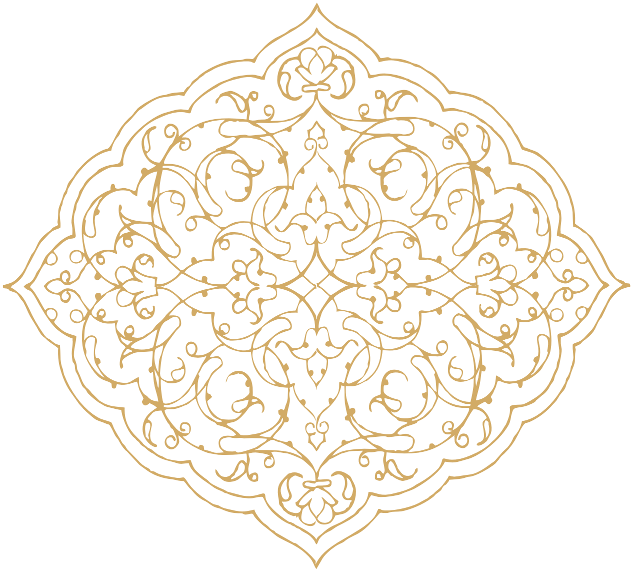
In The Name of God



Tehran University of Medical Sciences
Institute for Environmental Research

Ministry of Health & Medical Education
Environmental & Occupational Health Center

National Adaptation Strategy and Plan of Action (NASPA) for Climate Change and Health

for

Islamic Republic of Iran

The NASPA Coordination Team

Project Management Units:

Environmental & Occupational Health Center (EOHC) at the Deputy of Health of Ministry of Health and Medical Education (MOH & ME)

Institute for Environmental Research (IER) at the Tehran University of Medical Sciences (TUMS)

Technical Team and Contributors:

Professor Hassan Vatandoost of TUMS- (Vector-Born Disease)

Professor Simin Nasseri of TUMS- (Water Safety and Quality including Water-borne diseases)

Dr. Mohamad Reza Monazam of TUMS- (Occupational Health and Related Disease)

Dr. Kourosh Etemad of MOH & ME- (Non -Communicable diseases including Cardiovascular Mortality)

Dr. Zahra Abdollahi of TUMS- (Nutrition and Food insecurity including Food-borne diseases)

Dr. Ali Ardalan of TUMS- (Disaster Management)

Document Preparation Team:

Professor Kazem Naddafi of MOH & Me

Professor Masud Yunesian of TUMS

Dr. Elham Ahmadnezhad of TUMS

Ms. Sheida Malek Afzali of MOH & ME

Ms. Saeedeh Hemmati Borji of IER

Forward

Climate change is a life-threatening phenomenon and a great challenge for countries globally. Increasing environmental temperatures, decreasing precipitation, and ever-increasing evolution of greenhouse gases affect adversely all aspects our lives and sustainable development. The United Nations Framework Convention on Climate Change (UNFCCC) in ratified in 1995 and the Kyoto Protocol endorsed in 2003, aiming at sensitizing governments to take action concerning mitigation of the adverse effects of climate change, prompted national policy-makers and planners in many countries to devise policies and strategies to confront the climate change-related issues.

The Islamic Republic of Iran joined the Kyoto Protocol in 2005 and, since then, attempts have been made at the national level to formulate policies, strategies and programmes for adaptation to adverse effects of climate change. In the public health domain, the Environmental and Occupational Health Center (EOHC) at the Office of Deputy-minister for Public Health, Ministry of Health and Medical Education (MOHME) was made responsible for developing strategies and programmes for adaptation to climate change-related public health problems. Working groups, consisting of experts, policy-makers and planners, in various fields of public health were assigned to develop adaptation programmes in their respective fields. The process involved national situation analysis and literature review, as well as consideration of international experiences, through library work and group consultations. The focus was placed on six areas, namely, *Water Resources, Vector-borne Diseases, Occupational impacts, Non-Communicable Diseases, Nutrition and Food Security,* and *Disaster Health Management.* The output was the *National Adaptation Strategy and Plan of Action for Health and Climate Change* (NASPA). The main goal of NASPA is to identify and recommend urgent action plans for mitigation of, and adaptation to, adverse effects of climate change on the public's health I.R. Iran. A total of eighty-five priority projects were identified for implementation.

It is hoped that NASPA will not be considered merely as an academic exercise; rather as a serious step towards addressing the urgent and immediate needs of our country to confront the life-threatening effects of climate change.

On behalf of the Iranian people, I would like to take this opportunity to express our sincere gratitude to all the stakeholders for their support and cooperation with us in preparing this great strategy and plan of action. Specifically, I would like to thank the core team for their great efforts during the past several months and in preparing this document.

Alireza Mesdaghinia,
Professor of Environmental Health Engineering

Acknowledgment

As the technical partner of the **First** NASPA for Iran, Institute for Environmental Research (IER) of Tehran University of Medical Sciences (TUMS) provided this report under the supervision of Ministry of Health & Medical Education (MOH&ME) of I.R.Iran and World Health Organization (WHO).

The team consisted of six technical task forces based mainly on the main health-related issues associated with climate change, as expressed below: Vector-borne diseases taskforce supervised by Professor Hasan Vatandoost, Water safety and quality taskforce including water-borne diseases supervised by Professor Simin Naseri, occupational health taskforce supervised by Dr Mohamad Reza Monazam, Non-Communicable diseases taskforce including Cardiovascular Mortality supervised by Dr Kourosh Etemat, Nutrition and food insecurity taskforce including food-borne diseases supervised by Dr Zahra Abdollahi, and Disaster management taskforce supervised by Dr Ali Ardalan.

Final preparation of this report was done by Dr Elham Ahmadnezhad under the supervision of Professor Masud Yunesian.

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We are also grateful to stakeholders for their cooperation, guidance, and encouragement in developing the present strategy.

Abbreviations and Acronyms

CCHIM	Climate Change Health Impact Management
CIS	Climate variables Information System
CL	Cutaneus Lishmaniasis
CVD	Cardio Vascular Disease
EM/RC55/R.8	Eastern Mediterranean Regional Committee issued at its fifth-fifth session a Regional Committee Resolution
EMRO	Eastern Mediterranean Regional Office
EOHC	Environmental & Occupational Health Center
GIS	Geographic Information Systems
GPS	Global Positioning Systems
I.R	Islamic Rpublic
IER	Institute for Environmental Research
IPCC	Inter-gvernmental Panel for Climate Change
KM	Kilometers
MCA	Multi Criteria Analysis
MOH & ME	Ministry of Health and Medical Education
NASPA	National Adaptation Strategy and Plan of Action for Health and Climate Change
NCD	Non-Communicable Diseases
NDMO	: National Disaster Management Organization
NGOs	Non-Governmental Organizations
PHC	Primary Health Care
RR	Relative Risk
SQ	Square
STEEP,v	Social, technological, environmental, economic, political and value-based
SWOT	Strengths, Weaknesses, Opportunities, and Threats analysis
TUMS	Tehran University of Medical Sciences
UNFCCC	United Nations Framework Convention on Climate Change
VBD	Vector-Borne Disease
WBGT	Wet bulb Globe Temperature
WHA	World Health Assembly
WHO	World Health Organization

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Executive Summary

Nowadays, global warming and climate change are the most significant challenges worldwide. According to the fourth IPCC report (2007), the influences of climate change are the global, and every country faces the causes and consequences of this problem.

In October 2008, the World Health Organization (WHO) Eastern Mediterranean Regional Committee issued at its fifth-fifth session a Regional Committee Resolution (EM/RC55/R.8).

The resolution on Climate Change and Health aims at protecting human health from the impacts 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 future burden of disease attributable to climate change will depend in part on the timeliness and effectiveness of the interventions implemented. I.R.Iran has experienced the climatic hazards over several decades. The most serious ones have been flood, drought, flush floods, and extreme temperatures. Some of these, especially droughts and floods, have increased in frequency, intensity, and magnitude over the past two decades and have adversely impacted all the aspects of sustainable development. Despite limited published evidences, Iran is highly vulnerable to the adverse effects of climate change due to arid and semi-arid areas, limited water availability, low forest cover, being liable to drought and desertification, being prone to floods, high urban atmospheric pollution, fragile mountains, and finally with an economy highly dependent upon production, process, and export of fossil fuels.

The Iranian government represented by the Ministry of Health and Medical Education (MOH & ME) 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 & ME is in the process of developing national measures to protect health from climate change.

Ministry of Health & Medical Education (MOH & ME) of I.R.Iran in collaboration with World Health

Organization (WHO) and other national partners took an initiative to shape a National Steering Committee (NSC) for Climate Change & Health to develop and implement a National Adaptation Strategy and Plan of Action for Health and Climate Change (NASPA) in regard with the health impacts associated with climate change for the **First** time in the country. Environmental & Occupational Health Center (EOHC) at the Deputy of Health of MOH&ME was the coordinating body of NST-CCH and the Institute for Environmental Research (IER) of the Tehran University of Medical Sciences (TUMS) contributed in this program as the technical partner.

Accordingly, six technical task forces for climate-sensitive health areas, selected based on the relevancy according to the Multi-Criteria Analysis (MCA), were ranked and established for identifying the most urgent needs to prioritize the immediate adaptation interventions. Members of each taskforce comprised faculty members of IER and TUMS, scientific members of other academic institutes, and national programme mangers in MOH & ME and other ministries and organizations pertaining to sensitive areas.

The Framework of NASPA

The purpose of this project was to develop NASPA based on the evidence derived from a vulnerability and adaptation assessment of the Iranian population's health and Iran's public health system all over the country.

The report included four phases with the overall objectives of developing NASPA based on assessing vulnerability and adaptation status of the Iranian population's health and Iran's public health system with respect to current and future climate change, with special focus on six major climate-sensitive health issues, as mentioned below:

1. Vector-borne diseases;
2. Water safety and quality, including water-borne diseases;
3. Occupational health and related diseases;
4. Non-Communicable diseases, including cardio-vascular mortalities;
5. Nutrition and food insecurity, including food-borne diseases;
6. Disaster Management.

In Phase (I) of the project, the researcher(s) provided a comprehensive literature review of the existing literature on the subject of interest.

Phase (II) included the development of a step-by-step assessment of vulnerability, according to the following steps:

1-1 Frame and scope the assessment

- Define the geographical range and health outcomes of interest;
- Identify the questions to be addressed and steps to be used;
- Identify the policy context for the assessment;
- Establish a project team and a management plan;
- Establish a stakeholder process.

1-2 Conducting the vulnerability and adaptation assessment

- Establish baseline conditions by describing the human health risks of current climate variability and recent climate change, and the public health policies and programmes to address the risks;
- Describe current risks of climate-sensitive health outcomes, including the most vulnerable populations and regions (*Identify vulnerable populations and regions, Describe risk distribution using spatial mapping);*
- Analyze the relationships between current and past weather/climate conditions and health outcomes;
- Identify trends in climate change-related exposures;
- Take account of interactions between environmental and socioeconomic determinants of health;
- Describe the current capacity of health and other sectors to manage the risks of climate-sensitive health outcomes, considering health system adaptive capacity and resilience.

The Phase (III) of the project included the following areas:

1. Implement the assessment methodology through synthesizing the available information. This phase included the participatory approach and related stakeholders;

2. Analyze the data and interpret the findings followed by a clear comprehensive list of conclusions along with related recommendations in terms of vulnerability reduction and adaptation and copying capacities enhancement in a form that were applicable for policy making and practice.

The final phase (IV) included the development of the NASPA related to the climate-sensitive health issues of interest, including key adaptation measures by a prioritized list of activities and short profiles of projects and/or activities intended to address urgent and immediate adaptation needs.
After finalizing the six reports, a technical workshop was held on 3-8 May (2013) by IER. Based on that workshop, some changes were made and the reports were also improved. The present report has incorporated all of the six reports provided by the six task forces based on the WHO guidance. The final strategies were selected based on the urgent and immediate concerns in relation to adaptation to climate change for future works.
The analysis of the results for vulnerability assessments are summarized briefly below:

Climate Variability

Based on meteorological data on 1960-2005, the minimum and maximum temperature and precipitation (the amount and number of days with precipitation higher than 10 mm), wind speed, and dew point temperature (as an indicator of humidity) are important climatic variables.
During this time period, temperature has risen between 2.5 and 5 degrees Celsius on average. The increase in minimum temperature is more significant than the maximum temperature. The discrepancies are significantly higher in larger, heavily populated and industrialized cities, most likely because of urban heat island. Due to increases minimum temperatures, the variability of daily temperature has decreased almost everywhere. There are also cities with clear temperature descent rates.
Southwestern parts of the Caspian Sea as well as northwest and west of the country have experienced the highest rates of the precipitation reduction. On the other hand, the numbers of days with precipitation higher than 10 mm have decreased in the west, northwest, and southeast of the country, whereas precipitation has increased in other regions except for the southeast of the Caspian Sea.

Over the period of 1960-2005, the highest rates of decrease in the wind speed were observed in the central part of the country as well as in the northeast.

The dew point temperature, which is an indicator of humidity, has also consistently decreased in most parts of the country, except for the northern and northeastern parts.

According to MAGIC-SCENGN (HadCM2 and ECHAM4 models in combination with 18 available emission scenarios), until the year 2100, both models predicted a higher temperature distribution nationwide with small variations. The temperature will rise between 0.4 and 3 degrees Celsius based on one model and between 0.5 and 4 degrees based on the other. However, there are significance differences between the changes projected for precipitation and its spatial distribution. According to HadCM2, the northern half of the country will experience a rise in the level of precipitation, while the southern half will suffer from a net loss in precipitation.

According to LARS-WG Weather Generator model and based on the data of 43 synoptic meteorological stations, the climate of the country was also forecasted for 2010-2039, the results of which were compared with observations during 1976-2005. The results indicated that the amount of precipitation will, on average, decrease throughout the country by 9% between 2010-2039 in comparison with 1976-2005. Temperature projections show an average increase of 0.9 degrees Celsius, while minimum and maximum temperatures will, on average, rise by 0.5 degrees Celsius. The rise is more pronounced during the cold seasons.

Vector-Borne Diseases

Malaria and Leishmaniasis have been well-characterized in terms of the effects of temperature and precipitation on the life cycles of the vector and disease agent based on laboratory studies. Based on the climatological information and using Spline interpolation modeling, *Hormozgan*, *Bushehr*, *Khuzestan*, and Southern part of *Sistan-Baluchestan*, all in south of the country, as well as *Mazandaran* and *Gilan* provinces in northern part of the country, will have the highest risk of Malaria transmission. Pertaining to leishmaniasis, analysis of environmental variables affecting the disease transmission with Boolean logic and linear regression showed that the main foci of the disease in I.R.Iran are *Esfahan*, *Khorassan-e-Razavi, Markazi*, *Fars*, *Khorassan-e-Jonoobi*,

Kerman, *Qom*, *Tehran*, *Qazvin,* and *Semnan* provinces, respectively.
Improving the health status of the population by preventing and managing vector-borne diseases caused by changes in the temperature and flooding (due to extreme rainfall) has the **First** priority in the adaptation strategy for this task force.

Water safety and quality, including water-borne diseases

Severe outbreaks of cholera, in particular, have been directly associated with flooding in other parts of the World. Compelling evidence points to the effect of climate on specific diarrhea pathogens. The number of cases is reported either through clinics or through laboratory-based surveillance; therefore, this only represents a small proportion of the total disease burden, especially for diseases that are not severe. Further, relationships between climate and diseases derived from passive reporting may differ from those based on other methods of surveillance.
Based on the vulnerability assessment, the relative risk (RR) of diarrhea diseases for each 1°C temperature increases is equal to 0.08. The highest RR over 2025-2050 for different climatic regions of the country is equal to 0.11, which was projected for *Mediterranean & Semi-Humid* and also *Humid & Hyper-Humid* regions. The projected RR for 2050 up to 2070 is 0.13 for *Semi-Arid* areas. The highest RR over 2075-2100 is equal to 0.13, which was projected for *Arid* regions.
The **First** priority in the adaptation strategy for this task force is improvement of irrigation methods (for other sectors) and provision/improvement of registration systems for water-borne diseases (for MOH & ME).

