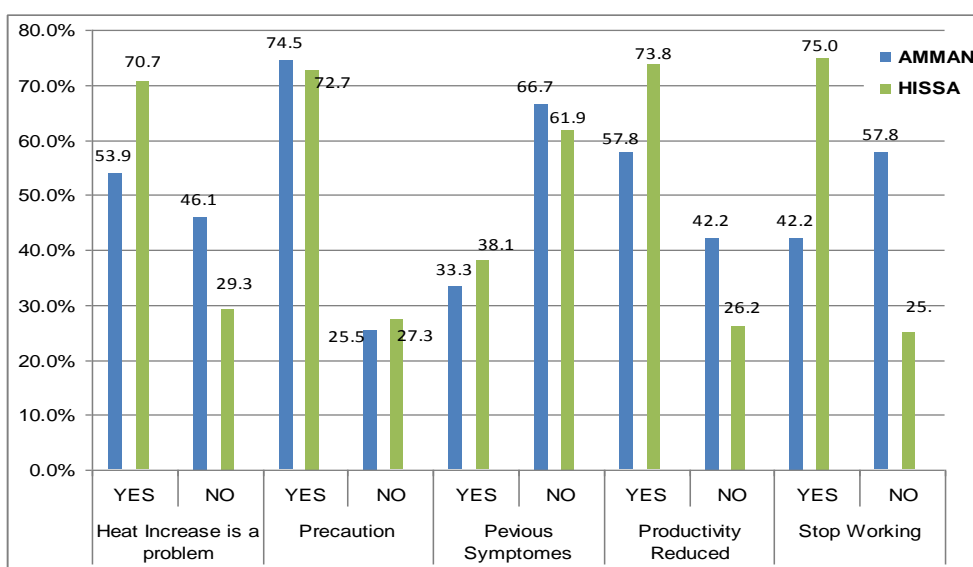


A comparison between the responses of construction workers working in temperate climate (Amman City) and those working in hot climate, indicates that the impact of high temperatures and heat is noticed and felt to a larger extent in the hot climate region, as shown in Table 5 and Figure 4.

Table 5 Comparison between the responses of construction workers who work in temperate climate and those working in hot climate

CONSTRUCTION (and surface miners)	Heat Increase is a problem		Precaution		Previous Symptoms		Productivity Reduced		Stop Working	
	% YES	% NO	% YES	% NO	% YES	% NO	% YES	% NO	% YES	% NO
AMMAN	53.9	46.1	74.5	25.5	33.3	66.7	57.8	42.2	42.2	57.8
HISSA	70.7	29.3	72.7	27.3	38.1	61.9	73.8	26.2	75.0	25.0

Figure 48 Comparison of responses between construction workers in Amman (temperate climate) and Al Hassa (hot climate)



Factors other than climate that determine vulnerability

Workers are exposed to many types of hazards that depend on their type of work, geographic region, season, and duration of work time (*NIOSH Safety and Health Topic, Hazards to Outdoor Workers*). Climate is not the only factor affecting the vulnerability of occupational health and safety. Non-climatic factors can have a strong effect on occupational health and safety vulnerability. These are: the educational level; the nutritional status; susceptibility of the worker (age, weight, degree of physical fitness, degree of acclimatization, and metabolism); use of drugs and alcohol; medical conditions, e.g. hypertension or thyroid disease; prior heat injury; type of clothing worn at work; changes in the built environment; socio-economic conditions; emerging industries; and changes in the state of the environment.

Current Programs and Activities to Manage Occupational Health

Several governmental agencies are involved in managing occupational health and safety, and have their own programs and activities, which are mostly preventive in nature, whereas curative programs are carried out in healthcare facilities, as follows:

1. Occupational Health Directorate (OHD) at the Ministry of Health:

The OHD is responsible for the health and safety of workers. The current program and activities deal with the prevention of occupational diseases and are mainly directed towards the indoor (industrial plants) workers only. It is composed of the following:

- Risk assessment and hazard analysis for specific industrial sectors, in which individual hazards of the workplace are identified and assessed as well as all those affected by the hazard. The assessment ranges from the storage of raw materials to the industrial process itself, byproducts, the machinery, and the final products. The assessments are recorded and reviewed periodically and whenever there is a significant change to work practices. The assessments include practical recommendations to control the risk.
- Routine inspection of industrial plants that covers all aspects, such as, lighting, ventilation, noise, storage and handling of chemicals, heat, cleaning, availability and use of personal protective equipment, availability of a clinic, and whether the firm offers medical insurance coverage for workers or not.
- Conducting pre-placement medical tests to determine the fitness of workers for the type of work and to be used as baseline data for the future.
- Periodic medical examination of the workers according to the type of job.
- Conducting environmental measurements to ensure that the workplace is safe and free from occupational hazards and pollutants, in accordance with the Jordanian regulations, directives, and instructions.

2. The Ministry of Labor (MOL):

The MOL is responsible for enactment of by-laws and directives to regulate the labor force, as well as legislative tools that pertain to workers health and safety, according to the Labor Law No 8 of 1998, such as:

- The regulation on periodic examination of workers in industrial firms (1999).
- The regulation on the protection of workers and establishments from workplace hazards.
- Regulation No. 43 of 1998 on the protection and safety pertaining to industrial machinery and equipment and workplace.
- Instructions on the pre-placement medical examination of workers in various industrial establishments.

- Regulation No 7 of 1998 on establishing occupational health and safety committees and supervisors.
- Instructions on establishing occupational health and safety committees and supervisors specified sectors.
- List of industrial illnesses entitles to compensation.
- Regulation No 42 of 1998 on preventive and curative health care in firms.
- List of occupational injuries.

3. The Institute for Occupational Health and Safety (IOHS):

The IOHS is affiliated with the Vocational Training Corporation. It is mainly a training center for occupational health supervisors, as these supervisors are required by law to obtain this certificate of training. In addition, the IOHS conducts several specialized trainings on occupational health and safety issues that are open to the public. Upon request by firms, the IOHS carries out specific case studies and environmental measurements. The IOHS has a well-equipped laboratory.

4. The Social Security Corporation (SSC):

The Jordanian Social Security Law was issued as a provisional law under No. 30 of the year 1978, as a result of the economic and social development in the Kingdom. It addressed the working groups uncovered with any other retirement rules or laws, such as civil or military retirement, and provided a socio-economic umbrella to protect those productive groups, and grant them subsequently more security, safety, and stability, especially after the issuance of the Jordanian Labor Law at the beginning of the sixties of last century. Several amendments were made to the provisional law, followed with the enactment of the Provisional Social Security Law No (7) of 2010. Chapter (4) of the Law is on insurance against work-related accidents and occupational diseases; Table (1) and Table (2), annexed to the Law, contain a list of occupational diseases and a list of work-related accidents, respectively.

The employers are required by the Law to report to SSC the work-related accidents and injuries that occurred in his/her firm. The employer is required to transport the injured employee to the healthcare facility and bear the expenses of the transportation and the coverage of the first day in the hospital if the case needs admission.

The SSC has an Occupational Safety and Health office. In order to determine the causes of work injuries and take the required actions to reduce them, the corporation has made several visits to the firms that suffer from considerable rates of work injuries. The aim of these visits is to make sure that those firms adhere to the occupational safety and health standards as well as to provide them with advices in this respect. The SSC offers a special Excellence Award for Occupational Safety and Health to nominated firms who have high occupational health and safety standards.

The SSC was founded in order to enforce the rules of the Social Security Law through achieving several objectives. One of these objectives is, “to raise the health standard in the society through implementation of the insurance against work injuries and occupational diseases taking into consideration that this trend imposes a diligent and major participation in the efforts exerted for work safety and health intended to reduce the number of the work injuries and their risks and negative reflections on the national income”.

The above-mentioned programs and activities are effective to a certain extent in reducing the work-related accidents as can be concluded from the SSC’s reports and the recent value of the work-related accident index per 1000 worker. Yet, not all establishments are covered in these programs, as well as the outdoor workers, due to lack of manpower and scarcity of financial resources.

Moreover, the current classification of work-related accidents, causes of accidents, and the types of injuries do not include exposure of workers to high temperatures and heat. Whereas such impacts on workers remain largely unexplored and unreported, particularly in relation to future climate change, the future programs and activities, remaining as is, are not expected to influence occupational health vulnerability. Therefore, there is a need to develop a national strategy for the adaptation of health to climate change, which focuses on, among other climate-sensitive health issues, protection of workers.

Vulnerability Assessment of the Impacts of Climate Change on Occupational Health

Previous local studies that have investigated the weather records, showed an increase in the magnitude and frequency of extreme temperature. Higher temperature and lower precipitation are expected as a result of climate change. Water resources, environment, and other related issues such as rangeland and livestock are most likely to be vulnerable to climate change. The MD projected that, for the next 20 years, temperature will increase by 1-2 °C, whereas the distribution of projected heat waves by months and regions could not be determined, although data for the period 1980-2010 has shown that there is an increasing trend in the number of heat waves in all region (Details in Chapter 1).

The increase in average maximum temperatures and the increase in the occurrence of heat waves can significantly compromise the health of workers, especially those who cannot reduce their exposure to heat, and in particular, workers in low and middle-income countries.

Exposure to heat presents a health hazard to all workers who are physically active; mainly outdoor workers who perform heavy labor under strong sunlight during the hot season, such as construction workers, farmers, garbage collectors, traffic police, firefighters, etc. and indoor workers with minimal, or no access, to cooling systems while working. The future impacts of climate change on occupational health will vary over spatial and temporal scales, and will depend on changing socioeconomic and environmental conditions.

Occupational health risks can be affected by climate change either directly, such as heat stress, heat stroke, mortality and morbidity resulting from floods, storms, increased ultraviolet radiation; or indirectly, through exposure to infectious diseases, air pollution, and deteriorated water quality, etc.

The prediction of future impacts on occupational health is a challenge because of the highly complex relationships that exist between workers, socio-economic factors, and their environment. In addition, the non-availability of specific data, such as data on WBGT, which is the index for measuring heat stress, and daily data on work-related accidents that take into consideration the exposure of workers to high air temperatures and climate changes are limiting factors in the assessment of impact of climate change on occupational health.

Jordan, as evident from the meteorological data, is already experiencing significant changes in average temperatures, and more frequent heat waves, which are expected to increase in the future. Extreme heat events (heat waves) are likely to increase in frequency and duration, and will be affecting larger geographical areas and thus more workers.

Although the available data on current vulnerability assessment lacks any information that links work injuries and accidents to climate; and the data from the SSC indicates that there is an improvement in the work accident index, which dropped from 2.5 accidents per thousand workers in 2006, to reach 2.0 accidents per thousand workers in 2010; yet, it is expected that heat-related illnesses and mortality among workers will slightly increase over the next 20 years.

The likely impacts of climate changes such as the reduction of productivity, the increase in thermal balance diseases (heat exhaustion, heat cramps, and heat stroke), the changes in the rainfall, the increase in frequency and severity of floods, storms, and changes in the growing seasons and regions will affect the occupational health directly and indirectly.

Heat stress due to high temperature and humidity can lead to an increase in deaths or chronic ill health after heat strokes, as several of the heatstroke deaths that were reported in the 2003 and 2006 heat waves in Paris were associated with occupational exposure. Both outdoor and indoor workers are at risk of heatstroke (as evidenced by the occurrence of heatstroke in metalworkers in Bangladesh). Indoor (chemical industries) workers and farmers may be exposed to higher levels of air pollutants due to increased temperatures.

It is evident that working in hot environments increases the risk of diminished ability to perform physical tasks, reduces mental task ability, increases accident risk, reduces productivity, increases absenteeism, and increases medical care expenses.

Moreover, climate change is expected to alter outdoor workers' exposure to solar ultraviolet radiation (UVR) to cause a range of health impacts, as higher ambient temperatures will influence clothing choices of workers. The greatest burdens result from UVR-induced cortical cataracts, cutaneous malignant melanoma, and sunburn.

Vulnerable Regions and Populations

The geographical areas that are expected to be affected by climate change are the hottest areas like the Jordan Valley, the southern areas (Gulf of Aqaba), and the areas with low rainfall such as Mafraq governorate and the desert areas.

The high risk groups are mainly outdoor workers, namely, farmers, construction workers, surface miners, refinery workers, municipality workers who spend most of their time working under the sun, as well as those workers required to wear semi permeable or impermeable protective clothing; personal protective equipment [PPE], gloves, and half-face, powered air-purifying respirators.

Part-time workers, who work on daily-basis, will be at highest risk because they are usually not included under the umbrella of social security and they often work under uncontrolled conditions. The other vulnerable groups are the traffic police who spend most of their time under the sun and the workers in gasoline pumping stations.

There are possible heat implications for indoor workers such as those workers in greenhouses, glass, or rubber manufacturing plants, and for those who work in buildings without air conditioning or proper ventilation systems.

Adaptation Assessment: Measures and Priorities

Climate is not the only factor affecting the geographic range and incidence of climate sensitive health outcomes. Non-climatic factors can have a strong or even dominant effect, either independently or by modifying climate effect. In addition, the population growth and the economic development, which will result in pressure on the environment, must be considered.

From the abovementioned, Jordan does not have any programs or activities employed for adaptation of occupational health to climate change. The occupational health policies and strategies should take account of adaptation measures to climate change, because increased attention to the human dimension of climate change can increase the likelihood of protecting the workers.

Accordingly, understanding and addressing the human consequences of climate change is a fundamental component of the climate change challenge. An adaptation assessment, which identifies

and prioritizes occupational health policies and programs to address occupational health risks and cope with the effects of climate change, regardless of future reductions in greenhouse gas emissions, is required to identify the opportunities for adaptation, gaps in current knowledge, and deficiencies in the coping and adaptive capacities of the health sector.

Public Health and Healthcare Interventions

The public health and healthcare sector must intervene and introduce adaptation measures to climate change into their policies and strategies in cooperation with the private healthcare establishments and the RMS. The interventions by the health sector can be categorized as follows:

➤ *Institutional Development:*

- Introduce climate change into the OHD Strategy.
- Establish a special unit/division in the OHD at MOH to become the focal point for occupational injuries, accidents, and illnesses related to climate change, to liaise with the other relevant organizations, and oversee the implementation of adaptation measures.
- Assign focal points in the occupational health units at the Health Directorate level in the governorates to facilitate notification on work accidents and diseases related to climate change.
- Establish a collaborative mechanism with the other relevant governmental and non-governmental organizations.

➤ *Awareness, Education and Capacity Building:*

- Train all occupational health physicians on climate change health sensitive diseases, their symptoms, signs and treatment, emergency examination, and first aid at work.
- Carry out a series of workshops about the concept of climate change and climate change health sensitive diseases targeting the health inspectors in the governorate to raise their level of awareness about the issue.
- Conduct a series of workshops to the safety officers and employers to introduce the concept of climate change, the impact of climate change on the health of workers, and the resulting impact on the productivity of the workers.
- Produce and distribute awareness materials (e.g. brochures and flyers) to the employers, workers, and occupational health physicians containing information on the impact of climate change on the health of workers and the necessary preventive measures.
- Prepare an awareness guide to provide information and advice on managing and controlling heat stress in the workplace, and educate workers to learn to recognize the early signs and symptoms of heat stress and know how to prevent them.
- Prepare guidelines on the management of occupational diseases and injuries related to climate change.

➤ *Surveillance/ Monitoring/ Data Collection*

- Develop or modify a notification system of reporting all diagnosed work-related injuries, accidents, and diseases linked to climate change.
- Develop an information system to register occupational diseases and injuries related to climate change and to evaluate the adaptation programs; this can be achieved by using the appropriate software to list all the vulnerable occupations, the number of employees, the work-related accidents and injuries, date of work-related injury, and other demographic information such as age, gender, and health condition.
- Coordinate with the Meteorology Department to introduce important climate indices, such as UV Index, Humidex ... etc.

➤ *Legislative/ Regulatory*

- Enforce the existing legislation related to pre-placement test and periodic examination of the workers according to the type of occupation, to ensure the uses of proper personal protective equipments, in order to protect the workers' health.
- Request/Initiate the amendment of MOL existing relevant legislation to impose the work-rest regimen during the hot days.
- Request/Initiate the amendment of MOL existing legislation so that workplaces with very hot work processes or where workers have experienced heat-related illnesses are required to measure the WBGT; workplaces that do not have "hot processes" but hot weather can pose health risks to their workers, a Hot Weather Plan, or a Heat Stress Plan is required.
- Request/Initiate amending/ issuing MOL legislation to require large companies to have an ambulance to be used in emergencies, in particular heat stroke cases; as well as to facilitate the arrival of the injured/sick workers to the health facilities by provision of adequate transportation system
- Request/Initiate amending/ issuing MOL legislation to require employers to provide workers who are exposed to hot work conditions and environments with an adequate supply of potable water and salt supplement, or the equivalent (provision of hydration systems), and to implement engineering methods to reduce the thermal index or isolate the worker from the source of heat.