Occupational Health and Related Diseases

Workers are considered as a vulnerable group and are more significantly affected by climate change. Although occupational health problems have been known for a long time, appropriate protective methods have not yet been fully developed and many workers are still exposed to unacceptably high temperatures and humidity at work.
The selected indicator for this task force is the Wet bulb Globe Temperature (WBGT) based on a

comprehensive literature review.

The WBGT map suggested that in all seasons changes on the map are smaller in the *northern half* of the country than in provinces in the *southern half;* in addition, it indicated that WBGT as we move from Northwest to Southeast.

The results of the projection up to 2039 showed that the WBGT will increase in *all* provinces of the country, except for the *Khuzestan*. Most significant WBGT increases were observed in the provinces of *North Khorasan*, *Gilan*, *West Azerbaijan,* and *East Azerbaijan,* with respective increases of 1.24, 1.13, 1.1, and 1.05 ° C in the rate of WBGT.

The **First** priority in the adaptation program for this taskforce is to preventive programs to reduce heat stress in outdoor environments.

Non –Communicable, diseases including Cardiovascular Mortality

Exposure to extreme temperatures at either side of a “comfort range” is associated with an increased risk of cardio-pulmonary diseases and mortality. Cardiovascular diseases (CVD) have the best characterized temperature-mortality relationships, followed by respiratory diseases and total mortality.

The findings revealed that the current top five vulnerable provinces are *Gilan*, *Mazandaran*, *Fars*, *Boyer Ahmad,* and *Sistan &Balochestan*. Five of the less vulnerable provinces are *Ardebil*, *Kurdestan*, *Qom*, *North Khorasan*, and *Hamedan*.

The projection for 2010-2039 revealed that *Gilan*, *Fars*, *Mazandaran*, *Sistan & Baluchestan,* and *Busher* are going to be the most vulnerable provinces respectively. At the same time, *Charmahal Bakhtyari*, *Ardebil*, *Zanjan*, *Markazi,* and *Qazvin* were ranked as the least vulnerable provinces with regard to adverse effects of excessive heat on CVD deaths.

Based on the assessment by this task force, strengthening of the health facilities is the **First** priority in the adaptation actions for MOH & ME, while for other sectors, improvement of public transportation system acquired the **First** priority in the adaptation strategy.

Nutrition and Food insecurity, including Food-borne diseases

The anthropometric indicators of Stunting, Under-Weight and Wasting among children under 5 years old, and the incidence of Food-Borne were considered for studying the impacts of climate change on the status of nutrition and food-borne diseases, because these were issues that are more sensitive to climate change.

The data showed that there was an improvement in the nutritional status in different provinces. There was no significant correlation between the total annual rainfall and stunting and underweight in different provinces, which shows that other factors rather than rainfall have more important impacts on the nutritional status of people. However, there was a negative significant correlation between the total annual rainfall and wasting, which shows that rainfall may have a short-term impact on the nutritional status.

Based on the ranking, the **First** priority in the adaptation action is providing proper food baskets for all people, especially vulnerable groups being at high-risk areas.

Disaster Management

There is an increasing trend in natural disasters, both globally and in I.R.Iran. Based on the climate change affected pathways, increasing number of extreme events is the direct consequence of changing climate. Among these events, floods, drought, heat waves, cyclone, and storms are the main hydro-climatologically hazards that were evaluated.

Based on the vulnerability assessment, the risk of death and injury due to hydro-climatologically disasters after adjusting for population were 0.002 and 0.001, respectively. The risk of trends for the occurrence of such disasters over 1970-2010 was 8.3.

Based on the projection of occurrence of flood in the country, the highest RR is 6.01 up to 2030. Despite the importance of drought in I.R.Iran and the necessity of evaluating it, no models have yet been developed to link climate scenarios, frequency of drought, and associated health effects; therefore, quantitative estimation of climate change effects is not currently possible.

Based on the pooled risk approaches, both qualitative and quantitative methods (coping strategy, frequency of hydro-meterological hazards, and affected people), *Ardebil*, *Fars*, *Gilan*, *North Khorasan*, *Qazvin, West Azerbaijan*, *Tehran, Yazd,* and *Zanjan* are the most vulnerable provinces to probable future natural hazards due climate change.

Continuous training and holding national conferences on an annual basis with the contribution of other sectors has the **First** priority in the adaptation program for the disaster management task force.

Introduction

Study area

Iran (the Islamic Republic) is located in the center of the Middle East and is surrounded by Turkey in North, Iraq in west, Pakistan and Afghanistan in east. Caspian Sea in the northern part and Persian Gulf and Oman Sea in the southern part are the main water bodies of the country. Total land area is approximately 1,648 million km^2, so it is one of the largest countries of the world. Generally, Iran is a mountainous and Semi-Arid land, with a mean altitude of more than 1200 meters above the sea level. More than half of Iran is consisted of mountains, one quarter is plains and deserts, and less than one quarter is arable land. The southern coast of the Caspian Sea with an altitude of 28 meters is the lowest point in Iran, while the summit of Mt. Damavand in the central Alborz Mountains with an altitude of 5628 meters is the country's highest point. In addition, the Lut Desert with an altitude of 56 meters is the lowest internal point (DEO, 2010). Almost 11.2% of the country is agricultural lands, while forests, rangelands, and deserts account for 8.7%, 52.1% and 19.7% of the country surface area, respectively. The country' map is shown in Figure 1.

Figure 1- I.R.Iran’s Location in the Middle East (Country’ Map)

Social and Demographic index of I.R.Iran

The 2011 census indicates that the population is 75,801,000 (Male: 50.4%; Female: 49.6%) with an average population density of about 46 per km^2, with the highest density in the capital city (Tehran) and the lowest density in deserts. I.R.Iran has the third largest population in the WHO Eastern Mediterranean Region, after Pakistan and Egypt. The annual population growth rate is about 1.29 percent. The Life expectancy is 73.4 for (Male: 72.1; Female: 74.6), while infant mortality rate is 21.1 per 1,000 live births. Adult literacy rate is 92.4 percent and total fertility rate is 1.67 per 1000 female. Over 72.5 percent of the population live in urban areas. The gross domestic of Iran in the year 2009 was about 331 Billion USD, and the per capita income was 4,526 USD, based on the World Bank's information.

One of the most critical economic and social factors that can be attributed to climate change is the increasing rate of unstructured urbanization, which occurs due to drought, damage to agricultural lands, and decrease of agriculture products.

There are approximately one million registered refuges in the country (and two million unregistered), equivalent to 14 refugees per every 1000 residents. Based on the 2007 estimation, I.R.Iran is the second largest host country for refugees in the world after Pakistan.

During the past 30 years, the human development index (HDI) of the Islamic Republic of Iran has grown at an annual rate of 0.95%, rising from 0.562 in 1975 to 0.721 in 2002. Yet, the country ranked 106th among other nations in 2001, having dropped from 90th in 1999. This figure has been contested on the grounds that it is based on an estimated life expectancy of 69.8 years and a rather low adult literacy rate. Using a life expectancy of 70.6 years and an adult literacy rate of 80% (75.5% for women and 84.3% for men) for 2001, the HDI would rise to 0.736 and to 94th place among other nations.

The Islamic Republic of Iran is highly vulnerable to natural disasters, particularly earthquakes, flash floods, and droughts. Earthquakes pose a particularly great threat. The Islamic Republic of Iran ranks first in the world in terms of the number of earthquakes per year with a magnitude of at least 5.5 on the Richter scale. It also ranks first in terms of relative vulnerability and of the number of people killed per year as a result of earthquakes. Three quarters of the country's major cities are in potentially major earthquake zones. While the probability of earthquakes is always high, the probability of floods has increased during the recent decade and they have affected more people than earthquakes. Rangeland degradation and drought have also affected large parts of the country.

Increased social problems and poverty, especially in rural areas, are common after major disasters due to loss of livelihood and infrastructure – with women and children often experiencing greater hardship, thus requiring tailored assistance and preparedness plans. Table 1 shows the key socio-economic and environmental indicators of the country.

Table1- Key social, environmental, and economic indicators of I.R.Iran

Social Indicators		Year	Total Number
Estimated Population (N)		2011	75,801,000
Population Growth Rate (%)		2012	1.29
Life expectancy (year) – male/female / total average		2010	73.4
Maternal mortality ratio per 100,000 live births (estimated)		2010	22.0
Infant Mortality Rate per 1000 live births (estimated)		2010	18.0
Adult Literacy Rate (%)		2009	83.2
Total fertility rate (per 1000 female)		2006	1.8
Crude Birth Rate per 1000 People		2010	18.5
Under 5 mortality rate		2010	20.0
Crude Death Rate (per 1000 People)		2009	4.6
Age Distribution	< 15 Years Old	2010	22.5
	+65 years	2010	5.1
Dependency Ratio		2010	37.9
Environmental Indicators		**Year**	**Total Numbers**
Agricultural land (%)		2010	11.2
Forest cover (%)		2010	8.7
Population with sustainable access to improved water source (%)		2010	98.0
Population with access to improved sanitation (%)		2010	93.0
Economic Indicators		**Year**	**Total Numbers**
GDP per capita		2010	5,655
Per capita total expenditure on health		2010	317
Per capita government expenditure on health		2010	127

Administrating structures

According to the Governor division appointed by the Ministry of Interior, 31 provinces exist in the Islamic Republic of Iran. In addition, each province also includes some districts, with a total of 336 districts all over the country. Each district includes cities/towns and villages; a total of 889 cities and 69,000 villages exist in the country (based on the households survey in 2007).

Population

Iran has one of the highest rates of urbanization growth in the world. From 1950 to 2002, the urban proportion of the population increased from 27% to 60%. The United Nations predicts that by 2030, 80% of the population will be urban. Most internal migrants have settled near the cities of Tehran, Isfahan, Ahvaz, and Qom. The spatial distribution of population across 31 provinces of the country is shown in Figure 2. In recent years, Iran's birth rate has dropped significantly and reached 1.29% in July 2012. Studies project that the rate of population growth in Iran will continue to decrease until it stabilizes above 105 million by 2050.

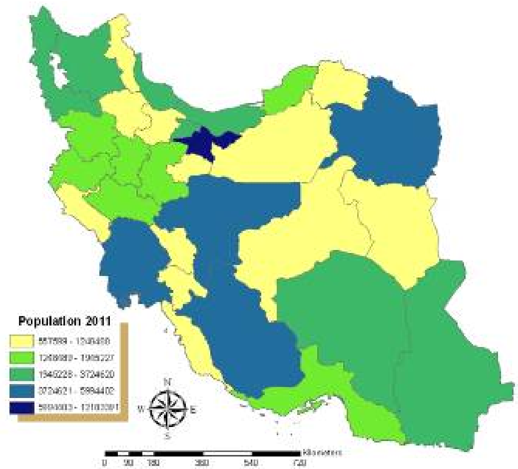

Figure 2- Spatial distribution of the population across 31 provinces, I.R.Iran

Climate Pattern of I.R.Iran

Climate Change

As defined by the Inter-governmental Panel on Climate Change (IPCC), climate change is described as the variation in either the mean state of the climate or in its variability, persisting for an extended period of time, typically decades or longer, encompassing temperature increases, “Global warming”, sea-level rise, changes in precipitation patterns, and an increased frequency of extreme events.

The global average surface temperature (the average of near surface air-temperature overland and sea-surface temperature) has increased since 1861. Over the 20th century, the increase has been approximately 0.6 degree of Celsius. Since the late 1950s (the starting point for observations of markedly higher intensity), the overall global temperature increased in the lowest 8 km of the earth’s atmosphere at the rate of 0.1 degree Celsius per decade.

Based on the evidence, climate change is recognized as a human-induced phenomenon caused by increased emission of green house gases. Changes in climate occur as a result of both internal variability within the climate system, and external factors (natural and anthropogenic).

Climate Variability in I.R.Iran

The climate variability, i.e. differences in parameters like the minimum and maximum temperatures, precipitation (the amount and the number of days with precipitation higher than 10 mm), wind speed, and dew point temperature (as indicator of humidity) were gathered in seasonal and annual time scales over the 1960-2009 time span.

Iran’s climate ranges from arid or semiarid to subtropical along the Caspian coast and the northern forests. On the northern edge of the country (the Caspian coastal plain), temperatures rarely fall below freezing point and the area remains humid for the rest of the year. Summer temperatures rarely exceed 29 °C. Annual precipitation is 680 mm in the eastern part of the plain and more than 1,700 mm in the western part [25].

To the west, settlements in the Zagros basin experience lower temperatures, severe winters with below zero average daily temperatures and heavy snowfall. The eastern and central basins are arid, with less than 200 mm of rain, and have occasional deserts. Average summer temperatures exceed 38 °C. The coastal plains of the Persian Gulf and Gulf of Oman in southern Iran have mild winters and hot summers and is very humid. The annual precipitation ranges from 135 to 355 mm.

Temperature

Maximum temperature

Table 2 presents average maximum temperatures between 1960 and 2009 for different seasons of the year in all of the provinces.

According to Table 2, in the autumn, winter, and spring, the provinces of West Azerbaijan, Zanjan , Ardabil, and Chahar Mahal Bakhtiari had the lowest maximum temperatures and Sistan & Baluchestan, Khuzestan, and Bushehr had the highest maximum temperatures.

In summer, the provinces of West Azerbaijan, Ardabil, Khuzestan, and Gilan had the lowest maximum temperatures, while the highest maximum temperatures were observed in Busher and Lorestan.

Minimum temperature

Average minimum temperatures in the four seasons of the year from 1960 to 2009 for all provinces are given in the Table 3.

According to Table 2, in the winter and summer, Hamedan, Zanjan, and Chahar Mahal and Bakhtiari had the lowest, while Sistan & Baluchestan, Khuzestan, and Bushehr had

Table 2- Average maximum temperatures from 1960 to 2009 for different provinces

Province	T_{max} °C			
	Winter	Spring	Summer	Autumn
Ardabil	7.21	21.64	26.98	12.33
Bushehr	21.13	34.98	37.89	25.67
Chahar Mahal	8.43	24.27	31.45	14.1
Esfahan	14.09	30.74	36.01	18.29
Fars	16.85	31.8	36.37	21.27
Qom	12.89	30.2	36.16	17.47
Ilam	17.46	34.5	41.15	23.03
Gillan	12.74	23.64	29.67	17.84
West Azarbayjan	5.72	22.19	29.41	12.29
Ghazvin	9.08	25.05	31.39	14.35
Kerman	17.13	31.65	35.48	19.58
Khorasan North	9.86	26.64	32.24	15.02
Mazandaran	13.72	24.35	30.87	19.45
Khorasan South	13.34	29.96	33.5	18.49
Khozestan	21.84	39.4	44.72	27.28
Kohgiloyeh	15.99	31.45	37.48	21.46
Kordestan	5.24	23.21	31.46	12.58
Kermanshah	11.46	28.11	35.86	17.93
East Azarbayjan	8.44	26.03	32.36	14.43
Golestan	14.02	26.59	33.04	18.78
Hamadan	7.98	24.7	33.02	13.9
Lorestan	14.4	30.38	38.81	20.1
Markazi	9.72	26.33	33.8	15.17
Semnan	11.81	29.46	34.89	17.1
Sistan	22.01	34.93	36.65	25.39
Tehran	8.91	25.46	31.39	14.14
Yazd	17.16	33.4	37.95	21.17
Zanjan	5.89	22.55	29.49	11.7
Khorasan Razavi	10.49	26.75	32.73	16.2
Hormozgan	18.15	32.13	36.31	18.3

Table3- The average Minimum temperatures from 1960 to 2009 for different provinces

Province	T_{min} °C			
	Winter	Spring	Summer	Autumn
Ardabil	-2.19722	8.7	14.32	1.97
Bushehr	12.44	24.4	27.34	15.42
Chahar Mahal	-4.49792	7.5	10.21	-0.47
Esfahan	3.89	18.78	23.11	7.79
Fars	4.31	16.74	21.28	7.43
Qom	1.44	16.03	21.2	5.82
Ilam	6.19	19.97	25.55	11.01
Gillan	3.87	14.73	20.6	12.19
West Azarbayjan	-2.89	10.91	16.96	2.99
Ghazvin	-0.93	11.72	16.79	3.79
Kerman	3.69	17.15	20.14	6.21
Khorasan North	-0.31	13	17.73	3.41
Mazandaran	5.59	16.7	22.37	10.77
Khorasan South	0.8	15.03	17.35	3.83
Khozestan	9.88	23.62	27.58	13.99
Kohgiloyeh	3.41	15.17	19.93	7.2
Kordestan	-2.35	9.66	15.52	1.33
Kermanshah	-0.8	10.95	16.55	4.21
East Azarbayjan	-0.64	13.99	21.74	5.85
Golestan	6.01	15.47	22.05	10.21
Hamadan	-3.83	8.72	14.32	8.2
Lorestan	3.14	15.58	20	6.91
Markazi	-2	11.35	17.13	3.25
Semnan	1.59	16.68	21.79	6.23
Sistan	9.64	22.57	24.65	12.35
Tehran	-1.95	12.2	17.1	2.82
Yazd	4.79	19.49	23.15	8.29
Zanjan	-4.12	8.75	14.44	1.05
Khorasan Razavi	0.89	13	17.67	4.05
Hormozgan	5.63	18.79	22.65	7.56

the highest minimum temperatures. In the autumn and spring, Ardebil, Zanjan, and Chahar Mahal and Bakhtiari had the lowest, whereas Sistan and Baluchestan, Khuzestan, and Bushehr had the highest minimum temperatures.

Based on the UNFCC' reports, the increase in minimum temperatures are more widespread than the maximum temperatures. The discrepancies are remarkably higher in the large, heavily populated and industrialized cities, which may be related to the urban heat island phenomenon. Due to the pattern of higher minimum temperatures, the daily temperatures variability has reduced almost everywhere. The analysis of results showed that the temperature has risen between 2.5 and 5 degrees centigrade during 1960-2005. There are also cities with clear descending temperature rates.

Relative Humidity

Mean relative humidity for the four seasons of the year from 1960 to 2009 for all provinces are presented in the Table 4.

According to Table 4, in the winter, spring, and summer, provinces of Gilan, Mazandaran, Yazd, Kerman, and Isfahan had the lowest relative humidity. In the autumn, provinces of Gilan and Mazandaran had the highest, while Yazd, Kerman, and Hormozgan had the lowest relative humidity.

The UNFCCC reports illustrate humidity variability by considering the changes in dew point temperature. One of the most interesting results is related to the sharply ascendant dew point in the two cities of Bam and Shahr-e-Kord.

Generally, it can be concluded that the dew point temperature is consistently lowering in most parts of the country. However, in the north and northeast, the average dew point is clearly ascendant. The highest rise is seen in the city of Sabzevar.

Precipitation

Mean precipitation for the four seasons of the year from 1960 to 2009 for all provinces are presented in the Table 5.

Table 4- Average relative humidity from 1960 to 2009 for different provinces

Province	RH			
	Winter	Spring	Summer	Autumn
Ardabil	67.18056	68.08	64.65	75.12
Bushehr	55.83	46.9	52.71	60.32
Chahar Mahal	56.94	39.19	26.2	52.94
Esfahan	41.77	23.93	19.96	41.36
Fars	44.59	28.75	23.53	40.3
Qom	52.21	30.85	21.07	46.13
Ilam	53.26	28.78	21.63	50.31
Gillan	77.58	75.28	71.27	81.32
West Azarbayjan	66.31	49.94	41.71	62.85
Ghazvin	59.17	44.6	37.26	54.51
Kerman	41.58	25.83	20.34	37.67
Khorasan North	61.3	50.7	42.1	61.9
Mazandaran	80.61	77.14	75.01	80.51
Khorasan South	48.95	29.92	22.12	45.85
Khozestan	56.12	27.5	24.98	53.8
Kohgiloyeh	59.57	33.71	26.99	52.74
Kordestan	45.87	40.31	28.39	58.49
Kermanshah	64.24	42.82	27.33	57.71
East Azarbayjan	60.23	44.99	35	54.98
Golestan	74.06	69.13	62.22	65.12
Hamadan	58.34	41.09	24.88	57.42
Lorestan	57.74	36.7	23.11	56.32
Markazi	56.75	35.53	23.16	54.67
Semnan	53.47	32.3	27.99	51.22
Sistan	50.2	40.73	36.4	46.84
Tehran	55.34	38.1	34.25	54.24
Yazd	40.5	20.5	14.35	37.2
Zanjan	66.2	48.2	41.25	62.36
Khorasan Razavi	64.58	62.76	50.8	71.15
Hormozgan	44.01	30.27	24.57	35.68

Table 5- Average rainfall from 1960 to 2009 for different provinces

Province	Rain			
	Winter	Spring	Summer	Autumn
Ardabil	23.93611	30.72222	12.25556	20.04444
Bushehr	29.4	5.494444	2.066667	34.36389
Chahar Mahal	89.04792	36.85833	1.30625	71.01458
Esfahan	20.82758	10.51515	0.384848	13.62121
Fars	30.78333	7.394444	1.305556	14.23056
Qom	25.82917	12.76667	1.045833	14.625
Ilam	45.91944	14.09167	3.483333	36.175
Gillan	69.50833	47.135	69.43833	146.6008
West Azarbayjan	59.39167	42.68889	10.225	42.96111
Ghazvin	36.66875	32.83958	3.925	30.65625
Kerman	18.99444	6.008333	1.127778	54.77778
Khorasan North	26.59167	17.425	4.7	16.675
Mazandaran	70.28333	19.99167	56.15417	126.7583
Khorasan South	25.50278	8.141667	0.019444	10.17778
Khozestan	28.91389	5.758333	0.138889	31.74167
Kohgiloyeh	91.63333	22.47917	2.191667	63.87917
Kordestan	43.76923	32.19487	2.558974	37.57179
Kermanshah	52.69583	24.23333	4.358333	41.29583
East Azarbayjan	24.89286	25.67857	9.766667	21.45238
Golestan	43.89	26.88	24.82	43.1
Hamadan	48.55417	29.49375	3.622917	45.26104
Lorestan	52.425	25.20556	1.922222	60.66944
Markazi	34.00833	22.10556	2.980556	28.91111
Semnan	21.47222	11.18333	1.502778	13.36944
Sistan	18.25278	5.972222	0.408333	7.244444
Tehran	34.975	21.79583	8.104167	25.02917
Yazd	12.38056	4.005556	0.027778	6.161111
Zanjan	31.3875	39.10833	7.104167	34.125
Khorasan Razavi	34.13333	23.55	8.258333	20.39167
Hormozgan	26.25	10.21667	4.583333	150.175

According to Table 5, in the winter, spring, and summer, provinces of Kohgiloyeh, Chahar Mahal & Bakhtiari, and Mazandaran had the highest, while Yazd and Semnan had the lowest rates of rainfall.

In the spring, the provinces of Gilan and Western Azrbayyjan had the highest levels of rainfall, whereas Yazd and Bushehr had the lowest rates of precipitation.

Gilan, Mazandaran, and Golestan had the highest levels of rainfall in the summer, while the provinces of South Khorasan ,Yazd , Sistan, and Khuzestan had the lowest rates of precipitation.

In the Autumn, Gilan, Mazandaran, and Hormozgan had the highest levels of rainfall, where as Yazd and Sistan & Balochestan had the lowest rates of precipitation. Thus, overall, Gilan and Mazandaran had the highest levels of rainfall, while Yazd and Sistan & Balochestan had the lowest rates of precipitation.

Second Report of the UNFCC claims that southwestern parts of the Caspian Sea, northwest, and west of Iran have experienced the largest reductions in the annual amount of precipitation, i.e. the number of days with precipitation higher than 10mm have reduced in these parts, whereas the level of precipitation has increased in other regions, except for the southeast of the Caspian sea.

The report of UNFCCC illustrates the changes in the amount of precipitation in selected station. Accordingly, it could be concluded that the southwestern part of the Caspian Sea, northwest, and west of the country have experienced the highest rates of reduction in the annual amount of precipitation.

Climate Change Projection

The MAGICC-SCENGEN and LARS-WG models were used to project future changes in the country's climate at the regional scale, while the PRECIS model was used for projection at the local scale.

Climate Change projection using MAGICC-SCENGEN (HadCM2 and ECHAM4 Models)

The HadCM2 and ECHAM4 in combination with 18 available emissions scenarios were utilized to project the changes in the country’s temperature and precipitation (as the main contributors to the formation of the climate) until the year 2100. Both GCMs predicted higher temperatures nationwide with small variations. According to HadCM2, the temperature will rise between 0.4 and 3 °C, while the results of ECHAM4 suggested that the rise will be in the range of 0.5 to 4 °C. However, there are significant differences between the projected changes in precipitation and its spatial distribution. According to HadCM2, the northern half of the country will have a rise in the amount of the precipitation, while the southern half of the country will suffer from a net loss in precipitation. However, the changes projected using ECHAM4 indicated that the northern half of the country will suffer from a net loss in precipitation, while the southern part of the country will observe an increase in the level of precipitation. Figure 3 and 4 illustrate the temperature and precipitation changes projected by the two HadCM2 and ECHAM4 models for the 21th century.

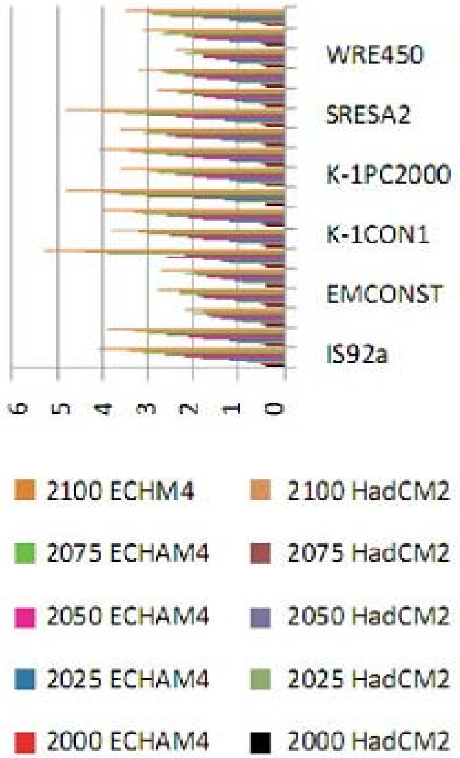

Figure 3- Temperature changes projected by two HadCM2 and ECHM4 models for the 21th century

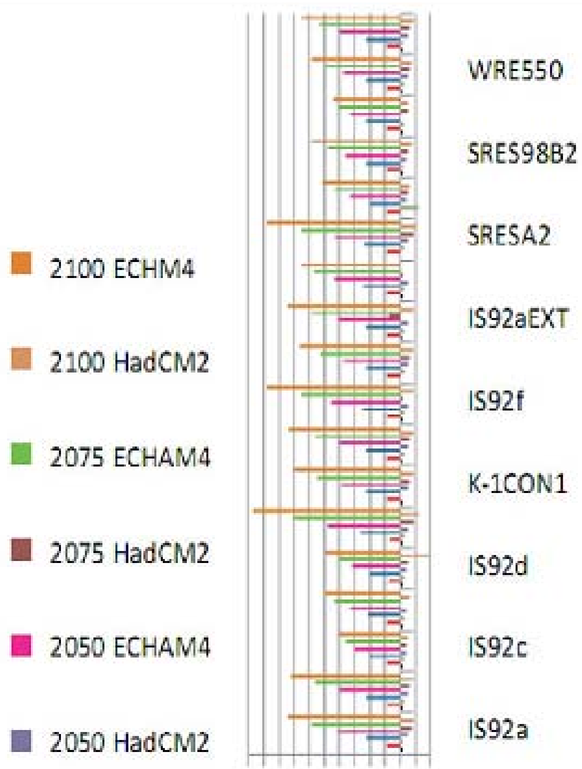

Figure 4- Percipitation changes projected by two HadCM2 and ECHM4 models for the 21th century

Climate Change Projection using LARS-WG Weather Generator

The Climatological Research Institute had already conducted climate change studies throughout the country by means of LARS-WG (the stochastic weather generator that was developed in 2002) in combination with the results of A1 scenario of ECHO-G model (a GCM model that is being used at Hamburg University and in South Korean Center for Meteorological Research).

That scenario was used to project the country's climate during 2010-2039 and to compare the results with observations during 1976-2005.

The results indicated that over 2010-2039, the amount of precipitation will, on average, decrease throughout the country by 9%, compared with the baseline time. Temperature projections show an average increase of 0.9 °C; minimum and maximum temperatures will also rise, on average, by 0.5 °C. The rises are more pronounced during the cold seasons.

Comparison between climate change projections

To address uncertainties in climate change projections, the outcomes of different models and scenarios were compared with each other. The results for the two models (i.e. HadCM2 and LARS-WG) with the two emission scenarios (i.e. IS92a and A1) are presented. To be able to compare the results of the projections with those of the baseline, the climate change projection by MAGICC-SCENGEN was changed from 1961-1990 to 1976-2005. The results indicated that there were no statistically meaningful differences between the projected changes in precipitation and temperature in the future according to the models and scenarios at 0.05 level of confidence.

Table 6 shows the differences between changes of participation and temperature projected by different models (2010-2039).

Table 6- Comparison between participation and temperature projected by different models (2010-2039)

	Precipitation		Temperature	
	MAGICC SCENGEN IS92a (HadCM2)	MAGICC SCENGEN A1 (HadCM2)	MAGICC SCENGEN IS92a (HadCM2)	MAGICC SCENGEN A1 (HadCM2)
MAGICC SCENGEN A1 (HadCM2)	** 0.99	---	** 0.99	---
LARS-WG A1 (ECHO_G)	** 0.77	** 0.78	** 0.84	** 0.85

** Correlation is significant at the 0.05 level

Dynamic Downscaling

PRECIS (Providing Regional Climates for Impacts Studies) uses the output of GCMs as its boundary parameter to project future climate on a regional scale by producing higher resolution results. Therefore, it could be considered as downscaling tools. Its outstanding difference with models like LARS-WG is that is uses the governing set of equations in the atmosphere to make the projection known as dynamical modeling.

At the time of carrying out the projection, the only available GCMs outputs from Hadly Center were for 2071-2100. Therefore, the regional climate projection was carried out for that period of time. The results of the projections for the changes in the parameters like rainfall and temperature are illustrated in Figures 5 and 6, respectively.

According to the model predictions, although in some provinces the average rainfall will increase, but as can be seen in Figure 5, the number of low precipitation areas will increase across the country.

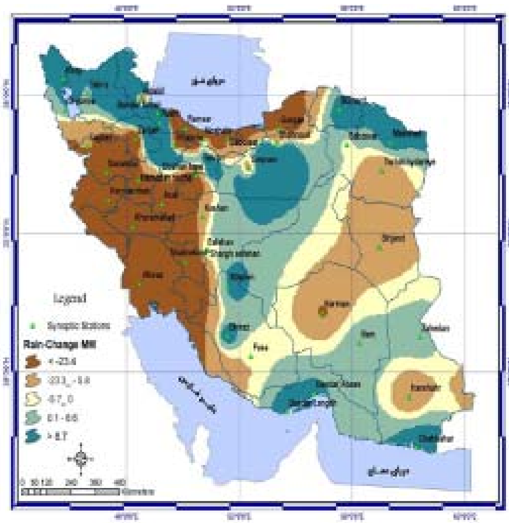

Figure 5- The difference in rainfall over 2010-2039 in comparison with 1976-2005

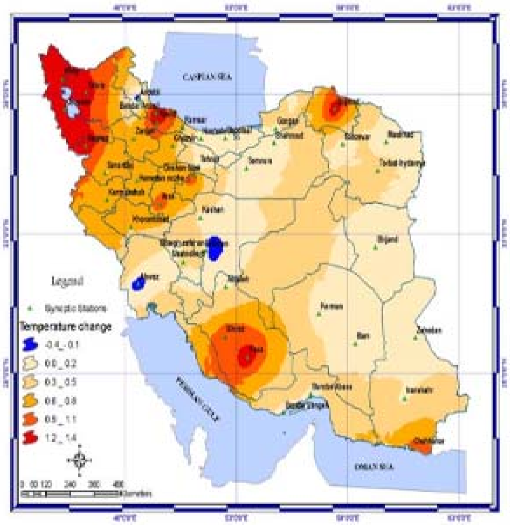

Figure 6- The difference in temperature over 2010-2039 in comparison with 1976-2005

The results of the model predictions also indicated that the average temperature in future will increase during all months of the year, except for July and August. The most significant increase in this average will be observed in winter (0.7^{o}C) and autumn (0.6^{o}C). On the other hand, the increase in the temperature of cold seasons will be more than that of the other months.