➤ *Infrastructure Development*

- Establish well-equipped specialized units in selected hospitals (Public and Private) in the climate-change vulnerable regions (governorates) to deal with cases pertaining to climate change sensitive health diseases, especially the provision of cooling units for heat stroke.

Additional Needed Measures by Other Sectors

The development and application of finance safeguards (between developed and underdeveloped countries) is necessary to prevent social and environmental harm and maximize participation, transparency between different countries to face climate change impacts. The technical and financial support of international agencies in implementing health adaptation measures is required.

Since the intervention measures and adaptation of occupational health to climate change is a complex issue where the collaborative efforts of several organizations and sectors, in addition to the MOH and the healthcare sector, are needed, the additional measures by other sectors are:

➤ *Agriculture Sector*

In addition to the main climate-change adaptation measures at the farm level, which include conservation agriculture, improvement of water-use efficiency, implementation of water harvesting system, and supplemental irrigation with treated wastewater, additional measures are required to protect the health of farmers against climate change impacts.

High temperature and humidity can affect the physiological response to environmental toxicants through their effect on thermoregulation, including skin blood flow, sweating, and respiration. Warm wet skin promotes the absorption of chemicals. Workers in agriculture, including pesticides applicators and sprayers, have potential increased exposure to organophosphate insecticides and reduction in cholinesterase when they are heat stressed.

The additional adaptation measures required by the MOA in order to protect the health of workers include enforcing proper pesticides application procedures as well as compliance with wearing suitable semi-permeable or impermeable protective clothing and using the proper PPE.

Another adaptation measure to be taken into consideration is the provision of shaded resting areas as well as drinking water sources in farms.

The MOA's continuous efforts to raise the level of awareness of the farmers should include the climate sensitive health issues, their symptoms, and first aid at the farm, in addition to prevention measures, including the hydration system while at work, and the proper light clothing.

➤ *Water Sector*

In addition to the continuous efforts of the water sector, headed by the MWI, in water conservation, finding additional water sources, and water demand management to ensure the availability of safe drinking water to the population, additional measures are required to ensure the reliability and sustainability of the supply.

Improving the performance of the municipal wastewater treatment plants (and extending this service as well as its coverage) will provide additional quantities of non-conventional water for reuse in agriculture. Expanding and improving the monitoring of the treated effluents' quality is fundamental in protecting farmers from being exposed to water and food-borne diseases.

In addition, farmers, mainly rainfed farmers, are affected by the high temperatures and low precipitation in their farming practices leading to a decrease in their income. This multiplier increases the health impacts of climate change on farmers. Enhancing the knowledge of farmers on agriculture adaptation measures to increase their resilience to climate changes is needed. Moreover, implementation and establishing of a National Disaster Fund for farmers and developing institutional capacity through provision of better infrastructure and more personnel training is required.

➤ *Meteorology Department*

Meteorology Department is required to develop its website to include daily weather forecasts and heat wave alerts accessible by the public. Enhanced collaboration with the health sector is required to introduce new parameters such as the UV index and Humidex.

➤ *Municipalities and Greater Amman Municipality (GAM)*

GAM and the municipalities must work on developing work protocols to protect their outdoor workers from the health impacts of climate change during hot and cold weather.

In addition, the municipalities must compel industries, before issuing their licenses, to create green belts to mitigate the impact of climate change and to provide shaded areas for workers.

➤ *Civil Defense Directorate (CDD)*

Being first responders, intensive staff training, as well as refresher training, on climate-sensitive health issues should be implemented covering their symptoms, signs and first aid treatment, in addition to handling emergencies (extended heat waves or extreme cold weather). Collaboration with the healthcare sector, in particular the Occupational Health Directorate should be strengthened.

The available ambulances and equipment should be revisited to cope with the projected climate change scenarios.

➤ *Ministry of Environment*

Being the national focal point for the UNFCCC and Kyoto Protocol and the Head of the National Climate Change Committee, the MoEnv is responsible for streamlining and overseeing the national efforts on climate change, as well as preparing a National Climate Change Policy. The MoEnv continues its climate change mitigation efforts in compliance with the International agreements, such as CDM (cleaner development mechanisms).

It is required to incorporate the health impact of climate change in Jordan's NAPA (National adaptation programs of action, which provide a process for Least Developed Countries (LDCs) to identify priority activities that respond to their urgent and immediate needs to adapt to climate change – those for which further delay would increase vulnerability and/or costs at a later stage). International donors, thus ensuring implementation of MoH's health adaptation plans, can fund such programs.

The MOH is represented in the National Climate Change Committee, though its membership was added 10 years after forming the committee. The SNC to the UNFCCC included a small section on health. The Third Communication to the UNFCCC, which is in progress, should cover health and climate change more extensively.

The MoEnv should develop its air pollution monitoring systems and information systems, as well as improve the dissemination of data.

➤ *Ministry of Transportation (MOT)*

The MOT is required to evaluate its bus routes, especially in industrial and farm areas, to provide efficient public transport service to workers together with shaded bus stops, as well as study the provision of air-conditioning in the public transport system.

➤ *Electricity Companies*

The Electricity Companies should expand their services (by constructing new power stations for electricity generation and exploring, together with the MEMR, other renewable energy sources) to face the expected overload due to climate change impact, either in the summer or the winter because of increased electricity demand for air-conditioning and heating.

➤ *The Media*

The media should be more involved in climate change issues by providing facts and awareness raising materials to the public, including workers in the various sectors. In addition, collaboration and coordination with the health sector should be strengthened in this area.

➤ *Ministry of Labor*

The MOL should amend the existing legislation concerning occupational related illnesses and protection of workers and issue new legislation regarding working hours in hot climates in cooperation and coordination with the OHD at MOH. Furthermore, MOL should engage in the preparation and distribution of awareness, education, and training materials together with the MOH.

➤ *Social Security Corporation*

Considering that raising the health standards in the society through the implementation of insurance against work injuries and occupational diseases is one of the objectives of the Social Security Law; and that the SSC is the main official source of data on work-related injuries, and issues annual statistical reports; strengthening the collaboration between the SSC and the OHD is fundamental in developing the surveillance and data collection systems for climate change and occupational diseases and injuries. Modifying the work-related injuries and accidents notification system to include daily data, demographic and geographic details is needed. Sharing of information and data with the health sector should be facilitated and enhanced. Establishing a monthly surveillance system for occupational diseases and injuries will assist in assessing their prevalence and link them to climate change.

➤ *The Employers*

The employers should have a major role in protecting their employees from the impacts of climate change. They are required to implement a heat stress prevention program that establishes: worker training; monitoring method for temperature and humidity; preventative measures (e.g. increase frequency of breaks, reduce the work pace and workload, avoid working in direct sunlight, schedule

heavy work for cooler part of day, wear hat and sun screen outdoors, etc.); a water supply plan and encourages hydration (e.g. at least 1 cup every 20 min.); and first aid and emergency responses, including monitoring of worker symptoms, and investigating incidents of health related illnesses.

Cost-Benefit Analysis of Adaptation Measures and Interventions

The cost of the adaptation measures and the health benefits is difficult to estimate due to several constraints especially the lack of quantifiable and readily usable data on the existing burden of occupational health diseases and injuries and the projected impact of climate change in the future. Therefore, a qualitative cost-benefit analysis of some adaptation measures is presented in Table 6 instead. Table 7 shows the steps and cost of implementing the activities of the adaptation measures.

Table 6 Qualitative cost-benefit analysis of some adaptation measures

	Adaptation Measures (Cost)	Avoidable Health Impact (Benefit)
1.	Capacity building of ER health workers to detect symptoms of heat stroke and other climate sensitive health issues	Decrease in heat-related deaths Decrease in heat-related morbidity
2.	Establishment of a modified work-related diseases and injuries surveillance system, which includes detailed demographic and geographic information on a daily basis	Reduction of morbidity and injuries of workers Reduction of absenteeism Increase in productivity
3.	Establishment of well- equipped occupational health units in private and public hospitals and provision of ambulances in large companies	Reduction of morbidity and mortality due to occupational diseases and injuries
4.	Amending MoL relevant legislation (e.g. heat stress plans, provision of transportation to facilitate the arrival of workers to hospitals, work/rest regimen, introduce important climate indices, such as UV Index, Humidex ... etc.)	Reduction of morbidity and mortality of workers by speeding up the process of identifying symptoms, diagnosis, and treatment
5.	Development of guidelines on the management of occupational diseases especially climate sensitive ones	Saving lives of workers by proper diagnosis
6.	Capacity building of health inspectors, occupational health specialists, employers, employees and first responders on the impacts of climate change on occupational health	Reduction of morbidity among workers Increased productivity
7.	Enforcement of rules and regulations related to pre-placement test and periodic examinations	Increase productivity Maintain the workers in good health Reduce absenteeism
8.	Shading areas, creating green belts, provision of hydration system for outdoor workers	Reduction of heat-related illnesses Increase the productivity of the workers

Prioritization of Potential Adaptation Measures

Tables 8 and 9 rank health risks attributed to climate change and describe the required management actions. This provides decision makers with an indication of the adaptation measures that need to be considered, together with the priorities of these measures and the need for action in the short, medium, and long term.

See Chapter 8 for detailed Climate Change Adaptation Strategy and Plan of Action to Protect Health.

Table 7 Steps and cost of implementing activities of adaptation measures

	Activity	Needed Steps	Estimated Cost (JD)
1.	Capacity building of relevant personnel	<ol style="list-style-type: none"> 1. Prepare training materials targeting ER physicians on climate change and occupational diseases 2. Conduct 10 one-day training courses to train 200 ER physicians working in public, private and Royal Medical services hospitals (101 hospitals) on the concept of climate changes and sensitive health issues signs, symptoms and treatment. 3. Prepare training material for occupational health inspectors and specialists on climate change and occupational diseases 4. Conduct 6 one-day training course for occupational health inspectors and specialists 5. Prepare flyers and brochures to raise level of awareness of employers and employees; general practitioners and first responders 6. Prepare and conduct 3 one-day training courses for the focal points responsible for notification about the occupational diseases and injuries 7. Prepare and print guidelines on the management of occupational diseases especially climate sensitive ones 	<ol style="list-style-type: none"> 1. 4000 (Training material) 2. 20000 (10 one-day training for ER physicians) 3. 2000 (Training material) 4. 12000 (6 one-day training for occupational health specialists and inspectors) 5. 10000 (design+ printing of flyers/brochures) 6. 6000 (3 one-day training of focal points) 7. 6000 (Guidelines)
2.	Development of the organizational structure of the Occupational Health Directorate to include climate change impacts on workers	<ol style="list-style-type: none"> 1. Establish a new climate change unit at the occupational Health Directorate 2. Assign focal points for notification about the occupational diseases and injuries 3. Establish a collaborative mechanism with the other relevant governmental and non-governmental organizations: <ul style="list-style-type: none"> - Correspondence - Form a multi sectoral committee - Prepare TOR for the committee and schedule of meetings 4. Establishment of well- equipped heat stroke cooling units in public hospitals (3 major hospitals) 5. Provision of additional ambulances for public hospitals (5 ambulances for 	<ol style="list-style-type: none"> 1. - 2. - 3. - 4. 1,000,000 5. 180,000

		major hospitals in vulnerable and heavy industry and farms regions)	
3.	Development of information system	<ol style="list-style-type: none"> 1. Procure 15 computers and proper statistics software to be used in data registering and analysis, and evaluation and monitoring of the adaptation measures 2. Establish and design the notification system 3. Review international requirements regarding important climate indices 4. Meetings with the Meteorology Department to introduce important climate indices, such as UV Index, Humidex, ... etc. 	<ol style="list-style-type: none"> 1. 15000 (PC's) 2. 2000 3. - 4. -
4.	Enforcements and amendment of legislation pertaining to occupational health to incorporate climate change	<ol style="list-style-type: none"> 1. Form a special multi-sectoral legislation committee 2. Review existing relevant legislation 3. Prepare recommended amendments 	<ol style="list-style-type: none"> 1. 5000 (per deim for committee members) 2. - 3. -

Table 8 Risk ranking of health impacts arising from climate change

Risk	Health impacts arising from:
Extreme	
	Heat events UV exposure Reduced rain fall and availability of water for food production Reduced access to health care, food and water Inability to meet energy demand
High	
	Drinking and recreation water contamination Changes to disease vector distribution Impact on mental health Changes to biodiversity Loss of goods and services
Medium	
	Volatile organic compounds exposure Exposure to contaminated food Availability and quality of food Changes to the incidence in of accidents and loss of green space and gardens
Low	
	Increased pesticide exposure Increased chemical exposure

Table 9 Management actions for risk priorities

Risk levels of health	Description of management action
Extreme	Requires urgent attention at the most senior level and cannot be accepted
Medium	Risks can be expected in normal circumstances but is under review by the appropriate sector
Low	Risks under review; but it is expected that existing controls will be sufficient and no further action will be required to treat them unless they become severe

Early Warning System to Monitor and Assess the Impacts of Climate Change on Occupational Health

“Too hot” working environments are not just a question of comfort, but also a concern for health protection and the ability to perform work tasks. This occupational health problem has been known for a considerable time and protective methods have been developed. Still, many workers are exposed to unacceptably high temperatures and humidity in work situations that cannot be modified. Heat strain and heat stroke are important issues not only for health but also for labor productivity in outdoor jobs, particularly in low and middle-income countries. Climate change will increase average temperatures, as well as shift the distribution of daily peak temperature and relative humidity – so that heat episodes will become more frequent and extreme. In order to cope with heat, a distinctive adaptive action by workers is to reduce work intensity or increase the frequency of short breaks.

The health impact of very hot days is likely to be the “slowing down” of work. Whether it occurs through rescheduling of the work time (which reduces output) or interventions in the occupational health management (which increases costs), the result is productivity reduction (which is defined as the value of output over labor costs). The adverse effects of climate change on workers’ health are largely preventable. In order to reduce the morbidity and mortality among Jordanian outdoor workers, the development of an appropriate early warning system is crucial.

Objectives of the EWS

The objectives of the EWS are:

- To maximize the preparedness of the targeted population, about the coming hazards due to increase in temperature to take timely action to protect their health and property.
- To reduce morbidity and mortality among Jordanian workers.

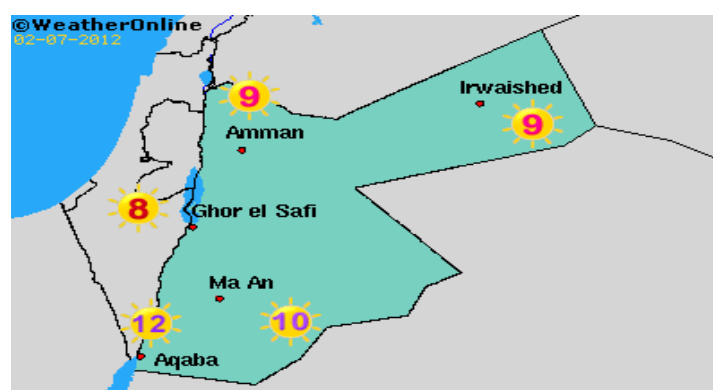
EWS Indicators

The indicators for EWS and Occupational Health are the Wet Bulb Globe Temperature (WBGT) and the UV index.

UV index in Jordan

The UV index is the measure of the level of intensity of the sun's UV radiation in the sunburning spectrum. The values of the index ranges from zero upward- the higher the index the greater the potential for damage to the skin and eye. Figure 5 is a map from Weather Online showing the UV index for Jordan.

Figure 49 Map showing UV index for Jordan



According to the exposure category, the UV index for Jordan ranges between very high and extreme (Figure 6). The level at which early warning is essential is when the UV index ranges from 8 to 10.

Figure 50 UV exposure categories

EXPOSURE CATEGORY	UVI RANGE
LOW	< 2
MODERATE	3 TO 5
HIGH	6 TO 7
VERY HIGH	8 TO 10
EXTREME	11+

Wet Bulb Globe Temperature (WBGT)

Researchers use the WBGT as an easily measured general heat-stress index. In time, its use widened. Because its use is recommended in the Standard ISO 7243, it is often used in Occupational Health and Safety guidelines for working in hot environments. A simple three-temperature element device similar to the picture below measures the WBGT. Therefore, the thermal index used to measure the heat stress is the WBGT.

The WBGT is formally defined as a combination of natural wet bulb temperature (T_{nwb} , measured with wetted thermometer exposed to the wind and heat radiation at the site), the black globe temperature (T_g , measured inside a 150 mm diameter black globe), and the air temperature (measured with normal thermometer shaded from direct radiation). The unit is degree Celsius ($^{\circ}\text{C}$).