Overall, the country will encounter a 9% reduction in the level of rainfall. The most significant decreases will be observed in western provinces as well as southern and eastern coastal areas of the Caspian Sea, including Kordestan, Hamedan, Zanjan, Markazi, Kermanshah, Lorestan, Ilam, Khuzestan, Chaharmahal va Bakhtiari, Bushehr, Mazandaran, and Golestan provinces.

These areas will have more than 23 mm decrease in their levels of rainfall. Other provinces with reduced levels of rainfall in future are Kerman, Khorassan-e-Jonoobi, South of Khorassan-e-Razavi, as well as parts of Sistan va Baluchistan. Decreased rainfall and increased heavy rains will cause flooding in some parts of the country.

Framework for Vulnerabilities and Adaptation Program
NASPA Process

Context
According to the outstanding global priority of the international community, the NASPA project was conducted for assessing the impact of climate change variability on human health in I.R.Iran. Based on the collected evidence, Iran is highly vulnerable to the adverse impacts of climate change.
As prerequisites to carry out the vulnerability and adaptation assessment, six task forces were established to work on the high-sensitive health issues associated with climate change. Each task force studied the climate variability and modeled future climate change to predict their future impacts based on historical and current situation on the target health outcomes.
The Iranian government represented by the Ministry of Health and Medical Education (MOHME) 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 MOHME is in the process of developing national measures to protect human health from climate change.
Ministry of Health & Medical Education (MOH & ME) of I.R.Iran in collaboration with World Health Organization (WHO) and other national partners took an initiative to shape a National Steering Committee (NSC) for Climate Change & Health to develop and implement a National Adaptation Strategy and Plan of Action for Health and Climate Change (NASPA) in regard with the health impacts associated with climate change.
Environmental & Occupational Health Center (EOHC) at the Deputy of Health of MOH&ME was the coordinating body of NST-CCH and the Institute for Environmental Research (IER) of the Tehran University of Medical Sciences (TUMS) contributed in this program as the technical partner.
According to the UNFCCC, a NASPA focuses on urgent and immediate needs – those for which further delay could increase vulnerability or lead to increased costs at a later stage. A NASPA should use existing information; no new research is needed. They must be action-oriented and country-driven and be flexible and based on national circumstances. In addition, in order to effectively

address urgent and immediate adaptation needs, NASPA documents should be presented in a simple format, easily understood both by policy-level decision-makers and by the public.

Climate change will undermine the determinants of health. Major climate-sensitive health issues are: 1) vector- borne diseases, 2) Non-Communicable diseases including air-borne, heart, cancer, and respiratory diseases, 3) Nutrition and food insecurity including food-borne diseases, 4) Water safety and quality including water-borne diseases, 5) occupational health, and 6) disaster management.

Accordingly, six technical task forces for climate-sensitive health areas, selected based on the relevancy according to the Multi-Criteria Analysis (MCA), were ranked and established for identifying the most urgent needs to prioritize the immediate adaptation interventions. Members of each taskforce comprised faculty members of IER and TUMS, scientific members of other academic institutes, and national programme mangers in MOH & ME and other ministries and organizations pertaining to sensitive areas.

This project has been designed to ensure all committees' deliverables are developed based on a technically sound and coordinated methodology that meet the NSC needs and quality criteria.

Throughout this project, the following definitions were considered for key terms:

- **Climate** is the "average weather" in a particular place over a particular time period. It is the statistical description of the mean and variability of weather variables (e.g. temperature, precipitation) over a period of time ranging from months to thousands or millions of years; the typical time period is 30 years.

- **Climate change** refers to a statistically significant variation in either the mean state of the climate or its variability, persisting for an extended period (typically decades or longer). Climate change is due to natural internal processes or external forcing, and to persistent anthropogenic changes in the composition of the atmosphere. UNFCCC defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods".

- **Climate-sensitive health outcome** is any health outcome whose geographical range, incidence or intensity of transmission is directly or indirectly associated with weather or climate.
- **Adaptation** is a process by which strategies and measures to moderate, cope with and take advantage of the consequences of climatic events are enhanced, developed, implemented and monitored. In public health, the analogous term is “prevention”. Various types of adaptation exist, including anticipatory and reactive, private and public, autonomous and planned.
- **Adaptive capacity** is the general ability of individuals, communities and institutions to effectively prepare for and cope with the consequences of climate variability and change.

The above definitions were collected as part of the development of the national strategy and plan of action on health and climate change.

Purposes

The purpose of this project was to develop NASPA based on the evidence derived from a vulnerability and adaptation assessment of the Iranian population’s health and Iran’s public health system.

Research Objective

This was a four-phase study with the overall objectives of developing NASPA based on assessing vulnerability and adaptation status of the Iranian population health and Iran’s public health system with respect to current and future climate change, with special focus on six major climate-sensitive health issues, as mentioned below:

1. Vector- borne diseases;
2. Water safety and quality, including water-borne diseases;
3. Occupational health and related diseases;
4. Non Communicable diseases, including cardio-vascular mortalities;
5. Nutrition and food insecurity, including food-borne diseases;
6. Disaster Management.

Phases of the Project

Phase (I)

In Phase (I) of the project, the researcher(s):

1. Performed a comprehensive literature review of the existing a comprehensive literature review of the existing literature on the subject of interest. Developing and applying a clear "search strategy" was necessary. This phase done by each task force separately and finalized by the preparation team of NASPA;
2. Summarized findings of the literature review and submitted their report for review.

Phase (II)

In Phase II, the following items were developed:

1. A step-by-step assessment methodology. The methodology contained the following steps:

1-1 Framed and scoped the assessment-

- o Define the geographical range and health outcomes of interest;
- o Identify the questions to be addressed and steps to be used;
- o Identify the policy context for the assessment;
- o Establish a project team and a management plan;
- o Establish a stakeholder process.

1-2 Conducted the vulnerability and adaptation assessment-

- o Establish baseline conditions by describing the human health risks of current climate variability and recent climate change, and the public health policies and programmes to address the risks;
- o Describe current risks of climate-sensitive health outcomes, including the most vulnerable populations and regions (*Identify vulnerable populations and regions, Describe risk distribution using spatial mapping)*- Based on the outcome of interest, the methods may be varied among the task forces.
- o Analyze the relationships between current and past weather/climate conditions and health outcomes;

o Identify trends in climate change-related exposures;
o Take account of interactions between environmental and socioeconomic determinants of health if it was possible;
o Describe the current capacity of health and other sectors to manage the risks of climate-sensitive health outcomes, considering health system adaptive capacity and resilience.

2. An assessment tool considering both human health and public health systems. The tool contained the vulnerability and adaptation measurement indicators along with their definition, data collection method, source(s) of data, and unit of measurement.

3. A step-by-step methodology of NASPA development. The methodology contained the following steps:

- Identifying key adaptation measures, based on results of vulnerability and adaptation assessment, along with criteria for prioritizing activities, and selection of a prioritized short list of activities;
- Developing short profiles of projects and/or activities intended to address urgent and immediate adaptation needs.
- Submitting the report for review.

Phase (III)

In Phase (III) of the project, the researcher(s):

1. Implemented the assessment methodology through synthesis the available information. A participatory approach was done and many related stakeholders were contributed in this phases;
2. Analyzed the data and interpret the findings followed by a clear comprehensive list of conclusions along with related recommendations in terms of vulnerability reduction and adaptation and copying capacities enhancement in a form that applicable for policymaking and practice;
3. Submitted the report for review.

Phases (IV)

In Phase (IV), the researcher(s):

1. Developed NASPA related to the climate-sensitive health issue of interest including key adaptation measures, a prioritized list of activities and short profiles of projects and/or activities intended to address urgent and immediate adaptation needs;
2. Submitted the report for review.

For conducting above approaches, both qualitative and quantitative methods were applied in different steps by each technical group. The applied qualitative methods were the experts' judgment, comprehensive literatures review, stakeholder analysis, STEEP.V and SWOT analysis. The Quantitative methods were the Regression analysis based on time series methods and mathematical models for projection of modeling relationships and extrapolating future risks for different outcomes. Adaptation and strategies were also developed by pooling the abovementioned methods.

Criteria for Selecting Priority Projects

In order to match the resource requirement of potential adaptation projects with available resources, it is of paramount importance to devise evaluation criteria so as to produce prioritized set of projects by each task force.

The criteria selected for prioritizing adaptation options were based on the generic criteria as outlined in the Annotated Guidelines for the preparation of NASPAs, as well as those generated through national and regional stakeholder consultations. As the NASPA is intended to build upon and be integrated with existing national development plans such as poverty reduction strategies, sustainable development strategies, national conservation strategies, etc., the criteria selected were further examined in relation to national priorities and their advantages in climate risk avoidance, in poverty reduction, ensuring complementary and promoting synergies with national and sectorial development plans.

The selected criteria were:

1- Decrease of Climate Change Risk;
2- Impact on peoples' Income Growth;
3- Cost effectiveness;
4- Complementary with national and sectorial plans, policies and strategies;
5- Synergy with national plans.

Once the criteria were defined, the next step was to determine the importance of the criteria and assign corresponding weights to them. Although, all the identified criteria are relevant to prioritize adaptation projects, the study has assumed that their level of importance is different.

The evaluation criteria indicated the need for complementing the outcomes of the study with consultation outcomes to further rationalize the weight attached to each criterion. Table 7 shows the selected criteria and their weighting.

Table 7- Description of criteria and their weights for selecting the adaptation programs

Criteria	Weights
Decrease of Climate Change impacts on Health	**0.30**
Impact on Peoples Income Growth	**0.20**
Cost Effectiveness	**0.20**
Complementary with National and Sectorial Plans, Policies and Strategies	**0.15**
Synergy with National Plans	**0.15**

Implementation Challenges

The task forces faced numerous challenges and barriers when it came to the implementation of NASPA process. Some of the major barriers that were and will be overcome can be summarized as follows:

- Lack of coordination of other related organs, in case of information delivering, contribution as stakeholders and in case of inadequate support and involvement;
- Lack of appropriate models that can be implemented for I.R.Iran;
- Poor information regarding outcomes, exposures variables, and flow;
- A lack of awareness, both of the potential gravity and the extent of the problem as well as possible actions that could be taken, was the foremost amongst these barriers;
- Lack of incorporation of climate change impacts in developing policies, plans, and programmes in some of the most climate-sensitive sectors (e.g. water management, agriculture, disaster management, etc);
- Lack of adequate tools, knowledge, and methodologies to provide guidance and advice to the people making their decisions;
- Lack of a clear and specific legal and policy framework for climate change issues in the country;
- Inadequate institutional system and individual capacity in issues related to climate change;
- Inadequate human resources with skills to translate strategies into action at the community level where the impacts of climate change are the greatest;
- Lack of private sector involvement in issues related to climate change;
- Limited budget available for the implementation of the priority adaptation activities identified in this NASPA

Impact of Climate Change on
Vector-Borne Diseases Task Force

Context

The burden of vector-borne diseases such as malaria, leishmaniasis (coetaneous), as well as sting of venomous arthropods are major problems of the health system in I.R.Iran.

Disease vectors (mosquitoes, sand flies, ticks, and the agents they transmit) are highly sensitive to climatic conditions, including temperature and humidity. Therefore, changes in the mean and variance of these climatic variables can alter the incidence and geographic range of many climate-sensitive infectious diseases. Weather and climate change has strong direct and indirect effects on human life, from tropical to polar areas of the world. Climate conditions affect diseases transmitted through water or related to it, including diseases transmitted by arthropods, so that the climate-sensitive diseases are among the world's deadliest diseases. Climate change affects risk of disease by influencing the life cycles of vectors; it also has a significant effect on the vector's natural environment and ecology, animals that are reservoirs for the pathogen, and human behavior.

Vulnerability Assessments and Adaptation Plan

The assessment of the impact of climate change on vector-borne diseases was performed with a variety of methods, including mapping and integrated modeling. Some vector-borne diseases, like malaria, have been well-characterized in terms of the effects of temperature and precipitation on the life cycles of the vector and disease agent based on laboratory studies. Establishing current geographic boundaries on the basis of current climatic conditions, applying climate projections, and estimating changes in the geographic boundaries and transmission rates are the essential steps in the assessment. Therefore, the VBD task force analyzed the situation of important vector-borne diseases and their vectors in Iran to map the current vulnerability and potential of different provinces for each registered VBD. Based on their sensitivity to climate change, the following vector-borne diseases were chosen for assessment: Malaria and Cutaneous leishmaniasis.

Malaria

Malaria is the most important mosquito-borne disease in I.R.Iran. Although it has had a decreasing trend in the country during the past few years, autochthonous cases are reported from southeastern parts, including *Sistan & Baluchistan, Hormozgan,* and *Kerman* provinces. Based on world malaria report in 2011, Iran is classified to be in the Malaria Elimination Phase and this disease is expected to eradicate by 2025. Figures 7and 8 show the reported foci of P. falciparum and P. vivax in the country, respectively.

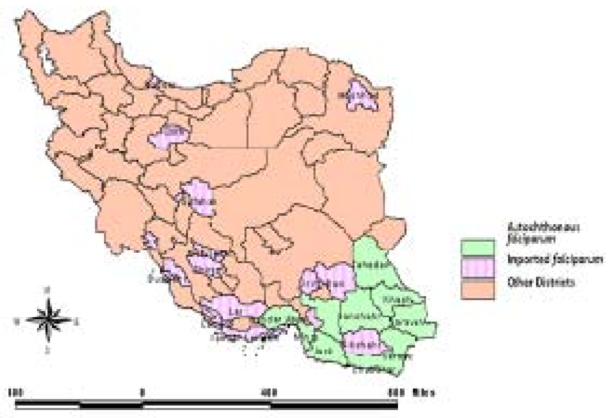

Figure 7- Plasmodium falciparum reported foci in Iran, 2009

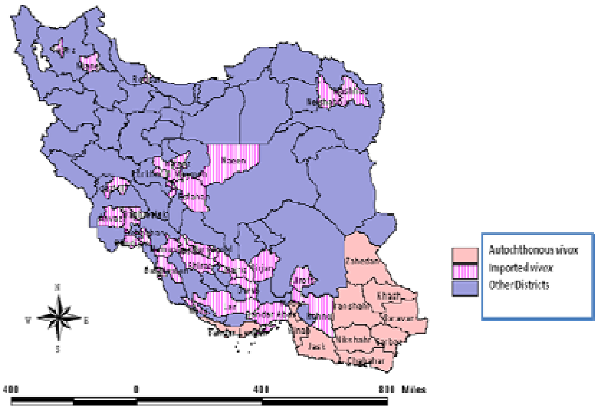

Figure 8- Plasmodium vivax reported foci in Iran, 2009

Based on the selected models (i.e. Spline interpolation modeling) and climatic variables influencing Malaria (both vectors and disease) distribution, the provinces being at the highest risk are the following: *Hormozgan*, *Bushehr*, *Khuzestan*, *Southern* part of *Sistan & Baluchestan*, all in south of Iran, as well as *Mazandaran* and *Gilan* in northern part of the country. Figure 9 shows the impact of climate on the risk of Malaria by province.

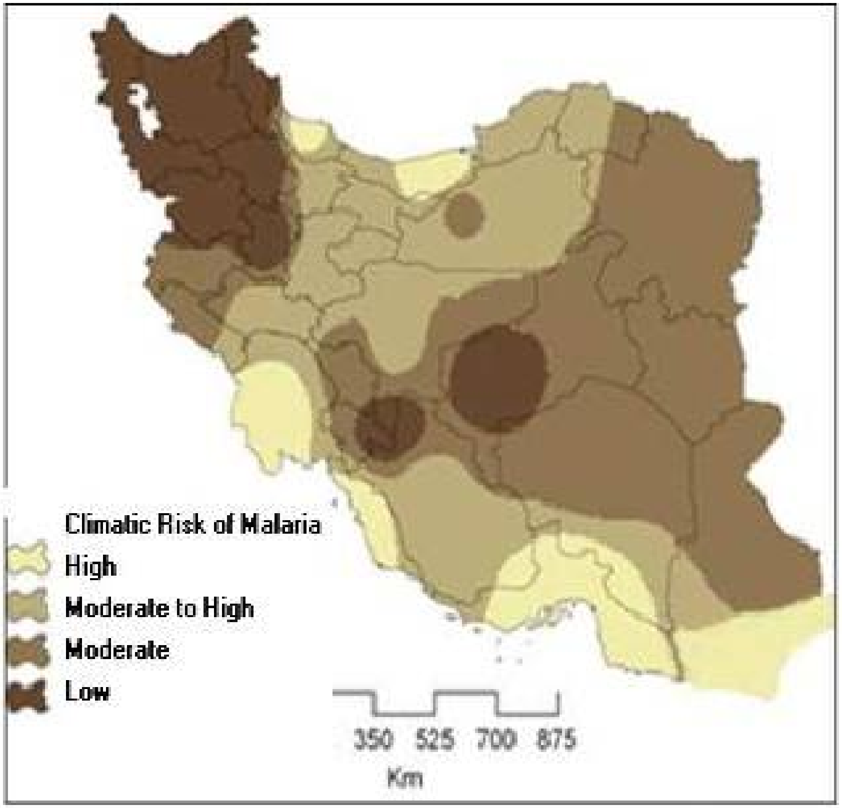

Figure 9- Climatic potential of malaria risk in I.R.Iran

Leishmaniasis

Cutaneous leishmaniasis is now common in 17 out of 31 provinces of Iran, and is mainly focused on a belt from northeast to southwest of the country, with more than 20000 annual cases. As shown in Figure 10 (the spatial distributaion of disease) *Fars*, *Khorassan Razavi*, *Isfahan*, *Kerman*, *Khuzistan*, *Yazd*, *Ilam*, *Golestan,* and *Bushehr* are the main foci for the disease.

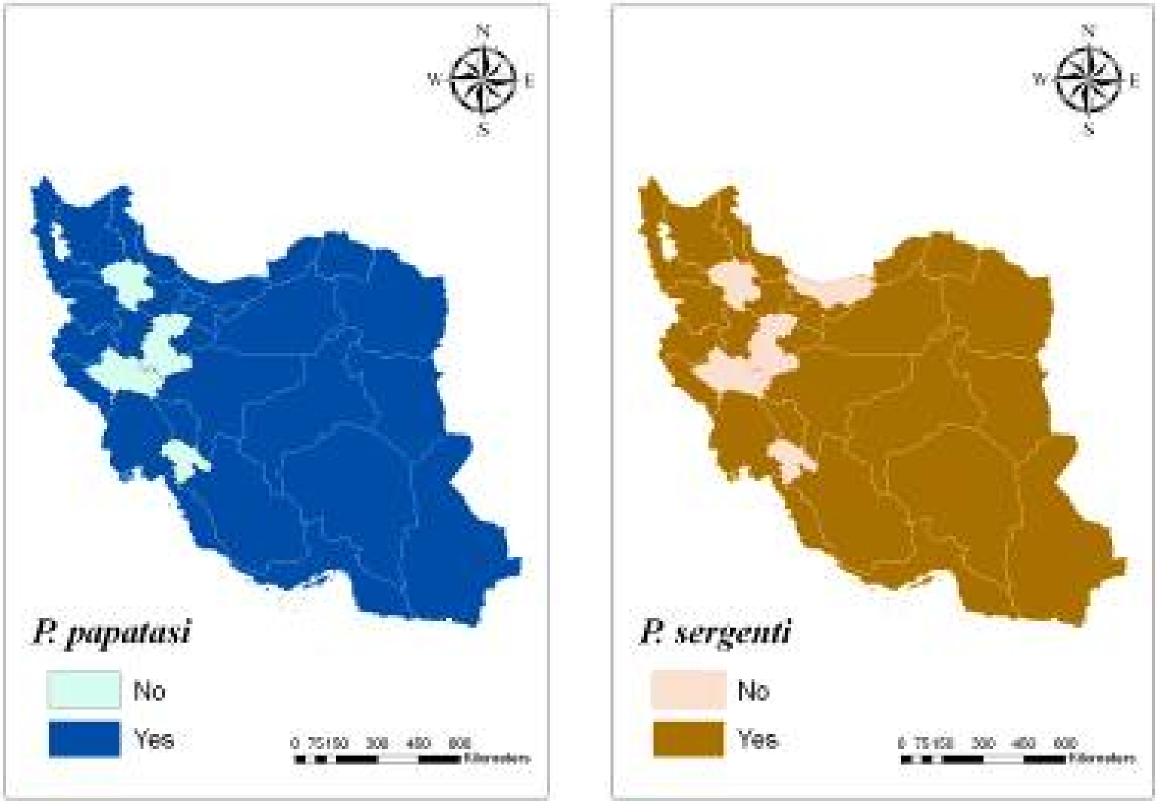

Figure 10- Spatial distribution of main CL vectors in I.R. Iran

Based on the Boolean logic and linear regression analysis for assessing the impact of climatic variables on CL, the provinces being at the highest risk are: *Esfahan*, *Khorassan-e-Razavi, Markazi*, *Fars*, *Khorassan-e-Jonoobi*, *Kerman*, *Qom*, *Tehran*, *Qazvin,* and *Semnan*, respectively. Figure 11 shows the climatic variables influencing CL.

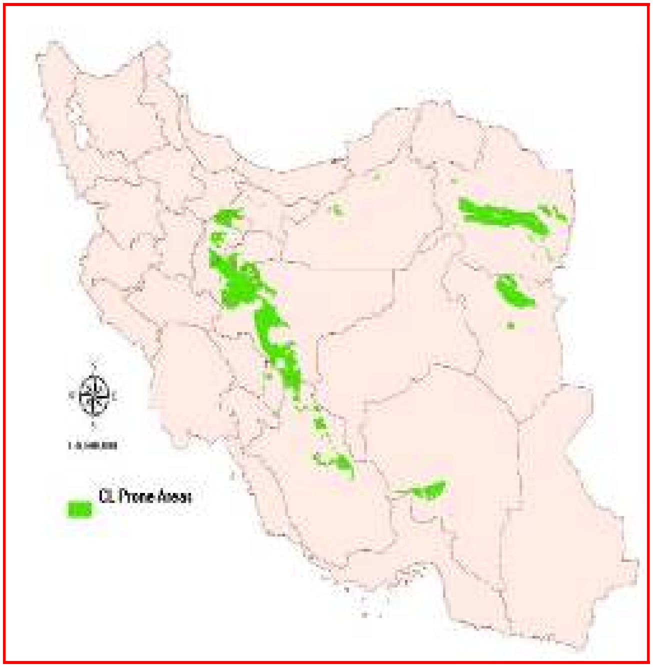

Figure 11- Map of areas prone to Cutaneous Leishmaniasis in I.R.Iran, using climatic and environmental variables

Considering the most climate-sensitive, vector-borne diseases of I.R.Iran, i.e. malaria and cutaneous leishmaniasis, that may be affected more by climate change, and based on the climatological information and using of Spline interpolation modeling as the vulnerability assessment method, *Hormozgan*, *Bushehr*, *Khuzestan*, Southern part of *Sistan & Baluchestan*, all in south of Iran, as well as *Mazandaran* and *Gilan* provinces in northern part of the country will have the highest risk

of Malaria transmission. Regarding leishmaniasis, analysis of environmental variables affecting the disease transmission combined with the Boolean logic and linear regression showed that the main foci of the disease in the country are *Esfahan*, *Khorassan-e-Razavi*, *Markazi*, *Fars*, *Khorassan-e-Jonoobi*, *Kerman*, *Qom*, *Tehran*, *Qazvin,* and *Semnan* provinces, respectively.
Decisions made by the central government can have a profound effect on the ability of communities to adapt to climate change. There are national guidelines for the important vector-borne diseases in the country, although they did not include the adaptation program for climate change. Therefore, it seems that the national programs developed for controlling these diseases should focus on strengthening their adaptation measures in the above-mentioned provinces.

Adaptation Program

It is necessary to establish national programs for other VBDs in relation to climate change. It is also suggested to improve the health status of the population by the prevention and management of vector-borne diseases caused by changes in temperature and flooding due to extreme rainfall; develop the necessary capacity to assess and address the implications of climate change for human health and health systems, including tools and methodologies; and assess health impacts of potential adaptation and mitigation measures undertaken by other sectors. Bilateral collaboration among neighboring countries is also a very important issue. Any policy taken in neighboring countries will affect the burden of diseases in Iran.

Water Safety and Quality including Water-Borne Diseases Task Force

Context

Climate directly affects the incidence of water-borne diseases through effects on water temperature and precipitation frequency and intensity. These effects may be classified as pathogenic and specific pollutants, and the risks for human health, which are markedly affected by local conditions, including regional water and sewage treatment capacities and practices. Domestic water treatment plants may be susceptible to climate change leading to human health risks.

Diarrheal diseases have multiple modes of transmission, such as via water, food, insects, or contact between humans.
There is strong evidence pointing out the associations between several important communicable diseases and climate in several temporal and geographical scales.
This is also the case for many enteric illnesses and certain water related diseases. These associations are not found everywhere; this is hardly surprising given the complexity of the causal pathways involved. Relationships between year-to-year variations in climate and communicable diseases are most evident where these climate variations are marked, and in vulnerable populations in poor countries. Major scientific reviews agree that El Niño can provide a partial analogue for the effects of global climate change on communicable diseases.

Vulnerability Assessment and Adaption Plan

The effect of climate variables on diarrheal diseases was estimated per each 1°C temperature increase for different regions of I.R.Iran based on time-series; the relative risk of diarrheal disease was found to be equal to 0.08. The incidence of Cholera and Typhoid fever were used for projection. Table 8 shows the incidence of Cholera in different provinces of the country. The highest incidence rates were 3.1 per 100,000 in Kordestan province that occurred in 2007 and 2.5 for Qhom in 2007. In addition, the incidence rate of Typhoid fever for the past 50 years showed that the highest incidence was registered in 1965 (133.4/100000 cases/year), while the lowest rate (0.52/100000 cases/year) was registered in 2011. Figure 12 shows the incidence rate of Typhoid fever by province. Table 9 presents the simulated increase in the mean seasonal relative risk of diarrhea for different climatic regions of I.R.Iran.

Table 8- Incidence of Cholera in Iran from 2006-2010 (Cases per 100000 population)

University	2006	2007	2008	2009	2010
AzarbayejanSharghi	0	0	0	0	0
AzarbayejanGharbi	0	0.4	0	0	0
Ardebil	0	0	0	0	0
Isfahan	0.02	0	0	0	0
Kashan	0	0.3	1	0.5	0
Ilam	0	0	0	0	0
Bushehr	0.11	0	0	0	0.11
Tehran	0	0	0.09	0	0
Iran	0	0	1.2	0	0
Beheshti	0	0	0.2	0.02	0
CharmahalBakhtiari	0	0	0	0	0
Birjand	0	0	0	0	0
Mashhad	0	0	0.2	0	0
Sabzevar	0	0	0	0	0
Gonabad	0	0	0.9	0	0
Bojnord	0	0	0	0	0
Khuzestan	0	0	0	0.02	0.05
Zanjan	0	0	0.3	0	0
Semnan	0.3	0	0.3	0	0
Shahrod	0	0	0	0	0
Zabol	0	0	0	0	0
Zahedan	0.5	0.04	1.3	0.6	0.5
Shiraz	0	0	0.6	0	0
Jahrom	0	0	0	0	0
Fasa	0	0	0	0	0
Ghazvin	0	0	1.5	0	0
Qhom	1	0.19	2.5	0	0
Kordestan	0	3.1	0	0	0
Kerman	0	0	0	0	0
Rafsanjan	0	0	0	0	0
Jiroft	-	-	-	0	0
Kermanshah	0	0	0	0	0
KohgiloyeBoyrahmad	0	0	0	0	0
Golestan	0	0	0	0	0
Gilan	0	0	0	0	0
Lorestan	0	0	0	0	0
Mazandaran	0	0	0.12	0	0
Babol	0	0	0	0	0
Markazi	0	0	0.4	0.07	0
Hormozgan	0	0	1.6	0	0
Hamedan	0	0	0.06	0	0
Yazd	0	0	0	0	0.2
Mean	0.02	0.02	0.3	0.08	0.03

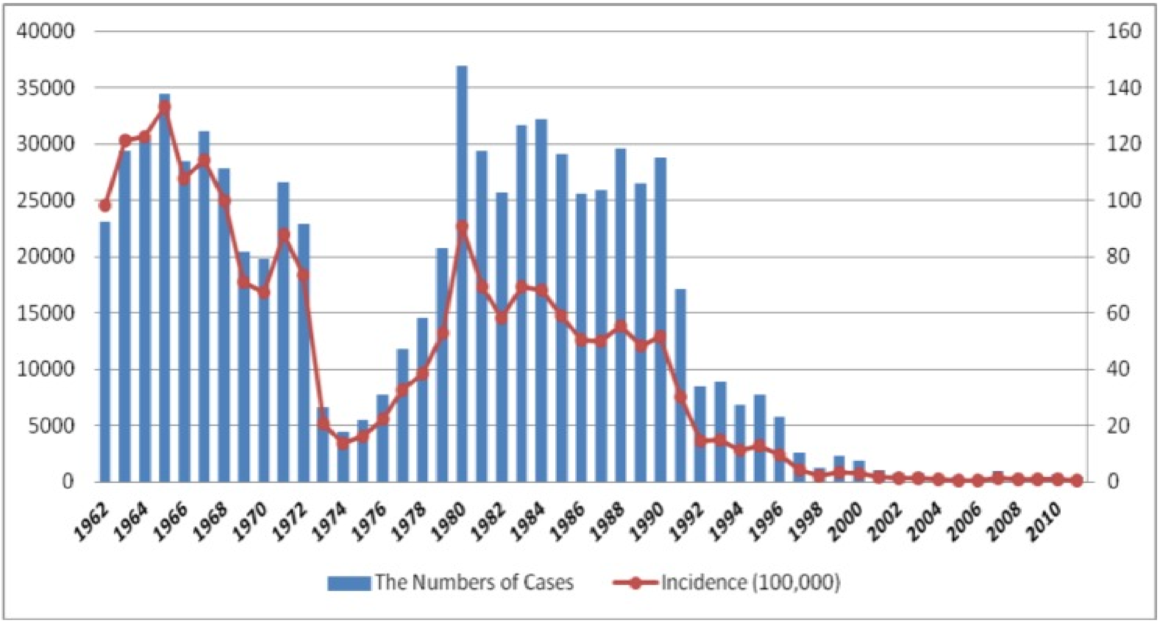

Figure 12- Incidence Rate of Typhoid Fever in I.R.Iran (1962-2010)

Table 9- Simulated increases in the mean seasonal relative risk of diarrhea for different climate regions of Iran

Year	Climate Region	Winter	Spring	Summer	Autumn
2025-2050	Arid	0.0808	0.0912	0.1056	0.0872
	Semi-Arid	0.00776	0.0808	0.0968	0.0544
	Mediterranean & Semi Humid	0.0696	0.0792	0.112	0.0584
	Humid & Hyper Humid	0.0464	0.0704	0.1184	0.052
2050-2075	Arid	0.0648	0.0864	0.052	0.0672
	Semi-Arid	0.064	0.0784	0.1344	0.0488
	Mediterranean & Semi Humid	0.072	0.092	0.088	0.048
	Humid & Hyper Humid	0.0432	0.0528	0.0544	0.0528
2075-2100	Arid	0.076	0.1056	0.1352	0.068
	Semi-Arid	0.0712	0.0792	0.0752	0.0448
	Mediterranean & Semi Humid	0.0736	0.064	0.0936	0.0504
	Humid & Hyper Humid	0.088	0.0624	0.088	0.016

Based on the results, the highest projected relative risk was 0.13 which may occur in Arid areas over 2075-2100.