Figures 7, 8, and 9 show the relationship between work capacity and WBGT, the days when the WBGT exceeded 29°C at Aqaba Airport Weather Station, and the monthly WBGT max from 1980-2011 at Aqaba Airport.

Figure 51 Relationship between WBGT and work capacity (Source: Tord Kjellstrom study)

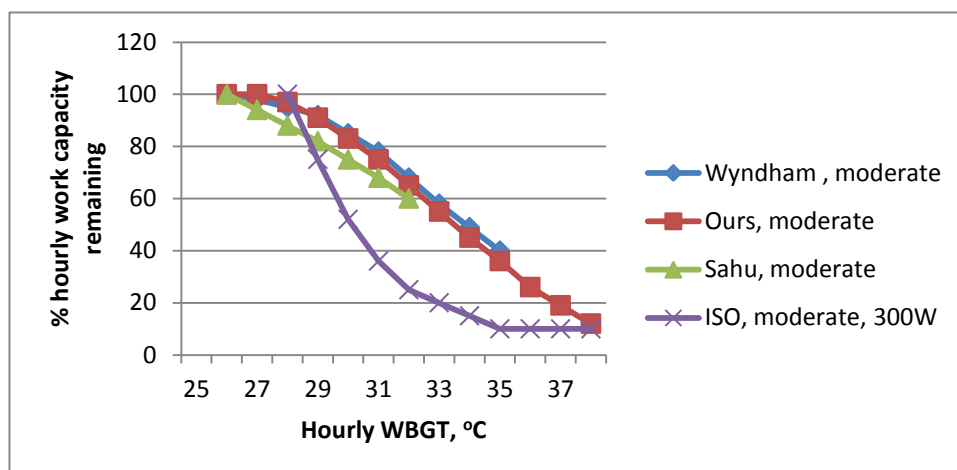


Figure 52 Number of days when the WBGT exceeded 29 °C at Aqaba Airport Station

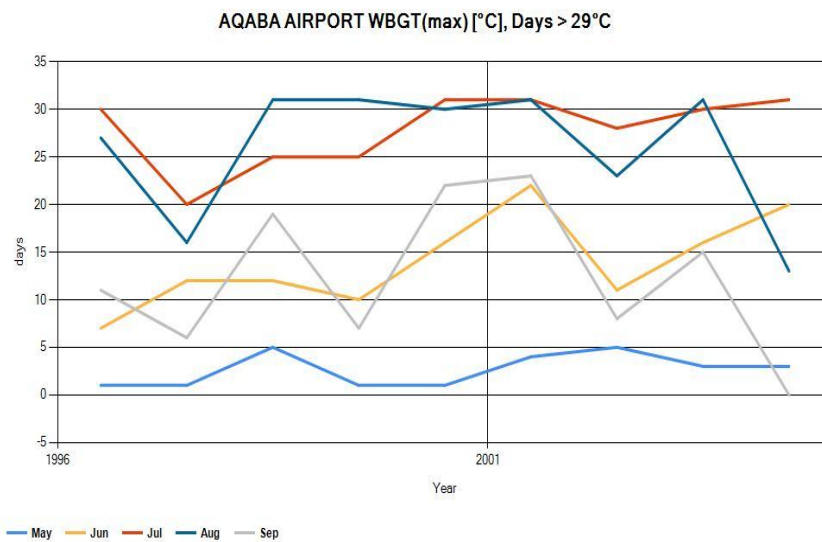


Figure 53 WBGT max at Aqaba Airport Station (1980- 2011)

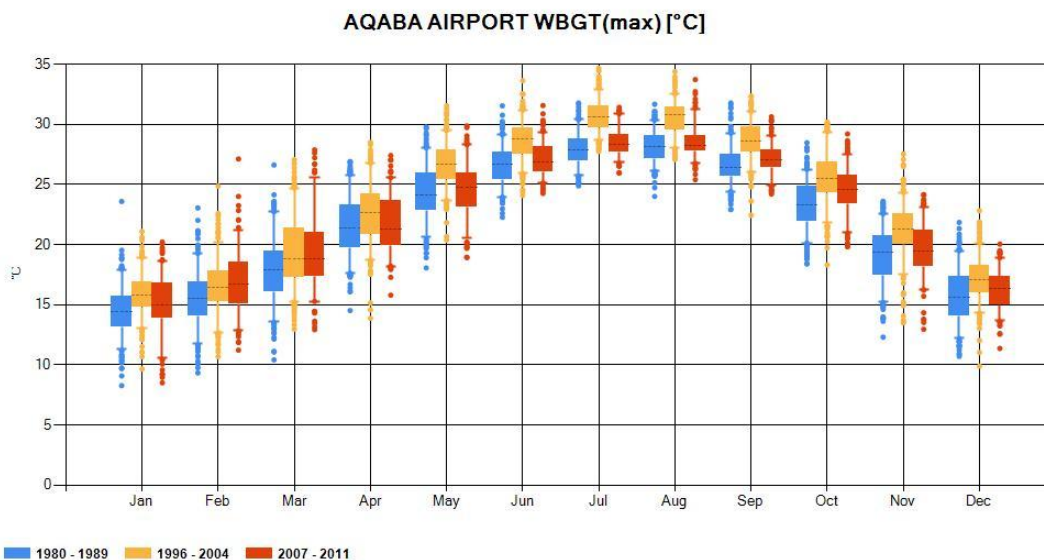


Figure 9 shows that the WBGT increased during the period 2007-2011 compared to the 1980s. It also shows that 1996-2004 was an especially hot period. Monthly heat stress distributions (WBGT) can be produced by showing the time trends in climate variables, and comparing the weather stations; spreading it out and looking at just some recent years by month.

The 3 degrees Celsius difference of afternoon WBGT between February and April is similar to the WBGT increase that may occur due to climate change during this century. If the working conditions are the same, such WBGT change could reduce the work capacity in February 2100 from 60% to 10% for people performing very physically active work tasks (Tord Kjellstrom).

Figures 10 and 11 show the monthly and annual maximum temperatures at Aqaba Airport, respectively.

Figure 54 Monthly maximum temperature at Aqaba Airport

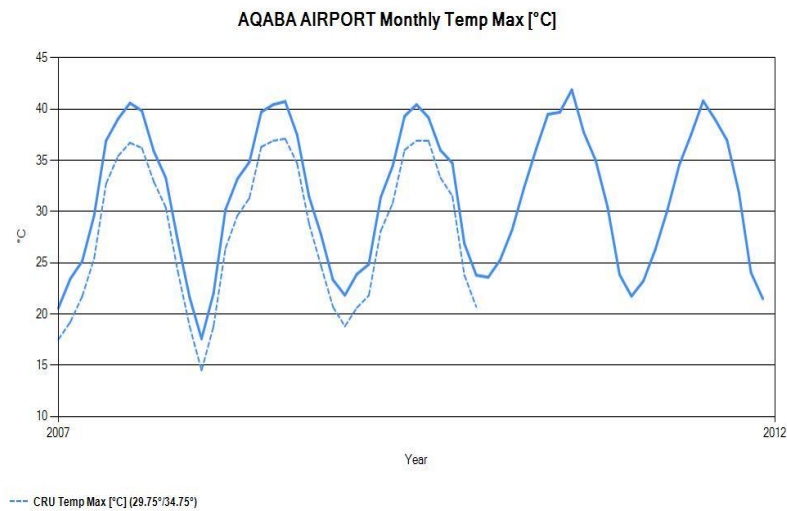
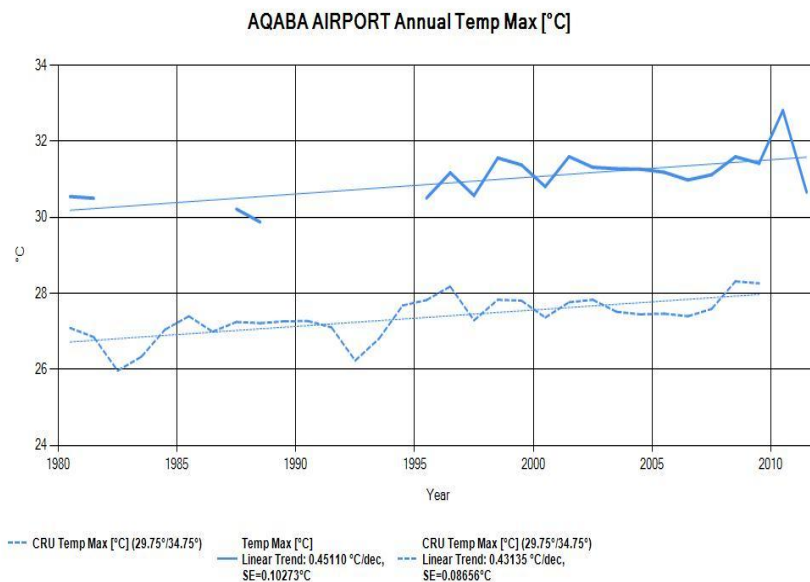


Figure 55 Annual maximum temperature at Aqaba Airport

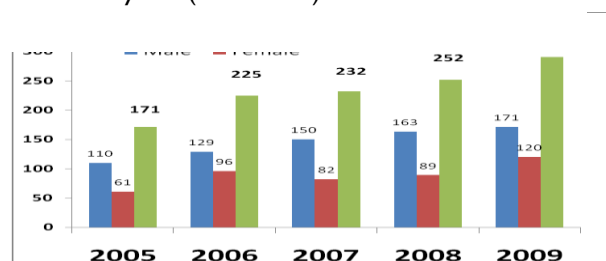


From the above figures, looking at the hottest months during the hot period 1996-2004, the number of days per month when WBGT in the afternoon, indoors in non-cooled environments, is above 29 °C (very hot for working people) can be seen.

Distribution of Skin Cancer

Figure 12 shows the distribution of skin cancer according to sex in Jordan during (2005 – 2009).

Figure 56 Distribution of skin cancer by sex (2005-2009)



Effectiveness of the EWS

The effectiveness of the warning system depends on:

1. Accurate weather and UV prediction and forecasting;
2. Effective coordination among stakeholders;
3. Timely dissemination of the information to the workers as well as public ;
4. Communicate the immediate prevention response to the workers as well as public. *The information to be communicated to the worker, employers, as well as the public, should be clear and uses simple language; the preventive actions to be taken by the workers, as well as the employers, should be clear and they must know when to ask for medical assistance and go to hospitals.*
5. Evaluate the preparedness and the immediate prevention response regularly to determine its effectiveness and efficiency.

EWS Phases and Actions

Phase One (White)

Action 1: Activate the website. (MD and MOH)

Action 2: Disseminate the educational material to the workers, employers, as well as the public. (MOH)

Action 3: Announce and publicize the level of WBGT and UV index, (MD).

Action 4: All adaptation measures should be available on the website (MOH).

Phase Two (Green): Attention should be taken:

Action: Raise the level of awareness of the workers as well as public about the climate health sensitive issues and its impact on health, by messages and through the mass media.

Phase Three (Yellow)

Action: Activate all (general and specific) adaptation measures mainly for workers as well as the public.

Phase Four (Red-Warning)

Action 1: Continuous and constant announcements through the mass media about the weather conditions (WBGT and UV index) (MOH)

Action 2: Implementation of specific action plans of the other institutions: MOH, MOL (rules and regulations on rescheduling of work time or to stop working), MoEnv (prevent sun tanning, in the shores) and MoEdu (education sessions on the health impacts of high temperature).

Action 3: Extension of duty hours for the EWS committee MOH.

Action 4: Distribution of safe water for workers as well as the public (MWI, Municipalities, NGOs).






Phase Five (Black)

Action 1: Intensify the advices to outdoor workers (farmers, construction workers, and public transport) if necessary in consultation with the relevant bodies to stop working or reschedule working hours.

Action 2: Proceed to declare a state of emergency.

It is the responsibility of the Committee to declare the State of Emergency in the country according to the guide below and announce to the workers, as well as the public, the severity of the weather condition. In addition, the committee is responsible for developing brochures on this guide explaining to the workers, as well as the public, the meaning of physical exertion in simple language and the meanings of the flag colors so that people take preventive precautions. At any phase, the committee will communicate using social media (radio, T.V, SMS, and through the internet) the weather condition and symbolize it using the relevant flag color code. The public will accordingly understand the situation of the weather.

WBGT as a guide in regulating intensity of physical exertion in hot weather

Flag Color	WBGT Index (C)	Intensity of Physical Exercise
	(Safe) Less than 21 °C	Extremely intense physical exertion may precipitate heat exhaustion or heat stroke; therefore, caution should be taken.
	(Attention) Equal or more than 21 °C	Discretion required in planning heavy exercise for unseasoned personnel. This is a marginal heat stress limit for all personnel.
	(Warning) Equal or more than 25 °C	Strenuous exercise and activity (e.g. close order drill) should be curtailed for new and un-acclimated personnel during the first 3 weeks of heat exposure.
	(Strong warning) Equal or more than 28 °C	Strenuous exercise curtailed for all personnel with less than 12 weeks training in hot weather.
	(Danger) Equal or more than 31 °C	Physical training and strenuous exercise suspended for all personnel (excluding operational commitment not for training purposes).

Steps for Developing Occupational Health EWS

1. Establish a committee chaired by MOH to coordinate the actions between institutions and direct the response if an emergency occurs, and composed of MOH (OHD), MOL, MoEnv, CDD, MD, Chamber of Industry, Workers representatives (e.g. Labor Union), Mass media
2. Establish accurate and timely alert systems (occupational-health warning systems trigger warnings, determine the mechanism of action, and communicate the risks). Such alerts will depend on WBGT and UV index.
3. Develop occupational health-related information plan (what is communicated, to whom and when) and prepare brochures and leaflets containing all needed information on self-protection measures when any of the last three flags are raised. Distribute such to all workers as well as the public.
4. Particular care for workers exposed, to climate change hazard.

5. Preparedness of the occupational health and social care system (capacity building and empowerment of the staff to face the climate change-health sensitive issues).
6. Real-time surveillance and evaluation: Establishment of a real-time surveillance system on occupational health supported by an efficient information system.

CONSTRAINTS:

- Lack of data about the injuries occurring during the hot season (summer)
- Non-availability of UV index measurement
- No information was provided by the MD on WBGT.

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CHAPTER 8 JORDAN'S CLIMATE CHANGE ADAPTATION STRATEGY AND PLAN OF ACTION TO PROTECT HEALTH

Introduction

Adaptation to climate change is the process through which people reduce the adverse effects of climate on their health and well-being, and take advantage of the opportunities that their climatic environment provides (Burton 1992, quoted in Smit et al. 2000). It involves adjustments to increase the viability of social and economic activities and to reduce their vulnerability to climate, including its current variability and extreme events as well as longer-term climate change (Smit 1993, quoted in Smit et al. 2000).

According to the IPCC Third Assessment Report, *Adaptation* “has the potential to reduce adverse impacts of climate change and to enhance beneficial impacts, but will incur costs and will not prevent all damages.” Furthermore, it is argued that human and natural systems will, to some extent, adapt autonomously, and that planned adaptation can supplement autonomous adaptation. Yet, some adaptation measures might have negative impacts on sensitive health issues (e.g. VBDs), such as certain water irrigation systems and water projects.

This National Climate Change Adaptation Strategy to Protect Health is intended to provide guidance to the health sector and the many organizations that work to improve the health of Jordan's population and the environments in which they live, work, and play. The Strategy recommends proactive steps to engage other sectors, NGO's, and the community to minimize the actual human health impacts of the risks and vulnerabilities identified in the assessments and cope with the changing climate. The Strategy lays the foundation for future discussions, planning efforts, and actions; it will be revised after five years or as resources allow and new information becomes available.

The Strategy intends to:

- Develop resilience and capacity of the health sector to prepare for changing climate conditions and extreme weather events in ways that promote and protect public health and safety
- Ensure a consistent, comprehensive and targeted approach to decrease vulnerability of the population and promote an equitable and prosperous society
- Deepen awareness and sensitization for the general population particularly policy makers about the critical role of adaptation in national development efforts
- Position Jordan to draw funding for meeting its national adaptation needs
- Strengthen International recognition to facilitate action
- Facilitate the mainstreaming of climate change – health risk reduction into national development plans.

Approach

The preparation of the National Adaptation Strategy was driven fundamentally by a participatory approach. An extensive network of stakeholders with varied and wide experiences in climate change from relevant organizations were involved in the process by participating in consultative meetings and workshops, as well as providing required data for conducting the vulnerability assessments.

Scope

The Strategy is intended to cover a period of 5 years (2013 to 2017). It is expected to be a roadmap for adaptation to be used and referred to by all stakeholders (relevant Ministries, Municipalities, Civil Society Organizations (CSOs), NGOs, the academia, and research institutions).

Key Principles

The following key principles guided the formulation of the Strategy:

- Stakeholders' participation is central to the formulation and implementation of the Strategy
- Promotion of sustainable development and poverty reduction are focus areas of the Strategy
- Gender sensitivity and reduction of vulnerability are widely adopted
- Cross-sectoral and integrative approach adopted
- The best available science and local knowledge was used to assess vulnerability and identify adaptation measures and priorities
- Priority was given to adaptation measures that modify and enhance effective existing policies and programs
- Recommended policies are consistent with the economic and political circumstances of the country and support Jordan's programs to address the Millennium Development Goals (MDGs), and Jordan's National Agenda

Vision

This strategy envisions a Jordan in which protection of health from the adverse impacts of climate change is an integrated component of sustainable development, reducing vulnerability and enhancing the resilience and adaptive capacity of all sectors and people, particularly women, children, the elderly, and the poor.

Goals

- Reduce or minimize health risks by improving adaptive capacity, leveraging new opportunities, and facilitating collaboration inside Jordan and with the global community
- Strengthen the preparedness and resilience of the health sector
- Increase the resilience and sustain the wellbeing of all Jordanians

Objectives

- Educate, empower, and engage citizens and organizations to take actions to reduce individual and community vulnerability to climate changes through
- Identify and promote adaptation strategies with public health co-benefits
- Improve public health preparedness and emergency response
- Strengthen the health infrastructure

- Build the needed capacities (including understanding and mapping of the health hazard, monitoring and forecasting imminent events)
- Establish, improve, and maintain mechanisms for rapid surveillance of environmental conditions, climate-related illness, and vulnerabilities
- Enhance working in partnership with other agencies (e.g., environmental, agricultural, transportation, education)
- Conduct research to enable enhanced promotion/protection of human health in light of climate change
- Promote increased access to health care
- Ensure that health care providers are educated about health impacts of climate change including diagnosis and treatment of climate-related illness and recognition of emerging trends.

Proposed Strategy Implementation Arrangements

MOH at the national level is responsible for overseeing the implementation of the Strategy, together with the relevant organizations and governmental bodies. It is envisaged that a Climate Change Committee headed by MOH, composed of representatives of key stakeholders, will be established.

Ministry of Health

As the supervisory body, the MOH will:

- Establish the institutional mechanism to implement the National Adaptation Strategy;
- Liaise with other sectors to mainstream the Adaptation Strategy into national development planning processes;
- Coordinate the efforts of the other Government sectors and agencies, the private sector and civil society organizations;
- Ensure that the programs/ projects under the strategy are in line with sectoral government policies and strategies;
- Provide technical, financial and logistical support for the various actors involved in program activities; and
- Supervise, monitor, and evaluate the performance of the strategy.

Climate Change Committee (to be established)

This committee will:

- Perform day-to-day management of the National Adaptation Strategy;
- Supervise programs / projects;
- Supervise the preparation of guidelines for programs / projects;
- Monitor and evaluate programs/projects and the preparation of project reports;
- Support the local institutions in capacity building and participation;
- Establish policy guidelines for programs/projects operations;

- Approve programs/projects/ research and recommend them for funding;
- Review progress reports.

Plan of Action

The health sector can respond to the adverse impacts of climate change with regard to the six climate-sensitive health issues in a number of ways by preparing for extreme events (e.g. heat waves), surveillance, monitoring, responding to infectious disease, increasing awareness, and by providing extra support for the communities. The adaptation actions and measures for each of the six climate-sensitive health issues can be classified into 7 major categories as follows:

- Regulatory/ legislative
- Capacity building
- Public education and communication
- Surveillance and monitoring
- Medical intervention
- Infrastructure development
- Research and further information.

The Plan of Action (2013-2017) for implementing the National Climate Change Adaptation Strategy to Protect Health is shown in the Table below.

PLAN OF ACTION FOR IMPLEMENTING THE CLIMATE CHANGE HEALTH ADAPTATION STRATEGY

2013-2017

ACTIONS	MEASURES	TIME FRAME	RESPONSIBLE SECTORS	INDICATORS (M&E)
AIR-BORNE AND RESPIRATORY DISEASES				
Objective 1: Ensure intersectoral cooperation to strengthen the surveillance of respiratory diseases				
1.1 Establishment of Steering Committee to oversee coordinated implementation of adaptation strategy activities to reduce impacts of air-borne pollutants on respiratory diseases	<ul style="list-style-type: none"> - Establish multi sectoral Committee - Form working groups to develop guidelines for reduction of toxic substances and air pollutants, building codes, and allocate economic incentives - Form working groups to amend/issue relevant standards - Convene regular meetings 	2103-2017	MOH, Multiple governmental and nongovernmental sectors	<ul style="list-style-type: none"> - Number of institutions who adopt adaptation activities - MoM - Guidelines - Amended air quality and emission standards - Indoor air quality standards issued - Required legislation
Objective 2: Raise awareness among health care providers as well as general population on the effect of climate changes on respiratory diseases				
2.1 Increase public awareness on climate change and respiratory diseases	<ul style="list-style-type: none"> - Conduct population-based educational campaigns to increase public awareness on climate change and respiratory diseases - Produce posters, brochures, educational materials - Raise awareness among the public of the harmful effects of exposure to pollen 	2013-2014	MOH, MoEnv, NGOs	<ul style="list-style-type: none"> - Number of training workshops - Number of education programs directed on allergen avoidance - Number of education programs directed on changing behaviors - Number of posters, articles, videos, etc
2.2 Increase knowledge among health care providers on relationship	<ul style="list-style-type: none"> - Produce training materials on links between climate change and respiratory disease 	2013-2017 2013-2017	MOH MOH, healthcare establishments	<ul style="list-style-type: none"> - Number of trained health care providers

between climate variables and respiratory diseases	- Conduct training sessions for health care providers			
Objective 3: Establish integrated and effective programs to reduce the impacts of climate change on respiratory diseases				
3.1 Planting non allergogenic street sides trees	- Draw plans to plant non allergogenic street sides trees and replace allergogenic trees - Coordinate among relevant sectors - Evaluate situation	2103, ongoing	MOH, Municipalities, GAM, MOA, MOEnv	- Percentage of replacing allergogenic street sides trees with non-allergogenic
3.2 Reduction in the burden of air pollutants	- Encourage shifting to hybrid system vehicles - Encourage measures to reduce ground level ozone and other air pollutants - Strengthen inspection of car exhaust emissions - Promote and encourage solar energy applications	2103, ongoing	MOH, MoEnv, Vehicle Licensing Directorate, MOE, other sectors	- Ground level ozone and other air pollutants monitoring data - Number of Hybrid vehicles - Number of vehicles violations - Number of solar energy units
3.3 Reduction of deforestation	- Encourage measures to save the green cover and prevent cutting trees - Strengthen EIA on ecology for development projects	2103, ongoing	MOEnv, MOA, RSCN, other sectors	- Percentage of green surface
Objective 4: Reduction of impacts of climate variables and air pollutants on respiratory diseases				
4.1 Establishment of monitoring systems for climate variables and air pollutants	- Establish long-term aeroallergen monitoring system - Establish real-time air quality monitoring system - Strengthen coordination among MOH and relevant bodies to access data	2103, ongoing	MOH, MoEnv, other sectors	- Availability of data on aeroallergen concentrations and major air pollutants - Correlation of health and environment data - Integrated report
4.2 Strengthening the MOH system used for recording and reporting respiratory diseases	- Define major air pollutants and their health impacts - Identify vulnerable areas with increased levels of air pollution - Identify vulnerable groups - Link respiratory diseases to climate variables and air pollutants	2013-2017	MOH, MoEnv, Metrological Department	- Improved recording and reporting system - Informed, evidence-based decisions to control air pollution

4.3 Developing a health forecasting system for acute respiratory diseases and climate variables	<ul style="list-style-type: none"> - Establish Climate Change and Respiratory Diseases Unit at MOH - Establish access to air quality surveillance system and weather monitoring data - Establish highly sensitive early warning system for pollen season and dust storms - Analyze morbidity data, hospital admissions, and emergency attendance related to respiratory diseases - Monitor seasonality (seasonal patterns) of respiratory disease 	2013-2017	MOH, MoEnv, Metrological Department	<ul style="list-style-type: none"> - Early communication - Press releases - Warning bulletins - Warning SMSs
4.3 Increasing the immunity of vulnerable groups and provision of improved health services	<ul style="list-style-type: none"> - Adopt policies for introducing seasonal flu vaccine to risk groups - Increase the capacity of emergency rooms 	2103, ongoing	MOH	<ul style="list-style-type: none"> - Percentage of people at risk vaccinated against flu - Number of well-prepared ER - Number of beds at ERs
4.4 Undertake research on population and individual level	<ul style="list-style-type: none"> - Draw solid basis for formulation of research related to climate change and air-borne and respiratory diseases - Assess impacts of elevated temperature on pollen and allergen production 	2103, ongoing	MOH, Universities, research institutes	<ul style="list-style-type: none"> - Number of conducted research

WATER AND FOOD-BORNE DISEASES

Objective 1: Increase awareness of water and food-borne diseases

1.1 Increase awareness among the public and health care providers on prevention of water and food-borne diseases	<ul style="list-style-type: none"> - Prepare educational materials on hygiene practices, safe water use, food safety - Disseminate information via training, lectures, media, social media, website - Increase campaigns especially during warm seasons - Design special educational materials for specific vulnerable groups 	2013-2017	MOH, JFDA	<ul style="list-style-type: none"> - Number of trainings, lectures, educational materials, - Number of water and food-borne disease cases
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Objective 2: Capacity building of the health sector to detect and manage water and food-borne diseases

2.1 Building the capacity of environmental health	<ul style="list-style-type: none"> - Conduct continuous professional development trainings on sanitary hygiene and inspection 	2013-2017	MOH, JFDA	<ul style="list-style-type: none"> - Number of trained personnel - Number of food poisoning
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inspectors and healthcare personnel regarding water and food-borne diseases	<p>surveillance of water supply sources and systems.</p> <ul style="list-style-type: none"> - Conduct continuous professional development trainings on sanitary hygiene and inspection surveillance of installations where food is produced, prepared, stored, and distributed - Increase training on symptoms and early treatment of water and food-borne diseases particularly in vulnerable areas 			<p>reported cases</p> <ul style="list-style-type: none"> - Number of reported water-borne disease outbreaks
2.2 Increase preparedness of the health sector to detect and manage water and food-borne diseases	<ul style="list-style-type: none"> - Procure necessary supplies, equipments, and field test kits - Procure necessary medical treatment - Ensure access to health services in remote areas - Develop, upgrade, and sustain the capacity of water and food laboratories - Develop, upgrade, and sustain the capacity of diagnostic medical laboratories 	2013-2017	MOH, JFDA, Private, Military and Educational hospitals and medical laboratories, WAJ laboratories, Water Companies	<ul style="list-style-type: none"> - Percentage decrease in number of food poisoning reported cases - Percentage decrease in number of reported water-borne disease outbreaks - Availability of medical treatment - Functional (accredited) water and food laboratories - Functional (accredited) medical laboratories

Objective 3: Protection from climate-related water and food-borne diseases

3.1 Controlling water-borne diseases	<ul style="list-style-type: none"> - Improve and expand water monitoring programs - Scale up WSPs - Undertake epidemiological studies to detect further risk factors related to water-borne diseases - Regulate grey water use - Disseminate information on grey water use and treatment - Disseminate information on maintenance of household water storage tanks - Field studies to detect vulnerable populations - Laboratory based surveillance system - Conduct epidemiological studies on grey water 	2013-2017	MOH, MWI, Water Companies, WAJ	<ul style="list-style-type: none"> - Percentage decrease in number of water-borne disease cases - Number of WSP for water systems - Epidemiological studies conducted
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	use/ reclaimed water and potential health impacts			
3.2 Controlling food-borne diseases	<ul style="list-style-type: none"> - Improve and expand food monitoring programs - Enforce HACCP (systematic preventive approach to food safety) - Undertake epidemiological studies to detect further risk factors related to food-borne diseases - Improve and expand monitoring of sewerage treatment near agricultural land - Regulate grey water use 	2013-2017	MOH, JFDA	<ul style="list-style-type: none"> - Percentage decrease in number of food-borne disease cases
Objective 4: Establishment of a national and international coordination mechanism in terms of prevention and control of water- and food-borne diseases				
4.1 Establishment of intersectoral coordination mechanism to prevent and control water and food-borne diseases	<ul style="list-style-type: none"> - Develop and strengthen coordination mechanism - Enhance regional and international cooperation - Oversee implementing required monitoring, surveillance, engineering, infrastructural measures - Review/amend/develop required legislative tools and/or standards - Evaluate preventive measures - Oversee implementation of relevant research and epidemiological studies 	2013-2017	MOH, MoEnv, MWI, MOA, MD, WAJ, International Organizations	<ul style="list-style-type: none"> - Coordination mechanism - Percentage decrease in number of water and food-borne disease cases - Evaluation reports
4.2 Early warning system for water and food-borne diseases	<ul style="list-style-type: none"> - Identify required information and environmental and weather indicators - Maintain a monitoring system for required indicators (water quality and quantity, weather variables, heavy rain, drought, high temperatures, etc) - Coordinate exchange of data and information - Make use of available resources - Prepare/modify/upgrade plans and plans of 	2017	MOH, MD, JFDA, Hospitals, HCC, MoEnv, MWI, other bodies	<ul style="list-style-type: none"> - Modified plans of action - Availability of data - Functional early warning system in place - Percentage decrease in the number of water and food-borne disease cases

	<p>action for the health sector in the event of disease outbreaks, focusing on vulnerable groups</p> <ul style="list-style-type: none"> - Prepare and implement early warning system 			
Objective 5: Decrease the occurrence of food-borne (and food poisoning) diseases				
5.1 Reduce the incidence of food-borne diseases (food poisoning)	<ul style="list-style-type: none"> - Continuous follow up of the results of the annual monitoring program for laboratory examination of foods in the markets - Provision of safe agricultural products and other foods - Enforce regulations/guidelines for appropriate food storage - Educate and train food-handling staff and food inspectors 	2017	JFDA, MOA, MWI, MOH	<ul style="list-style-type: none"> - Annual reports - Decreased incidence of food borne diseases
Objective 6: Strengthening of surveillance programs relevant to water and food-borne diseases				
6.1 Improve current surveillance of climate-sensitive water and food-borne diseases	<ul style="list-style-type: none"> - Early detection of relevant diseases - Share surveillance data with other bodies - Enhance reporting - Upgrade laboratories - Establish lab-based surveillance 	2013-2017	MOH, hospitals, JFDA	<ul style="list-style-type: none"> - Annual report - Shared information - Better case reporting system
6.2 Information Systems	<ul style="list-style-type: none"> - Enhance compatibility of information systems and data 	2014-2017	MWI, WAJ, JVA	<ul style="list-style-type: none"> - National Water Plan updated - Data bank of water WIS developed
Objective 7: Ensure reliable and adequate supply of safe water in view of the increase scarcity induced by climate change				
7.1 Provision of minimum household water requirement to protect health	<ul style="list-style-type: none"> - Limit expanding irrigated areas - Reduce groundwater extraction and protect groundwater aquifers - Promote use of brackish water and reuse of treated wastewater for agriculture and industrial purposes where applicable - Set water tariffs to ensure appropriate water 	2013-2017	MWI, WAJ, JVA, MOA, MOH	<ul style="list-style-type: none"> - Lower rates of irrigated areas in the Jordan Valley and in the upland - Installation of meters on private wells to include all wells - Percentage non-traditional water used for agriculture - Water tariffs set