Based on the estimation of vulnerability index for the country, the regions vulnerable to the occurrence of water-borne diseases in relation to factors such as climatic variables were determined; *Golestan* and *Bushehr* had the highest shortage of water resources, so they were considered as the most vulnerable provinces. Figure 12 shows the vulnerability index by province in 2010.

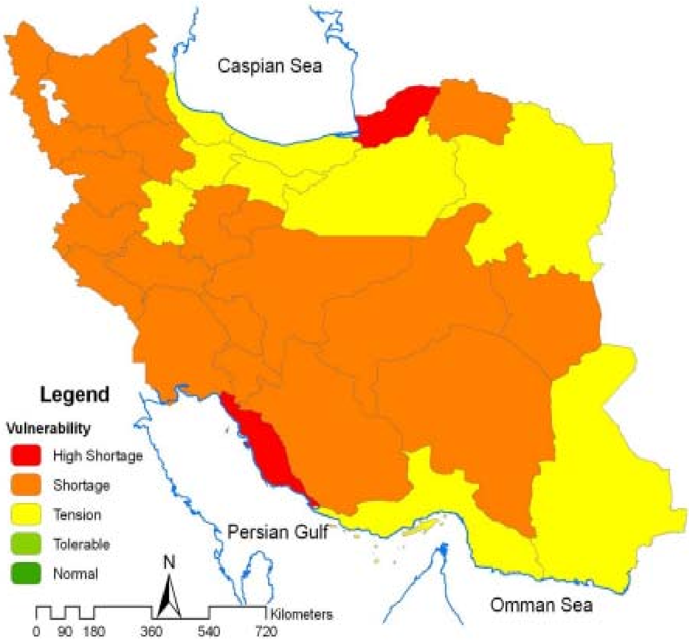

Figure 13- Classification of different provinces of Iran by vulnerability Index in 2010

The overall simulated (projected) occurrence of diarrheal diseases due to climate change in the context of water quality and water safety showed increasing risks. In other words, diarrheal diseases in this region are highly sensitive to changing climate over the time. Changing climate in I.R.Iran may influence the patterns of both agents and diseases.

Based on the vulnerability assessment, the relative risk (RR) of diarrhea diseases for each 1°C temperature increases is 0.08. The highest RR over 2025-2050 for different climatic regions of the country is 0.11, which was projected for *Mediterranean, Semi-Humid, Humid, and Hyper-Humid* regions. The projected RR for 2050 up to 2070 is 0.13 for *Semi-Arid* areas. The highest RR over 2075-2100 is 0.13, which was projected for *Arid* regions.

Adaptation Program

Based on the review of adaptation options identified, 78 potential adaptation options were initially proposed to be further prioritized and ranked to be included in the NASPA to address immediate adaptation needs. These adaptation options were proposed based on either the synergy assessment report or the regional consultative workshops, or otherwise. The adaptation program of the task force includes MOH & ME and other related sectors such as Ministry of Agriculture. Based on the prioritization, The **First** priority in the adaptation strategy for this task force is improvement of irrigation methods (for other sectors) and provision/improvement of registration systems for water-borne diseases (for MOH & ME).

Occupational Health and Related Diseases Task Force

Context

Heat stroke leads to severe illnesses with high fever and symptoms of systems failure such as the failure of cardiovascular, circulatory, respiratory, or ingestion systems as well as blood coagulation, decreased platelets, acute renal failure, and even death.

The above information suggests that increasing of earth surface temperature and its effect on productivity and human health are obvious. A large part of the workers, working inside or outside the bounded industry, are usually working in exposed areas; this may include farmers, fishermen, workers employed in open pit mines, and military. When a body carries out physical work, heat is produced internally which needs to be transferred to the external environment in order to avoid the increase of body temperature. If the body temperature exceeds 39◦C, heatstroke may occur; a temperature of 40.6 ◦C is life-threatening.

Vulnerability Assessment and Adaption Plan

This task force mainly focused on the effect of climate change on thermal stress. Therefore, the distribution of thermal stress in different provinces was evaluated, the results of which are illustrated in Figure 14. According to this figure, provinces of *Ardebil*, *Bushehr*, *Chahar Mahal*, *East Azarbaijan*, and *Esfahan* are classified as areas with low thermal stress factor. However, provinces of *Semnan*, *Sistan & Balochestan*, *Tehran*, *West Azarbayejan*, *Yazd,* and *Zanjan* had the highest heat stress factors.

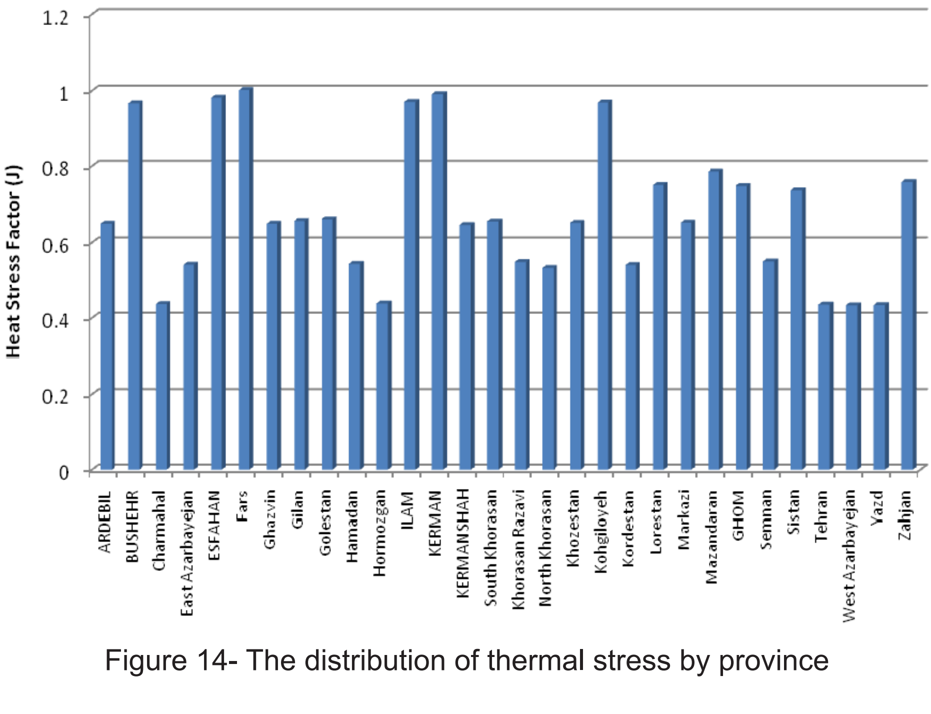

Figure 14- The distribution of thermal stress by province

Based on a comprehensive literature review, the selected indicator of this task force was the Wet bulb Globe Temperature (WBGT). To predict the, the following equation was used:

$$WBGT = 0.567 \times Ta + 3.94 + 0.393 \times E$$
$$E = RH/100 \times 6.105 \times \exp(17.27 \times Ta/(237.7 + Ta))$$

The average difference between WBGT and environmental temperature is 11.65 °C. As can be seen from the figure, in some cities this difference is smaller than the average, while in other cities the difference is larger than the average. Interestingly, the difference is larger in cold regions of the country, which proves that regions with low environmental temperatures have higher levels of heat stress index than that estimated according to their environmental temperature. Figure 15 shows the estimated Heat stress Index (WBGT) for different parts of I.R.Iran in summer months during 1976-2005.

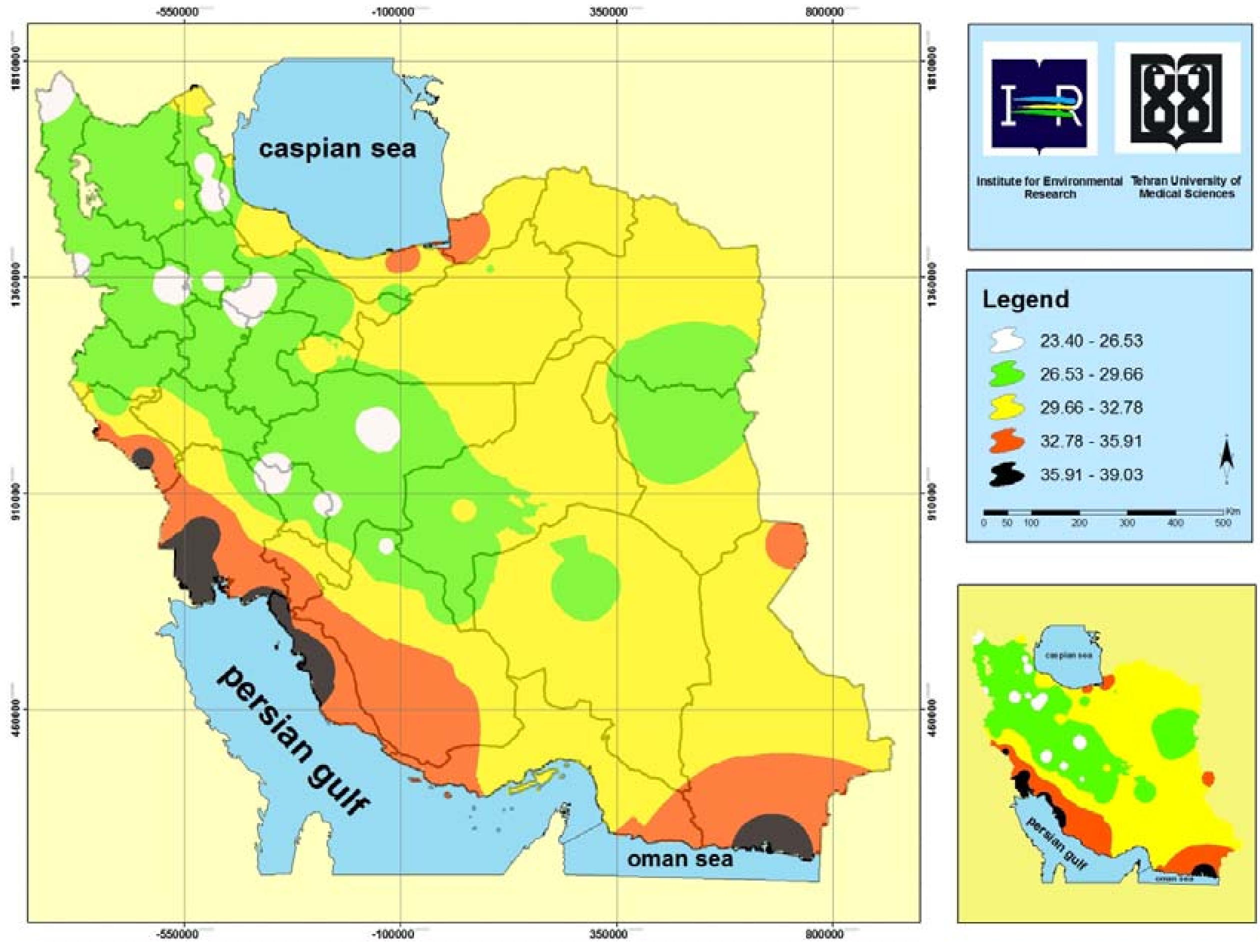

Figure 15- Estimated Heat Stress Index (WBGT) for different parts of I.R.Iran in summer months during 1976-2005

Exposure to heat stress in summer is much higher than that of other seasons. The provinces of *Sistan & Baluchestan*, *Khuzestan,* and *Bushehr* had the highest WBGT. However, provinces of *Charamhal & Bakhtiari* and *West-Azrbayyjan* showed the lowest WBGT.

Heat Stress WBGT index, which is based on a comparison with direct measures such as maximum temperature and minimum temperature, showed significant correlation with indirect indicators. Based on direct indexes, provinces of *Khuzestan*, *Bushehr,* and *Sistan & Blochestan* had highest maximum and minimum temperatures.

In all seasons in the northern half of the country, WBGT was lower than that of the provinces in the southern half. Thus, the provinces located in the Northwest, including *West-Azarbayjan,* showed the lowest thermal stress, while the provinces located in the southeast (such as *Sistan & Baluchistan*) had the highest thermal stress.

Regression projection of WBGT for future (2010-2039) showed an increase in the thermal stress in all provinces of the country, except for the *Khuzestan*. The average annual change and were similar in most of the provinces. Additionally, in many provinces, there was no considerable difference between the average and maximum difference. This represents the extent of climate change is similar to the ratio in all changes. Provinces of North *Khorasan*, *Gilan*, *West-Azerbaijan,* and *East- Azerbaijan* had the largest increases in the rate of WBGT, with respective values of 1.24, 1.13, 1.1, and 1.05 °C. The common point among all the provinces mentioned above is that they are located in northern part of the country, and that they are situated mostly in the highlands. Figure 16 shows the changes in mean and maximum WBGT index in the period 2010-2039 compared to the period 1976-2005 in different seasons and different provinces of the country.

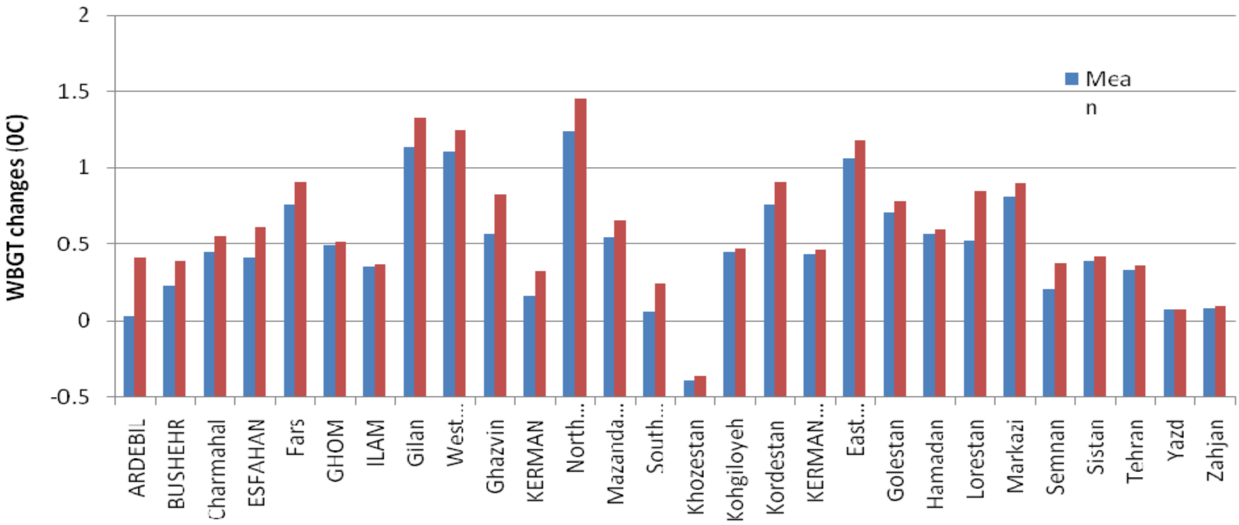

Figure 16- Changes in mean and maximum WBGT index in the period 2010-2039 compared to the period 1976-2005 in different seasons and different provinces of I.R.Iran

Based on the prioritization, the provinces with high sensitivity to thermal stress due to future climate change are listed in Table 10. *Semnan* and *Khorasan-e-Razavi* have the highest rank based on the final evaluation.