	<ul style="list-style-type: none"> use - Rehabilitate water supply systems to reduce water losses - Ban planting summer crops in order to maintain water sources - Lease of land from farmers when needed to prevent them from growing crops whenever the need arises 			<ul style="list-style-type: none"> - Per capita share of water - Number of projects to rehabilitate water supply systems and reclaimed water projects - Number of dams built
Objective 8: Reduction of water and food-borne disease epidemics				
8.1 Strengthening surveillance and establishment of highly sensitive alert system by the development of health forecast system for climate-sensitive diseases	<ul style="list-style-type: none"> - Reassess current surveillance system - Incorporate potential risks resulting from climate changes in the currently adopted surveillance system - Develop the mechanisms of statistical data analysis to provide instant alerts to potential risks 	3 years	MOH	<ul style="list-style-type: none"> - Updated Surveillance System include sensitivity analysis
8.2 Prevention and control of emerging and re-emerging water and food-borne diseases	<ul style="list-style-type: none"> - Define possibly-emerging water and food-borne diseases in light of the climate change risks - Develop the mechanisms of monitoring water and food borne diseases - Develop the system for providing early warning against arising water and food-borne diseases - Develop the systems of containment of these emerging diseases and prevention of their uncontrolled spread 	5 years	MOH, WAJ, MoEnv, JVA	<ul style="list-style-type: none"> - Number of water and food-borne diseases incidents
8.3 Strengthening the existing emergency preparedness and disaster management	<ul style="list-style-type: none"> - Identify potential areas for spread of emerging water and food-borne diseases - Develop emergency response plan to respond to increasing incidents of water-borne diseases - Develop disaster recovery plans where uncontrolled spread of diseases is possible 	3 years	MOH, MWI	<ul style="list-style-type: none"> - Effective emergency and disaster response plans
8.4 Improving data	<ul style="list-style-type: none"> - Develop the data management system at MOH 	3 years	MOH, MWI,	<ul style="list-style-type: none"> - Comprehensive database linked

collection on diseases related to climate change and establishing database for the collected data	<ul style="list-style-type: none"> - Link the database to the WHO database to provide inputs from nearby countries on water and food-borne diseases - Develop effective data monitoring and analysis system to support decision making 		MoEnv, MoA	to WHO database
8.5 Use of treated wastewater for unrestricted irrigation purposes (to provide higher amounts of safe drinking water to citizens)	<ul style="list-style-type: none"> - Deliver a comprehensive review of the current performance of the operating WWTPs in Jordan - Define deficiencies in meeting the 2006 WHO Guidelines for wastewater reuse. - Coordinate with WAJ for enhancing the performance of the WWTP - Coordinate with MoEnv for enforcing their role in monitoring treated wastewater reuse - Develop a mechanism for monitoring treated wastewater reuse for irrigation involving all concerned parties 	5 years	MOH, MWI, MoEnv	<ul style="list-style-type: none"> - Percentage of treated wastewater used in irrigation
8.6 Controlled wastewater reuse at domestic level	<ul style="list-style-type: none"> - Assess the current public practices in using treated wastewater for irrigation at households - Design and deliver an awareness campaign to encourage adequate practices of the public wastewater reuse 	3 years	MOH, MWI, MoEnv, MoA, JVA, NGOs	<ul style="list-style-type: none"> - Number of households using treated wastewater for domestic irrigation - Number of campaigns

VECTOR-BORNE DISEASES

Objective I: Promote public health policies related to VBDs control

1.1 Enforce Public Health Law No. 47/2008 and issue regulations regarding Vector Borne Diseases	<ul style="list-style-type: none"> - Amend Public Health Law to include clear cut statements regarding reporting of VBDs cases to MOH by various health sectors - Enforce Public Health Law among other appropriate official agencies - Identify the role of stakeholders (both governmental and non-governmental) in the 	2013-2014	MOH, other relevant bodies	<ul style="list-style-type: none"> - Public Health law amended - Regulations, directives issued - VBDs control and reporting improved
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control and prevention of VBDs				
Objective 2: Strengthening of VBDs control capacities				
1.1 Capacity building of relevant staff for effective VBDs control	<ul style="list-style-type: none"> - Recruit employees and workers - Procure equipment and supplies - Train employees and workers 	2013-2014	MOH, Municipalities, GAM	<ul style="list-style-type: none"> - Well prepared and trained teams formed - Availability of required equipment - Number of trained employees and workers
1.2 Developing sustainable vector control methods including preparedness for emergency control	<ul style="list-style-type: none"> - Larviciding with Temephos of breeding places - Source reduction by filling of breeding places - Cleaning from vegetation and channelization of breeding places - Space spraying by thermal fogging or ULV during epidemics - Set plans for management of vectors during periods of high risk - Strengthen surveillance programs to detect incursions of vectors and VBDs through uncontrolled movements of illegal migrants and refugees - Develop more effective and rapid electronic exchange of surveillance data - Collaborate comprehensively with relevant organizations to minimize vector breeding potential and vector control 	2013-2017	MOH, GAM, Municipalities, MoEnv, MOA, MWI	<ul style="list-style-type: none"> - Surface area treated with larvicide - Proportion of population at risk potentially covered with larval control - Vector management plans during periods of high risk
Objective 3: Control of animal reservoir of <i>Leishmania major</i>				
3.1 Reduction of potential risk of CL transmission	<ul style="list-style-type: none"> - Form Leishmaniasis Control Unit within MOH - Train Leishmaniasis Control Unit team - Conduct environmental management and mechanical destruction of <i>Psammomys obesus</i> borrows and colonies - Conduct physical and chemical control of <i>Psammomys obesus</i> 	2014 2014-2017	MOH, Municipalities, GAM	<ul style="list-style-type: none"> - Number of <i>P. obesus</i> colonies destroyed. - Proportion of population at risk protected

Objective 4: Early case detection, accurate diagnosis and prompt treatment of VBDs				
4.1 Improvement in diagnosis and treatment of VBDs	<ul style="list-style-type: none"> - Train laboratory technicians on preparation and testing of samples - Train medical staff on treatment and case management - Provide more doctors with appropriate specializations - Improve access to healthcare for remote communities and vulnerable groups - Ensure necessary resources are available for public health officers 	2014-2015	MOH	<ul style="list-style-type: none"> - Percentage of suspected cases that received parasitological test - Percentage of confirmed cases that received first line treatment according national policy - Remote communities have medical access
Objective 5: Health care providers awareness and education on prevention and management of VBDs				
5.1 Provision of more healthcare providers with appropriate awareness and education on prevention and management of VBDs	<ul style="list-style-type: none"> - Train health care providers on Malaria and Bilharzia diagnosis and treatment - Train dermatologists on CL diagnosis and treatment 	2014-2015	MOH	<ul style="list-style-type: none"> - Number of health care providers trained on diagnosis and treatment. - Number of dermatologists trained on diagnosis and treatment
Objective 6: Community involvement on the prevention and control of VBDs				
6.1 Ensure that the local community is aware of VBDs and the risks connected with living or recreating near vector breeding habitat	<ul style="list-style-type: none"> - Develop, plan, and conduct out-reach awareness programs that covers schools, universities and local communities - Develop, plan, and conduct educational campaigns to educate the general public of the risks of VBDs - Prepare educational materials and print - Produce media materials (Television and radio stations), newspaper - Adapt awareness and educational materials according to the targeted group - Encourage and support local societies to 	2014-2015 (Continuous)	MOH, Public Media, CSOs, NGOs	<ul style="list-style-type: none"> - Number of educational messages by Mass media - Number of populations targeted with educational campaigns - Number of leaflets distributed

	<p>promote public awareness campaigns on VBDs</p> <ul style="list-style-type: none"> - Promote health and hygiene among migrant populations and travelers - Strengthen collaboration between the health sector and planning, agricultural, forestry, water, environment, conservation sectors on projects and issues that affect VBDs 			
Objective 7: Monitoring and evaluation of control interventions and programs				
7.1 Improvement of control interventions and programs and increase efficiency	<ul style="list-style-type: none"> - Train national officers and supervisors on monitoring and evaluation of field control interventions - Train 20 workers on entomological field and laboratory techniques 	2015	MOH	<ul style="list-style-type: none"> - Number of officers trained on M&E of field control interventions - Number of workers trained on entomology techniques
7.2 Establishing a database that will provide baseline of information for monitoring and control of VBDs	<ul style="list-style-type: none"> - Compile all records for VBDs (Malaria, leishmania and schistosomiasis) reported to MOH - Compile all reports and previous studies on the VBDs in Jordan - Construct a webpage that includes records, reports etc on VBDs 	2013-2017	MOH	<ul style="list-style-type: none"> - Database established - Webpage established
Objective 8: Early warning system for VBDs				
8.1 Early prediction of increased risk of VBDs occurrence and epidemics due to climate change	<ul style="list-style-type: none"> - Set a system with the Meteorological Department for collection of data on climate parameters (weather forecasts) - Establish links between climate change and VBDs - Identify indicators, alarming signals, means of communication - Identify response actions and interventions - 	2014-2017	MOH, MD, other relevant sectors	<ul style="list-style-type: none"> - Functional EWS on VBDs and climate change - Reduction of local epidemics of Malaria - Reduction of local epidemics of Urinary Schistosomiasis - Reduction of incidence and epidemics of Cutaneous Leishmaniasis - Numbers of alarms
8.2 Maintain	<ul style="list-style-type: none"> - Training of surveillance workers on case 	2014-2017	MOH, MOA,	<ul style="list-style-type: none"> - Number of surveillance workers

preparedness of EWS prediction and response	<p>detection and sample collection</p> <ul style="list-style-type: none"> - Maintain a strategic standby storage of necessary resources for prevention, treatment and control of VBDs 		MOM, GAM	<p>trained on case detection</p> <ul style="list-style-type: none"> - Proportion of units and health districts provided with the needed stocks of drugs and insecticides
NUTRITION AND FOOD SAFETY				
Objective 1: Strengthening the nutrition surveillance by developing health forecast system for acute malnutrition and any climate sensitive diseases				
<p>1.1 Establish an efficient, easy to conduct, and sustainable nutritional surveillance system, which enhances the availability of a reliable and sustainable database on the nutritional status of people at the national level</p>	<ul style="list-style-type: none"> - Assess nutrition status, especially among vulnerable population groups to track trends in nutrition status over time. - Identify potentially at risk areas (early warning systems), and advocacy / empowerment of decision-making for the type of interventions required - Target population groups through reliable available database by collecting : <ul style="list-style-type: none"> - Population-based information which includes census, Civil Registration - Population surveys, through: <ul style="list-style-type: none"> - Large scale national surveys, such as DHS and MICS - Repeated small scale surveys - Rapid nutrition assessments - Services-based information (routine collection of data) from health services records, records of school-based programs 	2013-2017	MOH, DOS, NGOs, WHO, UNICEF, Red Cross	<ul style="list-style-type: none"> - Surveillance records established including datasets on the following: <ul style="list-style-type: none"> - % of children and pregnant women screened - Admission cases - Number of transferred cases - Number of nutrition campaigns - Number of therapeutic feeding centre established - Cases of deaths - People trained - Guidelines approved
Objective 2: Increasing awareness of the population through regular training workshops and capacity building on health and nutrition education				
2.1 Provision of nutrition	<ul style="list-style-type: none"> - Massive Screening effort and use of nutrition 	continuously	MOH, Mass media,	<ul style="list-style-type: none"> - Hours of broadcast - Number of people attending

information and knowledge needed to acquire new skills to help people understand their nutrition health situation and to voluntarily choose actions that improve their health	<p>messages for awareness raising</p> <ul style="list-style-type: none"> - Nutrition Week or Campaign to reach every child with screening and treatment of SAM - Develop communication materials for nutrition intervention for a proper counseling - Take advantage of MCH Week and add relevant Nutrition interventions 	<p>continuously</p> <p>2013–2017</p> <p>continuously</p>	<p>MOH, Mass media, NGOs, WHO, UNICEF, Red Cross MOH</p> <p>MOH</p>	<p>nutrition education activities</p> <ul style="list-style-type: none"> - % of malnourished children that are treated - Number of nutrition campaigns - Leaflets and brochures - produced and distributed to target population - Number of nutrition campaigns - Number of people attending the nutrition education activities
2.2 Capacity building and development to improve and Scale-up the quality of service	<ul style="list-style-type: none"> - Conduct training, supervision, facilitation, mentoring, on-the job training, monitoring etc - Four Major Categories of Training: - Nutrition in Emergencies (for Managers)- 5 days training - CMAM–(Community-based Management of Acute Malnutrition) for service providers - 3 days - Facility Based Management of SAM (Sever Acute Malnutrition)- 4 days - Nutrition Information System/ Nutrition Surveillance - Orientation of District Managers – 1 day - Develop communication material for each of the intervention and equip the service providers for proper counseling 	2013-2014	MOH	<ul style="list-style-type: none"> - Number of training programmes adopted - Number of Trained personnel
		2013-2014	MOH NGOs (WHO and UNICEF Red Cross)	<ul style="list-style-type: none"> - Number of training programmes adopted - Number of Trained personnel - Guidelines approved
	2013-2014	MOH		
Objective 3: Supporting and strengthening preventative health nutrition programs (fortification and supplementation) and projects within public health divisions, with emphasis on community involvement projects				
3.1 Establishing continuous supplementation programmes to high-risk groups at high-risk areas	<ul style="list-style-type: none"> - Capacity Building and capacity development to improve the quality of service 	<p>2013-2017</p> <p>continuously</p>	<p>MOH, NGOs, WHO, UNICEF, Private sector, hospitals</p> <p>MOH, Mass media,</p>	<ul style="list-style-type: none"> - Assessment report for the number of pregnant women and children under five years who had supplements of Iron ,folic acid and B12dose

e.g. supplements of iron, folic acid, and B12 to pregnant women attending health facilities; regular supplements of iron to all less than five years of age, especially for those under two years of age	- Develop and maintain operative national supplementation program		NGOs, WHO and UNICEF	
3.2 Diversification consumption of iron rich foods and vitamin A	- Public health education for diversification consumption of iron rich foods and vitamin A - Develop communication material for each of the intervention for proper counseling	continuously 2013-2017	MOH, Mass media, NGOs, WHO and UNICEF MOH	- Number of people attending the nutrition education - Number of Educational programmes adopted - Hours of broadcast - Leaflets and brochures - Produced and distributed to target Population
3.3 Disseminating supplementation programmes of vitamin A to target groups through distribution of vitamin A supplementation to infants at the time of measles and MMR vaccination, giving one shot of vitamin A to every case of measles, and mass campaign to cover primary school children in under-privileged areas with two doses of vitamin A	- Capacity Building and capacity development (training the health care providers on the adopted supplementation program) - Develop a package of guidelines and education material for health care providers - Nutrition Week or Campaigns - Mass campaigns	2013-2017 2013-2017 continuously	MOH, Private sector, hospitals MOH MOH, Mass media	- Number of training programmes adopted - Number of Educational programmes adopted - Guidelines approved - Number of nutrition campaigns - Hours of broadcast
3.4 Giving postpartum women one dose of vitamin A within six weeks after delivery	- Take advantage of MCH Week and add relevant nutrition interventions	continuously	Private sector, hospitals	- Assessment report for the number of women who had vitamin A dose

3.5 Developing communication strategy for behavior change	- Developing IEC materials and mass media programmes.	continuously	MOH	- Leaflets and brochures - Produced and distributed to target Population - Hours of broadcast
3.6 Promote exclusive breast feeding and complementary feeding practices	- Training, supervision, facilitation, mentoring, on-the job training, monitoring etc - Develop a package of guidelines and education material for health care providers	continuously 2013-2014	MOH MOH, NGOs, WHO and UNICEF	- % of exclusive breast fed baby - Number of Trained personnel - Guidelines approved
3.7 Strengthening Monitoring and Evaluation (M&E) for the flour fortification program and lodization program through capacity building and research	- Conducting continuous monitoring and evaluation for the nutrition programmes - Conducting surveys and researches for the assessment of the program	continuously 2013-2017	MOH, JFDA, MOIT, Private sector (mills and bakeries) MOH	- Assessment reports for number of visits for the mills and bakeries - Research conducted

Objective 4: Strengthening the emergency preparedness and monitoring and management of food insecurity and acute malnutrition programmes and initiatives via research on food insecurity and malnutrition in Jordan in light of climate change

4.1 Undertaking research on population and on individual level to provide a solid basis for Prevention and control food insecurity and acute malnutrition (hidden hunger) for high risk people in high risk areas	- Establish the community based approach works and building capacity in risk group and areas - Conduct research on food insecurity and malnutrition in Jordan in light of climate change. - Education and sensitization of the community so that they know how and where to bring their malnourished patients for screening and treatment	2013-2017 2013-2017 continuously	MOH, Private sector hospitals, NGOs MOH MOH, NGOs, Private sector hospitals, Mass media	- Number of training programmes adopted - Number of Trained personnel - Number of CMAM – Community-based Management of Acute Malnutrition campaigns - Research conducted - Number of Educational programmes adopted - Total number of emergency care unit visits for children under 5 years and pregnant women - Number of transferred cases
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HEAT WAVES

Objective I: Provide a coordinated approach and functional cooperation between the sectors and the lead body to address heat waves

1.1 Establishment of a Steering Committee on Climate Change /Heat Waves and Health lead by MOH, and composed of members from other relevant bodies	<ul style="list-style-type: none"> - Appoint focal person (Coordinator) from MOH responsible for monitoring the implementation of the Heat/Health adaptation activities - Facilitate engagement in the implementation of Heat/Health Adaptation Strategy - Hold regular meetings of Committee 	2013 2013-2017 2013-2017	MOH in collaboration with other governmental and non-governmental sectors	<ul style="list-style-type: none"> - Decision to appoint the Coordinator signed by the MOH Minister - Minutes of meetings - Annual evaluation of Steering Committee work
1.2 Improvement of cooperation between MOH and other relevant sectors	<ul style="list-style-type: none"> - Strengthen institutional cooperation between the relevant institutions by assigning working groups for implementing activities 	2013-2017	MOH and other sectors	<ul style="list-style-type: none"> - Policy documents outlining heat wave action plans - Signed decisions appointing working groups
Objective 2: Raise public awareness about heat waves and their impacts on health				
2.1 Establishment of a national committee led by MOH in charge of raising public awareness on the health impacts of heat waves	<ul style="list-style-type: none"> - Develop a national communication strategy on the health impacts of heat waves - Prepare, print, and distribute information to the public about the impact of heat waves on health and protection measures during these events - Conduct workshops to raise awareness - Provide online access to all available information on the effects of heat waves on health 	2013–2017 2013–2017 Summer months 2013-2017 2013-2017	MOH, IT Department, other relevant bodies, NGOs, private sector, media	<ul style="list-style-type: none"> - Minutes of meetings - Educational leaflets and brochures produced and distributed to target population - Number of messages released - Number of workshops organized - Active website with regularly updated information
2.2 Capacity building of medical personnel on the effects of heat waves on health	<ul style="list-style-type: none"> - Prepare educational materials for general practitioners on climate change and heat waves, symptoms, diagnosis, intervention and treatment - Conduct training sessions/courses 	2013-2017	MOH	<ul style="list-style-type: none"> - Number of general practitioners trained
2.3 Introduction of climate change- heat waves related modules into secondary school and medical school curricula	<ul style="list-style-type: none"> - Prepare educational modules on heat waves and health - Introduce modules into educational programs 	2013- Before the start of the academic year	MOH, Ministry of Education, Universities (Medical faculties)	<ul style="list-style-type: none"> - Number of Educational programs adopted

Objective 3: Establish an integrated, efficient, and effective early warning system for heat waves				
3.1 Development of Heat Health Warning System	<ul style="list-style-type: none"> - Identify weather indicators - Identify health indicators related to heat waves - Develop data collection, processing, and dissemination systems - Create close coordination with MD 	2013–2017	MOH, MD, Media, Private hospitals, Crisis Management Centre, Civil Defense, MoEnv, Municipalities, NGOs	<ul style="list-style-type: none"> - Functional Heat Waves Warning System
Objective 4: Develop public health preparedness and intervention capacity for the health impacts of heat waves				
4.1 Enhancement of preparedness of hospitals and health care services during heat waves	<ul style="list-style-type: none"> - Ensure bed availability especially in emergency departments - Ensure availability of sufficient number of ambulances - Identify and actively monitor high risk patients to identify symptoms associated with heat - Adapt pharmacological treatments - Postpone non-emergency surgery - Increase medical care staff to ensure full coverage in case of an increase in admissions - Ensure high risk patients are placed in rooms with air conditioning - Increase patients' liquid intake and modify diet - Adjust patient bed and personal clothing - Train first aid and emergency room personnel - Enhance response to vulnerable groups/areas 	2013-2017	MoH, private hospitals, Educational hospitals, RMS, Civil Defense	<ul style="list-style-type: none"> - Number of trained medical staff on heat waves illnesses, symptoms and treatment - Areas within hospitals with air-conditioning - Written procedures for heat waves events and increased admissions
4.2 Capacity building of health professionals, support staff, parents in charge of vulnerable groups – elderly, hostels, day-care centers, schools	<ul style="list-style-type: none"> - Educate parents , teachers , care givers about heat risks of heat waves via media, educational materials, lectures, workshops - Train health professionals on impacts of heat waves and required measures to prevent heat-related illnesses 	2013-2017	MOH, Ministry of Social Development, Ministry of Education, CSO	<ul style="list-style-type: none"> - Number of trained health professionals and support staff - Number of information sessions held

4.3 Assessment of personal exposures associated with heat-related illness	<ul style="list-style-type: none"> - Develop reporting system to collect data on heat wave related admissions and illnesses - Adjust work schedules to avoid heat-stress exposure 	2013-2017	MOH, Hospitals, Civil Defense	<ul style="list-style-type: none"> - Assessment reports - Reports on working schedules-workplaces reports
4.4 Identification of people at risk and register of vulnerable individuals/groups	<ul style="list-style-type: none"> - Develop a registry for vulnerable groups - Design intervention measures - Evaluate efficacy of intervention 	2013-2017	MOH	<ul style="list-style-type: none"> - Registry book –vulnerable groups
Objective 5: Develop a national surveillance system for heat-related morbidity and mortality				
5.1 Set up a surveillance system for health outcomes due to heat waves	<ul style="list-style-type: none"> - Standardize information collected on heat waves to accurately measure morbidity and mortality due to heat waves. Include the following: <ul style="list-style-type: none"> - all-cause mortality data - hospital admissions - public health line phone calls - GP's records on morbidity data - ambulance calls, fire brigade calls - interventions and emergency department visit 	2013-2017	Emergency medical services of MOH, private hospitals, Educational hospitals, on-duty medical units, Civil Defense, Civil Registry Bureau	<ul style="list-style-type: none"> - Number of calls/cases/ emergency unit visits - Total number of emergency unit visits for children under 1 year and for people > 75 - Number of hospital admissions after emergency unit visits - Number of transferred cases, deaths, and day of death - Number of deaths
Objective 6: Infrastructure development to protect health from heat waves (by other sectors)				
6.1 Improve housing and public buildings design and construction materials	<ul style="list-style-type: none"> - Increased albedo of building envelope - External shading Insulation 		Municipalities, MoEnv, MOPW, Engineers Association	<ul style="list-style-type: none"> - Insulated buildings and codes
6.2 More effective design for air conditioning units	<ul style="list-style-type: none"> - Decreasing internal heat load - Passive cooling technologies - Efficient active cooling 		Ministry of Energy, Electricity Companies, Research institutes	<ul style="list-style-type: none"> - Developed designs for air conditioning
6.3 Improve urban design to reduce heat island effect	<ul style="list-style-type: none"> - Using plants and trees to create shading and reduce heat absorption and exposure - Develop regulations for urban design 		Municipalities, MoEnv, GAM	<ul style="list-style-type: none"> - Developed Urban Design Regulations

	<ul style="list-style-type: none"> - Decrease the distance between bus stops stations to decrease the exposure to high temperature under the sun - Maintain and repair the vehicles and provide air conditions to them 			
6.4 Encourage alternative energy	<ul style="list-style-type: none"> - Develop regulations for energy management - Develop programs to encourage alternative energy 		Ministry of Energy, Electricity Companies, MoEnv, Research institutes	<ul style="list-style-type: none"> - Leaflets for encouraging alternative energy
6.5 Extend opening hours of public swimming pools and increase their number	<ul style="list-style-type: none"> - Upgrade water infrastructure - Construct swimming pools 		Municipalities, Ministry of Tourism, MWI	<ul style="list-style-type: none"> - Number of accessible swimming pools
6.6 Ensure adequate telecommunication infrastructure is in place	<ul style="list-style-type: none"> - Upgrade Telecommunication infrastructure 		Ministry of Telecommunication, Civil Defense,	<ul style="list-style-type: none"> - Reports on telecommunication infrastructures

OCCUPATIONAL HEALTH

Objective I: Enhance cooperation and coordination between the relevant institutions responsible for occupational health and safety

1.1 Establishing a multi-sectoral committee from the relevant institutions responsible for occupational health and safety	<ul style="list-style-type: none"> - Appoint focal person (Coordinator) from MOH - Prepare Committee's TOR and mandate - Set up Committee for monitoring the implementation of the activities in the plan of action of the Climate Change Occupational Health Strategy - Hold regular meetings - Strengthen intersectoral cooperation and assign working groups for implementing climate change adaptation activities to protect the health of workers 	<p>2013</p> <p>2013-2017</p>	<p>MOH</p> <p>MOH, MoEnv, MOL, MOPIC, MD, SSC, IOHS, Coordinator</p>	<ul style="list-style-type: none"> - Decision to assign Coordinator - Decision to assign the Committee - MoM - Annual evaluation of the Committee's work - Decisions for appointing working groups - Tasks performed by working groups
1.2 Design programs to monitor the risks	<ul style="list-style-type: none"> - Assess climate change threat to workers' health 	2013-2017	MOH MOH and MD	<ul style="list-style-type: none"> - Assessment reports

connected with climate change and its impact on the health of workers	- Monitor climate change parameters (maximum temperatures, rainfall, UV index), and morbidity and mortality connected to climate change			
1.3 Upgrading health system's capacities for preventing occupational diseases and injuries related to climate change	- Prepare a training guide on diagnosis, symptoms and prevention of occupational diseases and injuries related to climate change - Train healthcare providers on the risks connected to climate change	2013-2017	MOH, IOHS MOH, IOHS	- Training Guide - Number of trained healthcare providers
Objective 2: Raise the awareness of employers and employees about climate change and its effect on health				
2.1 Design awareness materials on climate related work illnesses and preventive and adaptation measures	- Prepare, print, and distribute information on the impact of climate change on workers' health and protection measures during high/ low temperature - Participate in TV shows, radio programs, etc on the impact of climate change on workers' - Train general practitioners on the impact of climate change on occupational illnesses - Add a link on MOH website on occupational health and climate change - Regular media briefings	2013-2017	MOH, Multi-sectoral Committee MOH	- Number of leaflets and brochures produced and distributed to the employees and employers - Number of TV shows and radio programs - Number of GPs trained - Active web site with regularly updated information - Number of media briefings
2.2 Introduce modules on climate change and occupational health	- Prepare educational materials and programs for graduate and postgraduate curricula	2013-2014	Medical faculties, MOH, Ministry of Higher Education	- Educational programs and curricula adopted
Objective 3: Establish an integrated and effective approach for prevention, early warning, and management to overcome the health consequences of heat waves/ cold weather induced by climate change on occupational health				
3.1 Regular monitoring of occupational health illnesses and link to climate change	- Establish a surveillance system within the Occupational Health Directorate - Establish close coordination with MD	2013-2017	MOH	- Functional surveillance system established
3.2 Categorize climate change vulnerable occupations	- Conduct routine surveys on various occupations	2013-2017	MOH	- Number of surveyed occupations

	- Identify measures needed to prevent impacts of climate change			
3.3 Create cool zones and units within health facilities	- Procure air conditioners for major public hospitals - Identify major public hospitals to install cooling units for treatment of heat stroke	2013 2015	MOH	- Number of installed air conditioners - Number of cooling units procured and installed
3.4 Conduct regular educational campaigns targeting workers and employers on the adverse effects of working under hot/cold temperatures preventive measures	- Prepare training/educational/awareness materials on climate change and occupational diseases - Conduct training workshops for workers and employees	2013- 2017	MOH, IOHS	- Training materials prepared - Number of flyers and brochures produced - Number of training workshops conducted
3.5 Develop early warning system to protect workers' health from the climate change	- Develop early warning alert system regarding the weather, to protect workers' health - Introduction of legislation specifying the work/rest regimen and planning appropriate short-term interventions	2013-2016 2013-2014	MOH, MOL, MD	- Functional alert system for early warning - Legislation issued

Objective 4: Establish an integrated awareness system to protect workers, as well the public, from the adverse health impacts of exposure to UV radiation

4.1 Investigate establishing a system for monitoring the UV index and associated health risks on outdoor workers, as well as the public	- Investigate and coordinate with the MD developing UV index monitoring	2013-2014	MD and MOH	- Action plan for protection of workers from UV radiation prepared and adopted
	- Carry out clinical-epidemiological studies on workers to identify the impact of exposure to high UV index	2013-2017		- Operational measuring stations for the UV index
	- Identify and monitor vulnerable groups of workers exposed to UV radiation	2013-2017		- Number of outdoor workers trained and educated about the risks of and protection from UV radiation
	- Establish a database of occupational diseases associated with UV radiation	2014-2016		- Number of outdoor workers affected by UV radiation/ number of epidemiological studies conducted
	- Prepare a UV protection strategy and action plan	2014-2016		- Databases on workers' UV related diseases

4.2 Raise awareness among employees and employers on the harmful effects of UV radiation	- Prepare guidelines and other educational materials for workers and employers	2013-2014	MOH	- Number of educational materials produced
	- Inform, educate and raise awareness of outdoor workers, as well as the public on UV radiation	2013-2017		- Guidelines
	- Train defined target groups (workers)	2013-2017		- Number of trainings conducted

CHAPTER 9 ADAPTATION PROJECT PROPOSALS FOR THE SIX CLIMATE-SENSITIVE HEALTH ISSUES

NO	PROJECT TITLE	PROJECT JUSTIFICATION	OBJECTIVES	ACTIVITIES	INDICATORS	IMPLEMENTING AGENCY	BUDGET US\$
1.	Strengthening the surveillance system for respiratory diseases and establishment of a high sensitivity alert system in 6-8 sentinel hospitals	The data that was collected from the actual surveillance system for acute and chronic respiratory diseases is neither accurate nor reliable. The filing system for respiratory disease in health centers is based on disease groups. The system counts each group of these diseases as one entity; there is no detailed information in the registry (e.g. "group one" represents all the infectious diseases, "group nine" represents respiratory diseases)	<ul style="list-style-type: none"> - To identify the incidence and prevalence of respiratory diseases - To establish a sentinel surveillance system for respiratory diseases at health centers and hospitals 	<ul style="list-style-type: none"> - Form steering committee and write study protocol - Select sentinel sites - Risk assessment through systematic review of the existing surveillance system - Conduct training workshops and seminars for health workers - Design and print logbooks and reporting forms - Pilot Data collection - Quarterly data analysis - Hold first, second, and final Annual Dissemination Workshops - Ongoing weekly data collection 	<ul style="list-style-type: none"> - Steering committee formed - MoMs of Meetings - 3 Workshops convened - Logbooks and forms - Data for one quarter - Database for respiratory diseases - Magnitude of respiratory diseases 	MOH	200,000 (3-year project)
2.	Assessment and Mapping of the areas that have potential adverse effect on respiratory diseases (pollen or other allergens)	Adaptation practices require extensive high quality data and information on climate, health, social systems, environment, and agriculture. Detailed, data on natural resources are still lacking and scattered among institutions. There is a need for building a spatial database of different	<ul style="list-style-type: none"> - To build a spatial database to identify agro-ecological zones - To create multiple layer maps needed to determine any correlation or association between the 	<ul style="list-style-type: none"> - Form steering committee and write protocol - Carry out systematic review to identify the existing available data and map layers - Classify the different zones in terms of potentiality to respiratory diseases - Procure IT tools and laboratory instruments 	<ul style="list-style-type: none"> - Steering committee formed - MoMs of Meetings - Report on identified risk areas - Purchase instruments and tools - Database created - Workshop convened - A national database 	Royal Jordanian Geographic Centre, MOA, MoEnv, GAM, and MOH	2,000,000 (2-year project)

NO	PROJECT TITLE	PROJECT JUSTIFICATION	OBJECTIVES	ACTIVITIES	INDICATORS	IMPLEMENTING AGENCY	BUDGET US\$
		layers.	<p>climate variables and risk factors for respiratory diseases</p> <ul style="list-style-type: none"> - To create background for research and provide information for decision makers - To predict losses in the agricultural sector resulting from climate change 	<ul style="list-style-type: none"> - Collect and compile data, maps, and satellite images on the different resources of the agro-ecological zones - Convene final workshop 	<p>established</p> <ul style="list-style-type: none"> - Bulletins and maps on the agro-ecological zones in Jordan - Indicators for predicted losses resulting from climate change 		
3.	Establishment of air pollutants monitoring system focusing on ground level Ozone	Ozone is a powerful oxidant that has been associated with persistent structural airway and lung tissue damage. It contributes to more severe symptoms of asthma. Higher concentrations of ground-level ozone if accompanied with high temperature will lead to increasing frequency and severity of respiratory attacks, decrease lung function, aggravate asthma, exacerbate of chronic obstructive pulmonary disease and increase of hospital admissions for respiratory diseases with risk of premature death. There is no monitoring system for ground-level ozone in Jordan	<ul style="list-style-type: none"> - To establish a surveillance system for air pollutants, mainly ground-level ozone concentration - To establish a database 	<ul style="list-style-type: none"> - Form steering committee and write protocol - Systematic review to identify the existing available data - Procure laboratory instrument, reagents, and spare parts - Conduct training workshops - Collect and compile data - Convene final project workshop 	<ul style="list-style-type: none"> - Steering committee formed - MoMs - Procuring instruments, tools, reagents, and spare parts - Workshop convened - Database created - Bulletins and reports 	MoEnv, RSS, GAM, MOH	2,380,000 (3-year project)