Table 10- Prioritized provinces based on the sensitivity in order to control

Providence	Control Prioritize
Bushehr	1
Hamadan	1
North Khorasan	1
Markazi	1
Yazd	1
Charmahal	2
Esfahan	2
Fars	2
Ilam	2
Kerman	2
Kohgiloyeh	2
West- Azarbayejan	2
Ardebil	3
East Azarbayejan	3
Ghazvin	3
Gilan	3
Golestan	3
Hormozgan	3
Kermanshah	3
South Khorasan	3
Khozestan	3
Kordestan	3
Lorestan	3
Mazandaran	3
Qhom	3
Sistan & Blaochestan	3
Tehran	3
Zahjan	3
Khorasan-e- Razavi	4
Semnan	4

Adaptation Program

Since identifying high priority adaptation project profiles is the ultimate goal of this study, 68 potential adaptation projects in 6 major areas were initially identified through vulnerability assessments and consultation processes.

The following items had the highest rank as an adaptation program in this field:

Preventive programs to reduce heat stress in outdoor environments (Heat stress prevention program) consisting of 6 major steps including: Recognizing and Avoiding Heat stress, Heat stress risk assessment factor, Measures for evaluating heat stress, Controlling heat stress, Workplace responsibilities regarding heat stress, Evaluating program effectiveness.

Non-Communicable diseases including Cardiovascular Mortality Task Force

Context

One of the most challenging issues in this regard is the impacts of climate change on non-communicable diseases. NCDs, including cardiovascular disease, cancers, respiratory health, mental disorders, injuries, and malnutrition may be influence by climate change.

Potential impacts of global climate change on chronic non-communicable diseases (NCDs) are not well known, but several categories of ill health important at the global level are likely to be affected by climate change. There are negative impacts of climatic factors and climate change on some physiological functions and on cardio-vascular, respiratory, and cancer diseases. The risk of chronic disease is likely to increase due to climate change and related increase in air pollution, malnutrition, and extreme weather events.

As mentioned above, extreme air temperature is one of the most important aspects of global climate change. Exposure to extreme temperatures at either side of a “comfort range” is associated with an increased risk of cardio-pulmonary diseases and mortality. Cardiovascular disease (CVD) has the best-characterized temperature-mortality relationship, followed by respiratory disease and total mortality.

Vulnerability Assessment and Adaptation Plan

For this task force, the harm (health outcome) was translated as cardiovascular diseases and attributed mortalities. The selected exposure was the heat wave and the relationship between waves and CVD was estimated by the time-series regression models. The exposure sub-index is comprised of the percentage of heat wave days measuring extreme heat exposure in two time periods of 1976-2005 and 2010-2039. Table 11 shows the estimated number of CVD deaths due to heat waves by province. According to the findings, due to 6228 heat wave days, a total of **18683** cardiovascular deaths occured during 1970-2009 in I.R.Iran. Most of the deaths and heat wave days occurred in *Gilan* (997.2, 332), while *Ardebil* (53.8, 18) had the smallest number of deaths and heat wave days. During the time period mentioned above, *Bushehr* suffered from the higher threshold of the temperature comfort range (i.e. 42.45 °C), whereas *Ardebil* suffered from the lower threshold of the temperature comfort range (i.e. 21.57 °C).

The results of Times series analysis estimated a total of 26432 CVD deaths due to heat waves occurrence during 2010-2039. A comparison of these statistics (30 years) with the time period of 1970-2009 (40 years) revealed 1.5 times increase in both heat waves and associated CVD mortalities. Table 12 provides the comparison between the current and future estimation.

Table 11- Heat-wave-specific cardiovascular deaths: Health impact estimation for 1970-2009

Province	Comfort range temperature threshold (c°)	Total Heat Waves	Heat waves (days)	No of days observed	Adjusted Heat waves (days)	Estimated CVD deaths (3/HW day)
Ardebil	21.57	5	15	6121	18	53.8
Bushehr	42.45	43	203	7317	203	609.3
Ch & B	24.43	48	271	7316	271	813.6
Esfahan	29.17	38	240	7300	241	722.1
E.Azerbayjan	28.19	45	218	7313	218	654.7
Fars	29.91	44	287	7280	289	865.8
Golestan	33.18	46	215	7309	215	646.1
Hamedan	25.21	43	200	7320	200	600.1
Ilam	29.42	26	137	4384	229	686.3
K & B	26.87	19	141	4190	246	739.1
kerman	27.34	40	216	6400	247	741.3
Kermanshah	27.88	45	245	7307	245	736.4
Khozestan	40.45	38	210	7303	211	631.6
kordestan	27.95	39	173	7296	174	520.8
Lorestan	29.78	40	208	7278	209	627.7
Markazi	27.65	47	242	7277	243	730.4
Mazandaran	33.19	14	61	1858	240	721.1
N.Khorasan	27.15	36	153	5999	187	560.1
Qazvin	28.07	38	181	7308	181	544.0
Qom	32.14	26	130	4206	226	678.8
Gilan	30.92	65	332	7312	332	997.2
Semnan	32.81	40	242	7314	242	726.7
S.khorasan	28.39	50	249	7281	250	751.1
S &B	29.61	31	215	7305	215	646.4
Tehran	31.64	45	200	7321	200	600.0
W.Azerbayjan	25.12	40	228	7307	228	685.3
Yazd	31.87	39	211	5630	274	823.1
Zanjan	24.87	37	190	7317	190	570.3
Total		**1067**	**5613**		**6228**	**18683.2**

Table 12- Distribution of Heat waves and correlated CVD deaths: 1970- 2039 by provinces

HW/Outcome	1970-2009	2010-2014	2015-2019	2020-2024	2025-2029	2030-2034	2035-2039	2010-2039
Heat wave days	240.0	53.9	58.7	63.5	68.3	73.0	77.8	395.2
Deaths	720.0	161.7	176.1	190.4	204.8	219.1	233.5	1185.5
Heat wave days	249.0	60.4	69.8	71.5	77.1	82.6	88.2	449.7
Deaths	747.0	181.3	209.5	214.6	231.3	247.9	264.5	1349.1
Heat wave days	215.0	52.0	59.5	62.9	68.3	73.8	79.2	395.6
Deaths	645.0	155.9	178.5	188.6	204.9	221.3	237.6	1186.9
Heat wave days	332.0	91.6	113.4	111.6	121.6	131.6	141.6	711.5
Deaths	996.0	274.8	340.2	334.8	364.8	394.8	424.8	2134.4
Heat wave days	190.0	15.2	12.1	11.1	9.1	7.0	5.0	59.4
Deaths	570.0	45.6	36.3	33.3	27.2	21.0	14.9	178.1
Heat wave days	218.0	33.4	33.0	38.5	41.1	43.6	46.2	235.7
Deaths	654.0	100.1	98.9	115.5	123.2	130.9	138.6	707.2
Heat wave days	228.0	48.9	52.0	56.1	59.7	63.2	66.8	346.7
Deaths	684.0	146.7	156.0	168.2	179.0	189.7	200.4	1040.0
Heat wave days	173.0	38.0	46.6	45.0	48.6	52.1	55.6	285.9
Deaths	519.0	114.0	139.9	135.1	145.7	156.2	166.8	857.6
Heat wave days	245.0	65.6	56.7	79.7	86.7	93.7	100.7	483.2
Deaths	735.0	196.9	170.1	239.0	260.1	281.1	302.2	1449.5
Heat wave days	210.0	53.2	58.4	63.7	68.9	74.1	79.3	397.6
Deaths	630.0	159.6	175.3	191.0	206.6	222.3	238.0	1192.8
Heat wave days	203.0	55.2	66.9	67.7	74.0	80.2	86.5	430.5
Deaths	609.0	165.7	200.7	203.2	221.9	240.7	259.4	1291.6
Heat wave days	216.0	61.4	75.7	73.8	79.9	86.1	92.2	469.1
Deaths	648.0	184.3	227.2	221.3	239.7	258.2	276.6	1407.4
Heat wave days	215.0	57.9	63.3	68.6	74.0	79.3	84.7	427.7
Deaths	645.0	173.7	189.8	205.8	221.9	237.9	254.0	1283.1
Heat wave days	242.0	22.7	26.1	18.5	16.4	14.3	12.2	110.4
Deaths	726.0	68.2	78.4	55.6	49.3	43.0	36.7	331.1
Heat wave days	271.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Deaths	813.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Heat wave days	200.0	43.5	53.1	50.9	54.7	58.4	62.1	322.6
Deaths	600.0	130.4	159.3	152.8	164.0	175.2	186.4	967.9
Heat wave days	242.0	42.3	32.6	46.6	48.8	51.0	53.1	274.5
Deaths	726.0	126.9	97.8	139.9	146.4	152.9	159.4	823.4
Heat wave days	287.0	81.6	75.6	101.1	110.9	120.7	130.5	620.5
Deaths	861.0	244.7	226.9	303.4	332.8	362.1	391.5	1861.4
Heat wave days	208.0	25.6	26.3	24.6	24.0	23.5	23.0	146.9
Deaths	624.0	76.8	78.8	73.7	72.1	70.5	68.9	440.8
Heat wave days	200.0	33.6	56.5	37.2	39.0	40.8	42.6	249.8
Deaths	600.0	100.9	169.6	111.7	117.0	122.4	127.8	749.3
Heat wave days	181.0	23.6	23.4	24.1	24.3	24.5	24.8	144.8
Deaths	543.0	70.9	70.3	72.3	72.9	73.6	74.3	434.3
Heat wave days	226	42.7	50.1	55.5	61.9	68.3	74.7	353.3
Deaths	678.8	128.0	150.4	166.5	185.7	205.0	224.2	1059.8
Heat wave days	187	38.3	51.5	45.9	49.7	53.5	57.3	296.0
Deaths	560.1	114.8	154.4	137.6	149.0	160.4	171.8	888.1
Heat wave days	229	45.8	41.3	54.0	58.0	62.1	66.2	327.4
Deaths	686.3.0	137.5	123.8	161.9	174.1	186.3	198.5	982.2
Heat wave days	240.0	48.7	68.5	67.2	76.5	85.7	95.0	441.6
Deaths	721.1	146.2	205.5	201.7	229.4	257.1	284.9	1324.9
Heat wave days	246.0	31.4	19.7	31.4	31.4	31.4	31.4	176.7
Deaths	739.1	94.2	59.0	94.2	94.2	94.2	94.2	530.0
Heat wave days	274	38.3	40.2	42.1	44.0	45.9	47.9	258.5
Deaths	823.1	114.9	120.6	126.4	132.1	137.8	143.6	775.4
Heat wave days	18.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Deaths	53.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Heat wave days	**6228.0**	**1205.0**	**1331.1**	**1412.8**	**1516.7**	**1620.6**	**1724.5**	**8810.6**
Deaths	**18683.2**	**3615.0**	**3993.2**	**4238.4**	**4550.0**	**4861.7**	**5173.4**	**26431.8**

*Heat wave days and deaths adjusted for time period 1970-2009

Based on our findings, *Sistan & Balochestan*, *Kohgyloyeh & Boyer Ahmad*, *Lorestan,* and *Bushehr* are the four provinces with the least adaptive capacity, while *Qhom*, *Tehran*, *Yazd*, and *Esfahan* are the provinces with the highest adaptive capacity in the country.

Regarding the sensitivity to cardio-vascular diseases based on known risk factors, *Gilan*, *Mazandaran*, *Semnan,* and *Yazd* are the most sensitive provinces, while Kerman, *South Khorasan*, *North Khorasan,* and *Hamedan* are the least sensitive provinces.

Gilan, *Fars*, *Yazd*, and *Charmahal & Bakhtyari* are the most exposed provinces to heat waves during time of 1970-2009. However, *Ardebil*, *Kordestan*, *Qazvin,* and *North Khorasan* are the least exposed provinces.

The time-series analysis for future projection indicated that just like the time period of 1970-2009, *Gilan* and *Fars* will remain the most exposed provinces to heat waves. However, *Kermanshah* will replace *Yazd* in the third place and send it to the 19^{th} place. *Chaharmahal Bakhtyari* will fall surprisingly from the 4th place in exposure (1970-2009) to the 28th place by the year 2039.

Heat wave vulnerability assessment score during time periods of 1970-2009 and 2010-2039 showed that the current top five vulnerable provinces are *Gilan*, *Mazandaran*, *Fars*, *Boyer Ahmad,* and *Sistan &Balochestan*. Accordingly, the five provinces with the least vulnerability are *Ardebil*, *Kurdestan, Qhom*, North *Khorasan,* and *Hamedan*. The projection for 2010-2039 reveals that *Gilan*, *Fars*, *Mazandaran*, *Sistan & Baluchestan,* and *Busher* are going to be the provinces with the highest vulnerability, whereas, *Charmahal Bakhtyari*, *Ardebil, Zanjan*, *Markazi,* and *Qazvin* are ranked as the least vulnerable provinces with regard to adverse effect of excess heat on CVD deaths.

Adaptation Program

Based on the vulnerability assessment of CVDs in context of climate change, the best and immediate interventions are those that focus on interventions, those that decrease sensitivity to heart diseases rather than climate change, those that enhance the adaptive capacity, and those that are worthwhile in long run. The adaptation actions in this field require well-recognized coordination with other sectors. Then, the programs can be divided into two major categories based on health-related and un-related organs. Based on the assessment by this task force, strengthening of the health facilities is the **First** priority in the adaptation actions for MOH & ME, while for other sectors, improvement of public transportation system acquired the **First** priority in the adaptation strategy.

Nutrition and Food insecurity including Food-borne Diseases Task Force

Context

Climate change may affect health outcomes and food utilization with additional malnutrition consequences. For example, populations in water-scarce regions are likely to face decreased water availability, particularly in the sub-tropics, with implications for the consumption of safe food and drinking water. Flooding and increased precipitation are likely to contribute to increased incidence of infectious and diarrheal diseases. The increased livestock population in new areas with concomitant disease threats needs to be addressed.

Most of the projected climate-related disease burden will result from increases in diarrheal diseases and malnutrition. Diarrheal diseases particularly affect nutrient absorption and food utilization. Associations between monthly temperature and diarrheal episodes and between extreme rainfall events and monthly reports of outbreaks of water-borne disease have been reported worldwide.

Climate change and variability influences food contamination with non-infectious hazards such as biotoxins (e.g. mycotoxins or marine toxins) and chemicals, which may have an impact on food and animal feed stability, access and/or utilization. Chemical food contamination may lead to recommendations to limit consumption of locally produced food in order to protect human health, thus reducing the dietary options of rural communities and indigenous people and compromising their traditional diets. For example, high contamination with dioxins associated with severe droughts in Central Asia has led to recommendations that poor rural communities limit the consumption of locally produced foods.

Vulnerability Assessment and Adaptation Plan

The anthropometric indicators of Stunting, Under-Weight and Wasting (among childredn aged under

5 years), and the incidence of Food-Borne diseases were considered for studying the impacts of climate change on the status of nutrition and food-borne diseases. Thease indicators are sensitive to climate variations, are important in terms of global Health, and their quantitative information is available at both national and provincial levels. The results of assessment are presented in Table 13. Data related to the total annual rain-fall in different provinces of Iran were available for the years 1986, 1991, 1996, 2001, 2006 and the data for nutritional status (stunting, wasting and underweight) were available for the years 1998 and 2004.