NO	PROJECT TITLE	PROJECT JUSTIFICATION	OBJECTIVES	ACTIVITIES	INDICATORS	IMPLEMENTING AGENCY	BUDGET US\$
4.	Improving the management of Chronic Airway Diseases (Bronchial Asthma and Chronic Obstructive Respiratory Diseases (COPD))	There are no written protocols for the management of Bronchial Asthma and COPD in Emergency Rooms or to admitted patients at hospitals	<ul style="list-style-type: none"> - To reduce the risk of complications of diseases and treatment - To provide effective delivery service - To maintain ongoing medication supply for patients - To maintain the supply of adequate number of ventilators 	<ul style="list-style-type: none"> - Form steering committee and select sentinel sites - Systematic review of the existing respiratory diseases management protocols for Asthma and COPD - Review of management protocols from other countries - Prepare management guidelines - Establish asthma management corners in emergency department - Conduct training workshops and seminars for health care providers 	<ul style="list-style-type: none"> - Steering committee formed - TOR for steering committee - MoMs - Guidelines prepared - Asthma corners established - Equip asthma management corners in Emergency Departments - 5 Workshops convened - Supervisory visits 	MOH	240,000 (3-year project)
5.	Web-based notification for communicable and diarrheal diseases	Surveillance system in Jordan depends mostly on notifications from health providers (passive surveillance). Current surveillance includes about 45 infectious and diarrheal diseases. Notification to reporting sites and to DCD is done by fax or telephone, and does not enable DCD to follow the situation promptly	<ul style="list-style-type: none"> - To ensure early detection of outbreaks, including outbreaks due climate change-sensitive pathogens - To intervene promptly - To improve supervision 	<ul style="list-style-type: none"> - Develop a web-based surveillance system for data collection and analysis via user-friendly internet software - Train of staff on data entry and analysis 	<ul style="list-style-type: none"> - Functioning and updated system in health care facilities - Functioning and updated system in reporting sites - Functioning and updated system in DCD 	DCD/ MOH and reporting sites	85000
6.	Hygiene Promotion: an important measure to reduce the	Diarrheal diseases are still considered a health problem in Jordan (in 2010, 131000 cases of diarrhea were reported). This problem is more apparent in children	<ul style="list-style-type: none"> - To prevent or mitigate disease outbreak risks by adhering to safe hygiene practices - To develop and 	<ul style="list-style-type: none"> - Design materials by DCD through in-depth consultation with children, women/mothers and the community - Distribution of awareness 	<ul style="list-style-type: none"> - Number of conducted training workshops - Number of distributed awareness materials 	DCD/ MOH, MOEDU, Media	200000 (for 2 years)

NO	PROJECT TITLE	PROJECT JUSTIFICATION	OBJECTIVES	ACTIVITIES	INDICATORS	IMPLEMENTING AGENCY	BUDGET US\$
	incidence of water and food borne diseases linked to climate change	less than 5 years of age. Incidence of water and food borne diseases is affected by hygiene	<p>test programs on hygiene behavior change focusing on hand washing with soap and water, in particular before handling food and after contact with faecal material</p> <ul style="list-style-type: none"> - To develop materials and tools to promote hygiene behavior change - To raise awareness of the importance of improved hygiene in diarrhea prevention - To promote hygiene awareness through education in schools, involving children as agents of change 	<p>materials to the target group</p> <ul style="list-style-type: none"> - Train teachers and community leaders - Capacity building of health educators - Launch mass media Programs (TV, Radio, Newspapers, etc.) 	- Number of media messages		
7.	Protect health from the risks associated with wastewater reuse and implementation of adaptation	Climate change is expected increase water scarcity in Jordan. 60.8MCM of the total quantities of generated treated wastewater is being stored in reservoirs and only used indirectly in unrestricted agriculture in the Jordan	<ul style="list-style-type: none"> - To carry out risk analysis regarding re-using treated wastewater in irrigation along the Zarqa river - To monitor, evaluate and 	<ul style="list-style-type: none"> - Develop infrastructural measures - Develop institutional and regulatory framework for safe use of treated wastewater - Upgrade national health guidelines for safe 	<ul style="list-style-type: none"> - Number of households using treated wastewater for domestic irrigation - Percentage of treated wastewater amounts used in irrigation 	MOH	175000

NO	PROJECT TITLE	PROJECT JUSTIFICATION	OBJECTIVES	ACTIVITIES	INDICATORS	IMPLEMEN- TING AGENCY	BUDGET US\$
	measures in Al-Zarqa River basin	Valley, while 44.2MCM is used directly in restricted agriculture and the remaining 5MCM is left without any use because of its bad quality. Health risks resulting from increased use of wastewater must be minimized	<p>analyze the health impact of the existing practices and associated risks</p> <ul style="list-style-type: none"> - To strengthen the capacity of MOH and other stakeholders in controlling water and food-borne diseases linked to reuse of treated wastewater - To transfer the experience, knowledge and lessons learned at the national and regional level 	<p>wastewater reuse using the risk assessment approach</p> <ul style="list-style-type: none"> - Develop a manual and operating procedures on health protection measures for all vulnerable groups (farmers, nearby communities, and consumers) - Develop operational wastewater reuse safety plan and implement at 10 selected sites - Increase the capacity related to health protection measures - Strengthen monitoring and surveillance capacity 			
8.	Education to raise awareness for using safe drinking water	Diarrheal diseases are still considered a health problem in Jordan; contamination of water is an important factor. Awareness of the risks associated with drinking and using contaminated water is key to reducing diarrheal diseases	<ul style="list-style-type: none"> - To establish active surveillance to determine the level of knowledge and awareness of the population about the use of safe water in selected (vulnerable) sites - To raise awareness of the population on the use of safe water - To educate the public on the 	<ul style="list-style-type: none"> - Design educational materials - Distribute materials to target groups - Launch mass media programs (TV, Radio & Newspapers) 	<ul style="list-style-type: none"> - Number of distributed awareness materials - Number of messages, programs, etc by the mass media 	DCD/ MOH	122,000

NO	PROJECT TITLE	PROJECT JUSTIFICATION	OBJECTIVES	ACTIVITIES	INDICATORS	IMPLEMENTING AGENCY	BUDGET US\$
			methods/techniques that can be used to prevent water contamination or improve drinking water safety -				
9.	Malaria Vectors: Ecological research and surveillance development	At least 13 species of <i>Anopheles</i> mosquitoes are known to breed in Jordan. The current distribution and ecological requirements of these species are poorly known and requires updating to identify areas of higher risk for malaria.	<ul style="list-style-type: none"> - To identify priority malaria vectors for ecological research and surveillance capability development - To ascertain the current status of the ecology of malaria vectors at targeted locations in Jordan 	<ul style="list-style-type: none"> - Identification of the study sites - Sampling and data collection - Identification of collected samples - Mapping - Drafting a report and scientific paper 	<ul style="list-style-type: none"> - Report indicating study sites and initial sampling effort - List of identified samples - Bimonthly meeting - Distribution maps and a data set for all mosquitos' species collected from study sites 	MOH / Parasitic and Zoonotic Diseases Division	26500
10.	Establishing a Leishmania Unit in the Division of Parasitic and Zoonotic Diseases	Jordan is considered an endemic country for cutaneous leishmaniasis. So far, there is no specialized unit to deal with all aspects of leishmania epidemiology and control in Jordan.	<ul style="list-style-type: none"> - To establish a well-equipped unit within the Division of Parasitic and Zoonotic Diseases for the purpose of training, diagnosis and control of leishmania 	<ul style="list-style-type: none"> - Establish Entomology Section: training for insect identification and sampling methods - Equip Diagnostic Laboratory laboratory with needed equipments and staff training - Hire and train medical doctor for Treatment Unit - Produce awareness materials for the general 	<ul style="list-style-type: none"> - Report on progress on activities - Forming the Entomology Section - Establish Leishmania Strain Unit - Training conducted for the Diagnostic Unit - Public awareness campaigns conducted - Data on number of 	MOH / Parasitic and Zoonotic Diseases Division	55000

NO	PROJECT TITLE	PROJECT JUSTIFICATION	OBJECTIVES	ACTIVITIES	INDICATORS	IMPLEMENTING AGENCY	BUDGET US\$
				public - Establish Leishmania Strain Unit to keep reference samples for further studies and comparison	treated infected persons reported biannually to MOH		
11.	Efficacy assessment of various environmental interventions against the rodent reservoir for the control of Zoonotic Cutaneous Leishmaniasis (ZCL) due to <i>Leishmania major</i> (<i>L.major</i>)	The public-health problem posed by CL in Jordan is expected to increase due to climate change, population growth and movement, and the current boom in construction and investments in some areas known to be active foci for CL.	<ul style="list-style-type: none"> - To assess and compare the efficacy of some environmental manipulation against the rodent host of <i>L. major</i> (<i>Psammomys obesus</i>, <i>Meriones</i>) for the control of CL in two active foci - To reduce the rodent host population and incidence of CL among the population in the intervention sites of ZCL foci 	<ul style="list-style-type: none"> - Identification of the study sites (two similar ZCL foci will be identified and randomly selected for the application of either interventions) - Preparation of equipment and machines - Training of field teams - Application of control interventions - Data collection and analysis - Assess two various combined environmental control interventions - Reporting 	<ul style="list-style-type: none"> - Report indicating study sites and initial control efforts - Bimonthly meetings held - Final results with statistical treatment for the control methods 	MOH / Parasitic and Zoonotic Diseases Division	20000
12.	Geographical Distribution of the Intermediate Host Snail of <i>Schistosoma heamatobium</i> in Jordan	Urinary Schistosomiasis is an epidemic prone helminthes infection in Jordan. The potential risk of local transmission and spread is exclusively connected to the presence of the intermediate snail host (<i>Bulinustrancatus</i>). Geographic Information System (GIS) technologies are being used increasingly to	<ul style="list-style-type: none"> - To identify positive sites for <i>Bulinustrancatus</i> snails in Jordan with high risk of Urinary Schistosomiasis sporadic transmission and epidemics - To develop 	<ul style="list-style-type: none"> - Survey main water bodies - Train field work teams on use of GPS - Collect data - Test the site for the presence of <i>Bulinustrancatus</i> snails and collect a snail sample - Data entry, analysis and map production - Create data base for further analysis and mapping 	<ul style="list-style-type: none"> - Report with final results and maps using GIS - Bimonthly meetings held - Publishing scientific paper 	MOH / Parasitic and Zoonotic Diseases Division	20000

NO	PROJECT TITLE	PROJECT JUSTIFICATION	OBJECTIVES	ACTIVITIES	INDICATORS	IMPLEMENTING AGENCY	BUDGET US\$
		study the spatial distribution of vectors, intermediate hosts and the occurrence of VBDs.	mapping and GIS of <i>Bulinus truncatus</i> distribution in Jordan - To identify species of <i>Bulinus</i> snails in Jordan	- Draft a report and scientific paper			
13.	Nutrition surveillance system	Sustainable food security strategy in Jordan is important to ensure adequate food of good quality while helping to stimulate rural economies and to promote the social and environmental aspects of sustainable agricultural development. Nutritional status is a key Millennium Development Goal (MDG) indicator of poverty and hunger, and assessing it is consequently a prerequisite for all policies, programs, and processes that have a role to play in global development. A suitable nutrition surveillance system enhances the availability of a reliable and sustainable database on the nutritional status of people at the national level	- To assess nutrition status, especially among vulnerable population groups to track trends in nutrition status over time and identify potentially at risk areas by the end of 2017 - Advocacy /empowerment of decision-making for formulating the policy for the type of interventions required to target population groups during the 5 years (2012-2017) - To evaluate the impact of interventions to decrease the disease burden cost during 5	- Capacity building and development (Training, facilitation, mentoring, on-the job training, etc.) - Orientation of District Managers and decision making (supervision, facilitation, mentoring, evaluation) - Review and update relevant nutrition interventions for the vulnerable group at risk areas - Capacity building for monitoring and evaluation	- Number of accurate (calibrated) weight and height scales delivered to MCH - Number of health centers with all needs for blood test for 3.000samples - Number of training workshops conducted - Pilot study conducted - Focal points for nutrition surveillance monitoring system assigned - Training courses for data entry and data analysis conducted - Training workshops for heads of health directorates conducted	MOH, DOS, NGOs, Private health services, WHO, UNICEF	323,000 (6-year project)

NO	PROJECT TITLE	PROJECT JUSTIFICATION	OBJECTIVES	ACTIVITIES	INDICATORS	IMPLEMENTING AGENCY	BUDGET US\$
			years (2012-2017) -				
14.	Nutrition survey	It is important to consider systems that are or could be affected by climate change, such as the vulnerability of food production systems to changes in temperature or precipitation, and how associated changes in food production could affect undernutrition. The vulnerability baseline includes a qualitative or quantitative description of the current distribution and burden of climate-sensitive health outcomes by vulnerable population and region. The assessment evaluates the effectiveness of current policies and programs, identifies potential modifications to current policies and programs, and develops new policies and measures that may be needed to prepare for and respond to current and emerging health risks associated with climate change.	<ul style="list-style-type: none"> - To build further evidence on the links between climate and malnutrition, on projected effects and on threats that specific climate change mitigation actions pose on nutrition, along with a knowledge base to inform future programming on climate change and nutrition - To provide decision-makers, humanitarian and nutrition policy-makers and practitioners with the information to scale up nutrition interventions that successfully address the growing impacts of and threats from climate change - To develop comprehensive 	<ul style="list-style-type: none"> - Conduct research on food insecurity and malnutrition in Jordan in light of climate change - Capacity Building (Training, facilitation, mentoring on-the job training, etc) - Capacity development - Establish a multi- sectoral higher committee for nutrition and climate change which will evaluate and scale up nutrition interventions - Develop communication strategy with key national professional and interest group 	<ul style="list-style-type: none"> - Multi sectoral committee established - Website and communication tools established - Training conducted to prepare supervisors and field workers - Questionnaires prepared and filled out - One-day pilot exercise conducted 	MOH, DOS, NGOs, Private health services, WHO, UNICEF, WFP, FAO, JFDA	420,000 (2-year project)

NO	PROJECT TITLE	PROJECT JUSTIFICATION	OBJECTIVES	ACTIVITIES	INDICATORS	IMPLEMENTING AGENCY	BUDGET US\$
			and multi-sector programming to face malnutrition –by developing and expanding nutrition interventions especially at community level which successfully and sustainably address the immediate and underlying causes of malnutrition and develop populations’ resilience to the growing Impacts of climate change, e.g., nutrition education and the introduction of Ready-to-Use Therapeutic Food (RUTF) and Community-based Management of Acute Malnutrition (CMAM)				
15.	Supporting and strengthening preventative health nutrition programs	Jordan has launched a wheat flour fortification program in 2002 to address iron and other micronutrient (folic acid, zinc, niacin, and vitamins	<ul style="list-style-type: none"> - To develop and Strengthen a Monitoring and Evaluation system - (M&E) to increase 	<ul style="list-style-type: none"> - Capacity building for the health inspectors - Capacity building for the workers inside the 14 mills in Jordan 	<ul style="list-style-type: none"> - Number of training programs adopted - Number of trained personnel - Number of mills that 	MOH, Ministry of Industry and Trade, JFDA, RSS, Forensic Sciences	10,800,000 (6-year project)

NO	PROJECT TITLE	PROJECT JUSTIFICATION	OBJECTIVES	ACTIVITIES	INDICATORS	IMPLEMENTING AGENCY	BUDGET US\$
	(Fortification and Supplementation)	A, B1, B2, B6, B12, and D3). Eight years after the initiation of wheat flour fortification, there were improvements in iron deficiency in Jordanian children and mean ferritin concentrations in women. The fortification program should continue with program monitoring. Due to high prevalence rate of vitamin A deficiency (18.3% among preschool children), MOH distributes vitamin A supplements to infants at the time of Measles and MMR vaccination. This program should also continue.	<p>the number of mills, which fortify wheat, flour from 85% to 100% by the end of 2017</p> <ul style="list-style-type: none"> - To reduce the prevalence of micronutrient deficiencies - To decrease the Prevalence of iron deficiency anemia among women of reproductive age by the end of 2017 from 19.8 to 18% - To decrease Prevalence of vitamin D deficiencies among women of childbearing age by the end of 2017 from 60.3% to 54% - To decrease Prevalence of vitamin A deficiency among children under 5 years of age by the end of 2017 from 18.3% to 16% 	<ul style="list-style-type: none"> - Capacity building for laboratory technicians on official methods of testing wheat flour samples - Fortify Mowahad wheat flour with micronutrients - Distribute vitamin A supplements to infants at the time of MMR vaccination - Capacity building for midwives supervisors in the twelve Health Directorates as focal points 	<p>add the premix</p> <ul style="list-style-type: none"> - Assessment report on the number of children under five years who had vitamin A supplements - Number of Guidelines distributed - Number of lab results meeting required recommendation of iron addition - Assessment report on the number of premix boxes distributed to mills 	laboratory, UNICEF	
16.	National	It is imperative to improve	- To provide	- Introduce nutrition	- Number of	MOH,	222,000

NO	PROJECT TITLE	PROJECT JUSTIFICATION	OBJECTIVES	ACTIVITIES	INDICATORS	IMPLEMEN- TING AGENCY	BUDGET US\$
	awareness strategy on nutrition and climate change	nutritional awareness among Jordanian families. This in turn ensures that all its members get sufficient quantities and appropriate variety of healthy food. This can be reflected in the changing pattern of food and protection from the impact of a lack of essential nutrients on the health of family members, especially women and children.	comprehensive nutrition information and education to consumers - To promote adequate micronutrient intake - To promote safe and healthy food choices - To improve nutrition awareness services in health sectors	education in school curricula, and ensure the availability of nutrition education publications - Conduct nutrition education campaigns - Promote consumption of fortified food - Prepare a guide to increase knowledge about food and micronutrients - Train health staff - Provide educational tools to improve the use of safe food and promote hygienic practices - Conduct training workshops - Build up the nutrition awareness capacity of primary health care staff	educational publications distributed - Number of trained personnel - Number of participants in campaigns - Food-bases dietary guideline prepared	MOEDU, JFDA,	(6-year project)
17.	Development of a collaborative and coordination project of multi-sectoral engagement to prepare for and face the consequences of heat waves in Jordan	Protection of the health requires adapting mutual solutions and adopting decisions from the in charge institutions, as well as from all relevant stakeholders. The principle of sharing responsibilities and effective inter-sectorial cooperation is fundamental for preventing adverse consequences of the negative environmental influences on health. The use of an integrated approach in managing the living environment and health risks	- To provide a coordinated approach and functional cooperation between the various sectors and institutions - To establish an integrated, efficient and effective approach for prevention, early warning, management, and overcoming the	- Appoint a responsible person from the MoH for monitoring the implementation of the activities in the Action Plan of the Adaptation Strategy - Set up an intersectoral Commission for Monitoring the Implementation of the National Climate Change Health Adaptation Strategy - Conduct regular meetings and distribute MOMs to the members of the Commission - Assign working groups for	- Decision to appoint the Coordinator - Decision to set up the Commission - Minutes of meetings - Annual evaluation of the Commission's work - Policy or government documents outlining heat wave action plans - Assessment reports - Number of trained health workers	MOH (PHCA, Hospitals Administration, Disaster Preparedness and Response Unit, Public Relations Directorate), MoEnv, MOT, MOEMR, MOEdu, Universities, RMS, Private	7760 (each year)

NO	PROJECT TITLE	PROJECT JUSTIFICATION	OBJECTIVES	ACTIVITIES	INDICATORS	IMPLEMENTING AGENCY	BUDGET US\$
		requires close collaboration by the leading sector (MOH) with other sectors (governmental, non-governmental, private, and NGOs).	health effects of heat waves - To raise public awareness about climate change and health effects of heat waves and its preventive measures	implementation of activities in the area of climate change - Assess the heat waves threat to people's health and property - Train health workers on risks connected with climate change		hospitals and clinics, UNRWA, Crisis Management Centre, MD, Municipalities, CDD, Electrical Company, NGOs, Media	
18.	Communication-awareness to protect the Jordanian population from the harmful health effects of heat waves	The public expects to be warned of any natural phenomena that endangers life and property. In the case of excess heat, communicating the risks of hot weather, heat waves, and what to do, are recommended elements of a summer and heat wave prevention strategy. As our climate continues to change, heat waves are expected to increase in the future. It is important to create greater awareness of the dangers of heat waves and to inform individuals about how to minimize the risks. Everyone is potentially at risk from heat-related illnesses, and death can result.	- To raise public awareness and increase knowledge about the effects of extreme heat on health - To change health-related behaviors and develop skills for behavioral change to improve self-care during extreme heat events - To provide educational and informative material regarding measures to reduce risk of damage or injuries	- Establish national communication and awareness committee - Conduct training workshops to educate physicians and nurses in ER in hospitals about the effects and management of heat waves - Prepare, print, and distribute information leaflets and brochures about the impact of heat waves on health and protection measures during high temperatures for general population - Prepare Heat-health communication campaigns - Provision of regular information messages to the public - Send promotional material	- List of members and sectors of the committee - Number of trained physicians and nurses - Number of training courses organized - Guidelines - Leaflets, brochures, posters produced and distributed - Messages produced and distributed - Active web site with regularly updated information - Number of TV shows - Number of implemented campaigns - Number of Reports - Number of	MOH (PHCA, Hospitals Administration, Disaster Preparedness and Response Unit, Public Relations Directorate), MoEnv, MOT, MOEMR, MOEdu, Universities, RMS, Private hospitals and clinics, UNRWA, Crisis Management	310,000 (5-year project)

NO	PROJECT TITLE	PROJECT JUSTIFICATION	OBJECTIVES	ACTIVITIES	INDICATORS	IMPLEMENTING AGENCY	BUDGET US\$
			<ul style="list-style-type: none"> and maintaining health and safety during heat waves - To improve the communication of risk of extreme events to vulnerable regions and groups tailored to meet their specific requirements - To reduce vulnerability in key sectors, ecosystems, districts and regions of the country - To monitor and evaluate the effectiveness of educational materials, knowledge, and communications 	<ul style="list-style-type: none"> in early May - During periods of high heat and humidity warnings, media releases are distributed and interviews in electronic and print media are conducted 	Educational materials and messages distributed	Centre, MD, Municipalities, CDD, Electrical Company, NGOs, Media	
19.	Establishment of real-time surveillance and evaluation system	Measuring the effect of climate change on human health is difficult. Health departments cannot protect people from existing or emerging climate change-related health threats, such as heat waves or vector-borne diseases, without correct and pertinent information.	<ul style="list-style-type: none"> - To estimate the magnitude of morbidity and mortality associated to heat waves - To identify risk factors - To identify geographic 	<ul style="list-style-type: none"> - Establish national committee for prevention and control of health effects of climate change - Establish a heat waves health surveillance unit for data collection and analysis - Prepare , print, and distribute special heat waves register 	<ul style="list-style-type: none"> - Number of reports received from sentinel hospitals - Number of guidelines distributed to health care facilities - Number of reports with detailed information - Accuracy of data 	MOH –NCD (PHCD), and relevant bodies	32,500 (5-year project)

NO	PROJECT TITLE	PROJECT JUSTIFICATION	OBJECTIVES	ACTIVITIES	INDICATORS	IMPLEMENTING AGENCY	BUDGET US\$
		Surveillance is ongoing and systematic collection, analysis, interpretation, and dissemination of health data. Real-time data systems can inform health decision-makers about abnormal outbreaks or clusters of health impacts. The lack of timely and comprehensive surveillance system existing in Jordan can delay the identification of and response to serious health problems related to heat waves.	<p>distribution of an event</p> <ul style="list-style-type: none"> - To identify high risk groups - To detect trends of disease over time - To evaluate control measures 	<ul style="list-style-type: none"> - Prepare notification list of diseases resulting from heat waves - Prepare surveillance guideline of heat waves and distribute to all health facilities - Prepare weekly reporting form for heat waves (by sex and age) and distribute to all health facilities - Prepare reporting forms of deaths (by age, sex and cause of death) - Prepare weekly, monthly and annual reports of health effects of heat waves and distribute to concerned bodies - Conduct training for health workers in emergency departments in hospitals and health centers on reporting and surveillance of health effects of heat waves - Procure computers for data entry and analysis 	<ul style="list-style-type: none"> - Detection of all cases and deaths due to heat waves - Number of workshop conducted - Number of trained health care workers - Number of computers procured - Number of cases registered 		
20.	Public health preparedness to environmental heat waves and extreme heat events	Heat wave events are likely to become more common and severe over time. Certain temperature thresholds are linked with significant increases in mortality and morbidity for a community. Heat wave associated with community infrastructure and	<ul style="list-style-type: none"> - To predict, as far in advance as is rendered possible by the technical means available, any possible meteorological risk situation - To minimize the 	<ul style="list-style-type: none"> - Phase I: Plan Before heat waves occurrence - Advising media and healthcare services and emergency departments of the alert situation - Activation of the specific action plans. - Intervention of health social 	<ul style="list-style-type: none"> - Number of prepared hospitals and emergency departments - Number of visits to people who are most vulnerable - Hot Hotline to provide information 	MOH in collaboration with other relevant government and non governments hospitals	388,000 (5-year project)

NO	PROJECT TITLE	PROJECT JUSTIFICATION	OBJECTIVES	ACTIVITIES	INDICATORS	IMPLEMEN- TING AGENCY	BUDGET US\$
		service dysfunction such as power outage and transport breakdown can lead to a surge demand on emergency medical systems and therefore require a disaster management response.	negative effects of heat on the population especially the vulnerable groups - To coordinate the measures and resources currently available in hospitals in order to deal with possible heat wave	services in the detection of most vulnerable people - Relocating people - Establish Hot hotline MOH (NCD) or Civil Defense hotline will provide information and advice - Prepare hospitals: emergency department, discharge non-emergency admission to allow for admissions of heat wave-related cases - Phases 2: During heat waves: - Increase number of ambulances - Increase number of medical staff in emergency departments - Supply Protocols of treatment for doctors - Surveillance system: detailed registration of all cases of heat waves - Registration of all admissions to hospitals - Phase 3 : After heat waves period: - Reporting all cases with heat related illnesses to MOH - 2- Analysis: Conduct analysis of reported cases - Evaluation of action plan to detect gaps and weakness	and advice on heat wave established - Reports on morbidity and mortality data registered - Protocols of treatment prepared - Number of medical staff in charge - Number of ambulances in services - Number of cases transferred by Civil Defense		

NO	PROJECT TITLE	PROJECT JUSTIFICATION	OBJECTIVES	ACTIVITIES	INDICATORS	IMPLEMENTING AGENCY	BUDGET US\$
21.	Development of a comprehensive and integrated sun protection program	WHO report on "Global burden of disease from solar ultraviolet radiation" estimates that annually around 1.5 million DALYs (Disability-adjusted life years) are lost through excessive UV exposure. Premature wrinkling, skin cancer, and eye damage (cataracts, a leading cause of blindness) are caused by too much exposure to sun. The health risks associated with solar UV exposure are largely preventable.	<ul style="list-style-type: none"> - To minimize the risk of sun-related health effects (morbidity, mortality) among the workers, as well as the public - To raise the level of awareness of the workers, as well as the public, about the hazards of exposure to the sun (UV radiation) - To build the required skills and capacities of the health sector - To design and operate a system for reporting UV index 	<ul style="list-style-type: none"> - Prepare and print brochures about the health risks associated with working directly under the sun - Conduct two one-day workshops in each region (3 regions), to raise the awareness of employers and employees on the impact of occupational exposure to UV, and the policies and procedures to reduce sun exposure in the workplace - Develop brochures about the protective devices against the impact of UV - Conduct TV and radio awareness interviews, messages, talk shows about the health impact of exposure to UV - Introduce the health impacts of exposure to UV in the curricula of schools and universities - Investigate establishing a UVI reporting system with the MD 	<ul style="list-style-type: none"> - Reduction of the number of reported skin cancers and eye cataracts related to UV exposure - The number of employers (companies, contractors, industries) implementing preventive measures to reduce workers' exposure to UV - The number of employers (companies, contractors, industries) developing policies and procedures to reduce sun exposure in the workplace - The number of legislative tools issued relevant to UV exposure 	MOH in collaboration with MOL, MD, and Media	58,000
22.	Establishment of occupational health surveillance system	Ongoing surveillance is useful in identifying the magnitude of occupational health issues related to climate change and the preparedness measures that should be taken by employers, public, and private sectors to tackle the issues.	<ul style="list-style-type: none"> - To identify the magnitude and trend of the climate change-related occupational injuries - To estimate the 	<ul style="list-style-type: none"> - Establish units for occupational health in public and private hospitals - Develop a notification system on occupational diseases and injuries and accidents related to climate change 	<ul style="list-style-type: none"> - Number of the notifications received - Decrease in the number of cases and deaths due to adaptation measures - Number of training workshops 	MOH/ OHD and HD, public and private hospitals, MD, SSC, and Media	226,500

NO	PROJECT TITLE	PROJECT JUSTIFICATION	OBJECTIVES	ACTIVITIES	INDICATORS	IMPLEMEN- TING AGENCY	BUDGET US\$
		The reporting system for work-related illnesses and injuries do not consider those occurring due to working under extremely hot temperatures and heat waves.	<p>magnitude of morbidity and mortality among workers due to climate change-related occupational injuries</p> <ul style="list-style-type: none"> - To monitor and evaluate the adaptation measures - To develop a notification system on occupational diseases, injuries and accidents related to the climate change - To develop the necessary institutional infrastructure and the required skills 	<ul style="list-style-type: none"> - Develop guidelines for identification and recognition of occupational diseases and injuries related to climate change - Design the surveillance system - Provide all technical, logistics, and financial support to the surveillance system - Prepare and distribute awareness materials for workers and employers - Conduct a series of workshops to safety officers and public health inspectors about climate change and the health of workers - Carry out a series of workshops to the employers and employees on the impact of climate change and productivity - Monitor and evaluate progress 	<p>conducted to physicians, safety officers, employees, and employers</p> <ul style="list-style-type: none"> - Number of occupational health units established - Availability of an effective communication system between the central directorate and the periphery - Number of employees and employers receiving the educational/ awareness brochures about the impacts of climate change on the health of workers 		
23.	Raising awareness of the workers on the health impacts of climate change	Workers are the backbone of the economy. Maintaining their health in optimal state is crucial for sustainable development. When worker's health is protected against climate change, his/her family is also protected. Raising the awareness of workers on the dangers of extreme events	<ul style="list-style-type: none"> - To prevent workers' morbidity - To ensure the steady income of the workers 	<ul style="list-style-type: none"> - Downscale climate change scenarios will to the local level to provide information on occupational health risks for specific occupations - Assess existing emergency management and health response programs - Build the capacity of workers via a series of 	<ul style="list-style-type: none"> - Number of conducted workshops targeting workers - Number of workshops conducted to the policy makers - Number of messages by the mass media 	MOH/ OHD and HD, MOL, public and private hospitals, MD, SSC, and Media	130,000

NO	PROJECT TITLE	PROJECT JUSTIFICATION	OBJECTIVES	ACTIVITIES	INDICATORS	IMPLEMEN- TING AGENCY	BUDGET US\$
		and climate change impacts, as well as the preventive measures to minimize risks (related illnesses such as heat stroke, heat rash, heat exhaustion and heat edema), especially at the start of summer, is fundamental to prevent their illnesses.		<ul style="list-style-type: none"> workshops to their leaders - Train health care providers on developing a climate change health preparation plan preparedness, and - Work with the involved ministries to secure funding for response and research - Establish a network from workers, employers, involved ministries, stakeholders, and NGOs to demonstrate the reality of the threat - Involve the media in giving short messages to the employees and employers about the adverse effects of climate change - Prepare and distribute brochures and educational materials on impact of climate change on occupational health 	<ul style="list-style-type: none"> targeting workers - Number of assessments carried out 		
24.	Establishment of an occupational health information system	Information systems are implemented to improve the effectiveness and efficiency of the organization. There is a lack of databases on all occupations. The useful type of information systems for occupational health is the one designed to enable the directorate to perform all tasks required, perform difficult calculation, statistical	<ul style="list-style-type: none"> - To establish databases on all occupations - To establish a database on workers' pre-placement tests, to be the baseline for periodic examination and enable identifying the impact of 	<ul style="list-style-type: none"> - Appoint information technology specialist - Appoint data entry person - Design notification forms - Register all work-related accidents, injuries and occupational diseases in each firm - Correlate the number of accidents with weather conditions for each firm and outdoor workers 	<ul style="list-style-type: none"> - Number of the notifications received - Number of statistical analysis performed - Number of databases established (workers and firms, work-related accidents, pre-placement tests) 	MOH/ OHD and HD, MOL, public and private hospitals, MD, and SSC	65,000

NO	PROJECT TITLE	PROJECT JUSTIFICATION	OBJECTIVES	ACTIVITIES	INDICATORS	IMPLEMEN- TING AGENCY	BUDGET US\$
		analysis, and interpretation of the data	climate change	<ul style="list-style-type: none"> - Identify the trend of occupational injuries with climate changes - Disseminate information regarding the trend of occupational related diseases and injuries to employers and policy makers - Procure required hardware and statistical software - Subscription to internet services in periphery HDs 			