Table 13- Anthropometric indexes and climate variable by province for four years

	Precipitation					Under-weight 2004	Stunting 2004	Wasting 2004	Under-weight 1998	Stunting 1998	Wasting 1998
	1986	1991	1999	2001	2006	UW 2004	St 2004	Wa 2004	UW 1998	St 1998	Wa 1998
Ardabil	0	0	347	234	237	1.5	2.8	1	6.4	20.5	2.5
Ilam	0	676	578	598	555	2.9	4.6	1.2	11.7	14.6	4.7
Golestan	0	0	0	468	522	3.3	3.4	1.4	4	13.8	1.1
Gilan	1186	1298	1015	1262	1476	2.1	2.5	1.6	6.8	6.8	2.5
Lorestan	594	516	428	440	510	4.4	5.5	1.8	10.1	15.4	4.4
Zanjan	321	286	249	232	308	3.8	4.8	1.9	12.4	22.4	4
West Azarbaijan	386	269	263	228	372	3.3	4.5	2.1	8.6	16.3	4.2
Markazi	348	320	303	260	283	4.7	4.6	2.3	7.1	9.7	3.7
East Azarbaijan	323	236	259	210	129	2.6	4.8	2.4	6.5	15.3	3.3
Kordestan	548	382	413	310	449	6.3	4.3	2.5	11.5	21.1	3.4
Mazandaran	0	0	0	591	684	3.4	2.5	2.6	6.5	7.5	5.3
Kohkiloye	1228	1202	474	1126	777	5.7	8.5	2.7	17.6	26.3	5.8
Tehran	292	260	156	192	227	4	2.8	2.8	7.2	7.5	6
Hamadan	417	292	213	225	283	4.7	3.7	2.8	11.4	18.3	4.7
Gazvin	0	0	0	232	325	4.2	3.8	3	8.2	10.8	3.6
Kermanshah	569	451	396	357	430	4.5	3.9	3	9.6	14	3.7
Boshehr	119	171	217	488	224	3.3	3.3	3.3	8.8	11.3	6.4
Semnan	222	194	128	73	177	5.3	4.2	3.7	9.1	11.9	4.6
Gom	0	0	78	125	111	2.2	3	3.9	5.1	9.9	3.6
Khozestan	286	292	152	235	184	5.1	4.5	4.5	11.4	14.6	6
Fars	495	272	202	317	305	5.6	4.7	5	11.3	16.7	5.9
Yazd	45	60	29	60	44	4.8	4.8	5.1	12.9	10.3	8
Isfehan	138	112	67	94	220	5.7	2.6	5.7	10.6	10.8	7.4
Hormozgan	230	244	167	85	277	6.7	3.7	6.7	23.8	21.6	11.3
Sistan	42	44	73	14	55	15.7	16.5	7.1	25.8	38.1	9.5
CheharMahal	492	491	258	334	413	6.8	7.3	7.3	16.8	15.5	6.6
Kerman	159	115	123	119	134	10.7	8	7.7	18	21.7	7.9
Khorasan Razavi	250	326	170	153	223	6.4	8.2	8.2	13.7	20	4.4

Analysis of data showed a significant reduction in the mean of underweight between years 1998 and 2004 in different provinces.

Meanwhile, the data showed that there was a significant reduction in the mean of stunting between years 1998 and 2004 in different provinces. Mean underweight was 4.92 ± 2.8 percent in the year 2004, and 15.81 ± 6.7 percent in the year 1998.

There was a significant reduction in the mean of wasting between years 1998 and 2004 in different provinces. Mean underweight was 3.69 ± 2.1 percent in the year 2004, and 5.16 ± 2.2 percent in the year 1998.

Vulnerability assessment showed the improvement in nutritional status in different provinces. There was no significant correlation between the total annual rainfall and stunting and underweight in different provinces, which shows that other factors rather than rainfall have more important impacts on the nutritional status of people. However, there was a negative significant correlation between the total annual rainfall and wasting, which shows that rain fall may have a short term impact on nutritional status.

Disaster Management Task force

Context

In order to assess health impacts of and vulnerability to climate change, the disaster management taskforce considered climate-sensitive natural hazards based on vulnerable regions. The more direct impacts of climate change are the changes of extreme weather patterns (heat waves, winter cold) or increases in floods, cyclones, storms, and droughts. When the frequency and intensity of extreme events such as heat waves, floods and storms, and the risk of death increases, injury and serious illness will also increase. Nowadays, there are significant increases in the number of natural disasters caused by extreme weather events that cause mortality and morbidity worldwide. The geographical setting of I.R.Iran makes it vulnerable to most disasters. The risk class of the country based on the global assessment report in 2009 is 8 out of 10. The major natural hazards include flood, earthquake, drought, heat waves, cyclone, storm, flash flood, and landslide. According to the IPCC, a possible change in climate in the future will increase the frequency, the scope, and duration of hydro-climatological hazards in I.R.Iran. Natural disaster and risk management policies have not yet given priority to specific risk reduction at national and district levels in the country. Despite the fact that MOH & ME has developed a road map of disaster risk reduction for the country, legislations and institutions pertaining to disaster predominantly focus on post-disaster risk management; therefore, preparation activities in order to prevent the risks and reduce the probable effects are not yet prioritized.

Vulnerability Assessment and Adaptation Plan

The vulnerability assessment was done based on the risk formula (Risk=Vulnerability x Hazards/ Capacity). Information about the number of death, injured, and economic loss due to climatological hazards were available 1970-2010. Total events were 7,255 with the highest rank for flood (96.9%) for the past 40 years (1970-2010). Table 14 shows the total number of events that occurred from 1970 to 2010.

Table 14- Hydro- climatological hazards occurring in Iran, 1970-2010

Subgroup	Hazard type	Occurrence		
		Frequency	Percentage*	Average per year**
Hydrological	Flood	6,206	96.9	155.2
	Landslide	169	2.63	4.2
	Avalanche	24	0.4	0.6
Climatological	Drought	52	0.4	1.3
	Forest fire	85	0.6	2.1
Meteorological	Gonu cyclone	341	47.4	8.5
	Hail storm	116	16.1	2.9
	Thunder storm	111	15.4	2.8
	Snow storm	151	21.0	3.8
Total		**7,255**	**100.0**	**181.4**

* percent of all Hydroclimatological hazards subtypes
** during a 40-year period

The total number of events and impacts follow an increasing trend in the recent years. Table 15 provides the total numbers and consequences of hydro-climatological hazards for 10-year intervals during the past 4o years.

Table 15- Occurrence and consequences of Hydroclimatological hazards occurrence and consequences in I.R.Iran, 1970-2010

Year	No. of events	No. of Deaths	No. of injured	No. of Affected	No. of buildings destroyed & damaged
1970-1980	381	913	111	950,200	28,458
1981-1990	1,131	3,703	2,474	340,100	107,969
1991-2000	3,182	3,514	1,528	37,685,552	155,374
2001-2010	2,564	2,587	817	1,499,300	53,068
Total	**7,258**	**10,717**	**4,930**	**40,475,152**	**344,869**

Based on the results, floods are the most common hydro-climatological hazards in I.R.Iran. Figure 17 provides the number and consequences of flood by province from 1970 to 2010.

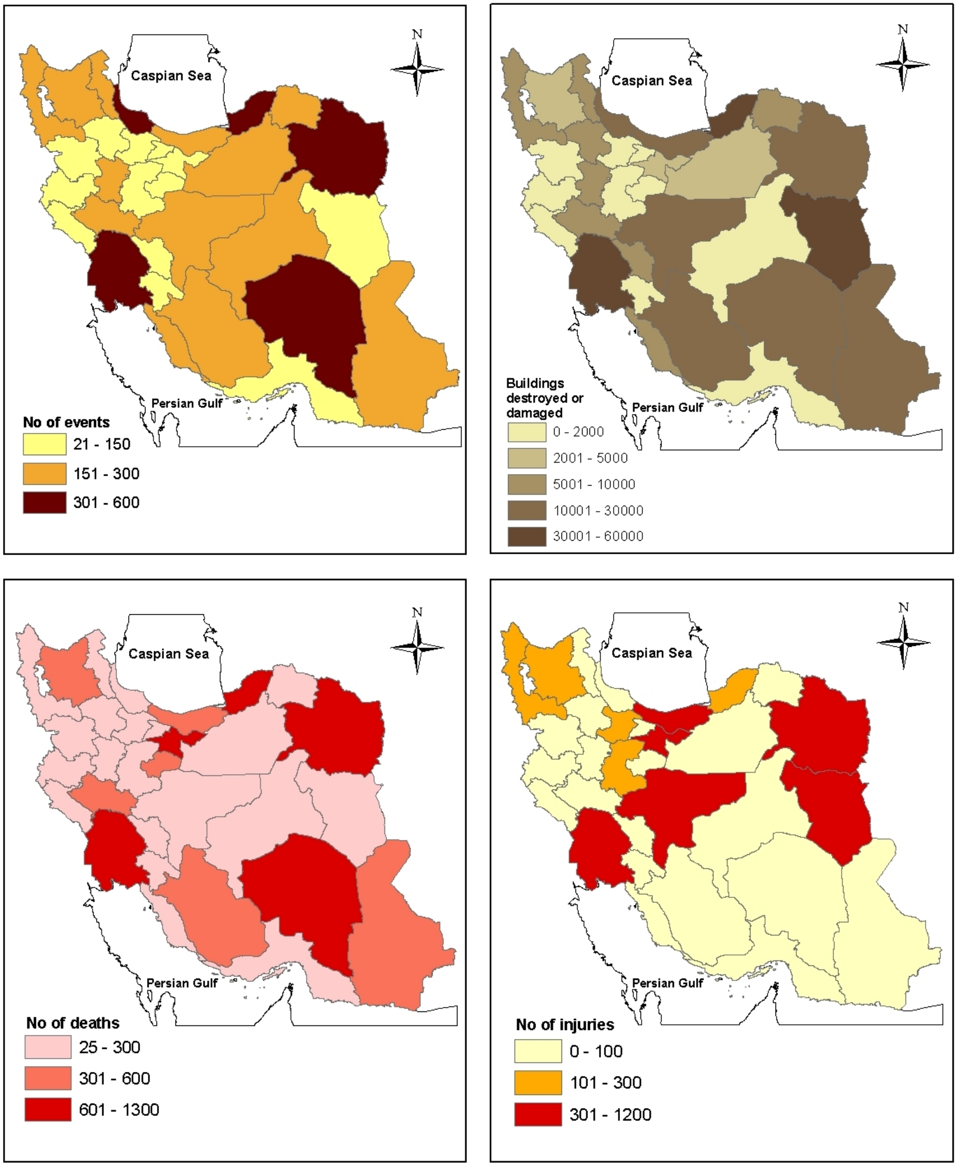

Figure 17- Frequency and consequences of flood in I.R.Iran (1970-2010)

Using the regression analysis, the trends of hydro-climatologiacl hazards were indentified for the country. The results showed that the trend of hazards increased by 8.3 times per year during a 40-year period (1970-2010). The analysis was repeated to identify the trend of death and injured both un-adjusted and adjusted for population. The regression estimation of death for the past 40 years (1970-2010) was 4.2 (un-adjusted) and 0.002 (adjusted). Figure 18 shows the adjusted trend of death due to hydro-climatological hazards during 1970-2010. In terms of injury, the trend also increased during the mentioned time period, with values of 1.8 and 0.001 for unadjusted and adjusted injuries, respectively.

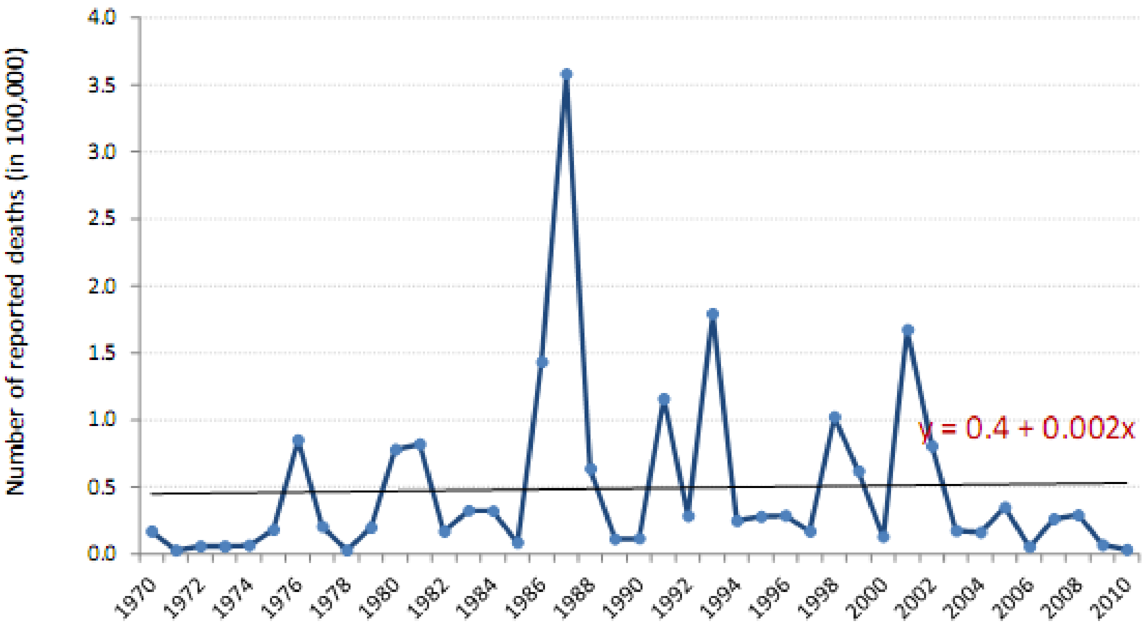

Figure 18- Trend of adjusted deaths due to hydroclimatological hazards in I.R.Iran, 1970-2010

Based on the projection of the occurrence of flood by 2030 in the country, the highest RR will be 6.01. Despite the importance of drought in I.R.Iran and the necessity of evaluating it, no models have yet been developed to link climate scenarios, frequency of drought, and associated health effects; therefore, quantitative estimation of climate change effects is not currently possible.

Based on the pooled risk approaches, both qualitative and quantitative methods (coping strategy, frequency of hydro-meterological hazards, and affected people), *Ardebil*, *Fars*, *Gilan*, *North Khorasan*, *Qazvin, West Azerbaijan*, *Tehran, Yazd,* and *Zanjan* are the most vulnerable provinces to probable future natural hazards due climate change.

Heat waves were not evaluated separately by this taskforce, mainly because no information is available regarding their occurrence.

Based on the results, the trend of occurrence and consequence of natural disasters in context of climate change are increasing in I.R.Iran. The projection of disasters was only done for floods, but it will also be done in future for others such as drought and storms. Climate change, however, is not the only factor that influences the occurrence and consequence of natural hazards; yet, it is still a major factor in this domain. Projection estimations in this report only focus on the climate variables and socioeconomic factors; aging, growing, and urbanization are also other factors mentioned in the literature. Thus, they will be considered in the future assessments.

Adaptation Program

The first draft of the road map for disaster risk reduction was developed two years ago (2011-2012), which is now integrated in the nationwide sustainable developing programs. Due to the similarity of the actions for hydro-climatologial hazards with those for others, the adaptation program should follow the road map. The adaptation strategies of natural disasters in relation to climate change were developed by making some changes in the items and programs of the road map. As the **First** priority strategy, we selected an Inter-sectoral, all- hydro-climatologial hazards, whole-health approach: developing and implementing a health impact framework in relation to climate change with an inter -sectoral, all- hydro-climatic hazard, whole-health approach; continuous training and holding national conferences on an annual basis with the contribution of other sectors should also be noticed for the beginning of the program by disaster management taskforces.

Key Adaptations based on Prioritization

Following is 15 prioritized actions that were selected by each task force. Table 16 shows the adaption actions.

Table 16- Prioritized Adaptation Program based on the task forces (Maximum 15 programs)

Task Force	Priority Actions
Vector-Borne Disease	1. Implementing climate-adaptive health programs 2. Awareness activities and training for staffs 3. Developing early warning systems and emergency measures 4. Developing climate-health cooperation program 5. Adapting new roles for Quarantine system 6. Rapid diagnosis and prompt treatment 7. Community awareness 8. Borderline collaboration 9. Quarantine establishment in the high risk area 10. Effective vector control 11. Vaccination of people and cattle vaccination for some zoonosis diseases 12. Applied research 13. Early warning and preparedness system 14. Using the experience of international agencies 15. Strengthening the capacity for health services

Table 16- Prioritized Adaptation Program based on the task forces (Maximum 15 programs)

Task Force	Priority Actions
Water Safety and Quality including Water-borne diseases	1. Integration of NASPA in policies and national development plans 2. Surface water quality monitoring 3. Upgrading and developing water treatment plants 4. Incorporating of national disaster plan to climate change hazards in relation to water resources and infrastructures 5. Developing a monitoring system and preparation of a database for water- related diseases affected by climate change 6. Increasing water efficiency in crop production irrigation (to boost production and conserve water in all areas) 7. Setting up erosion control mechanisms in sensitive areas 8. Considering climate change issues and adaptive measures needs as a regular part of the activities of water sector managers 9. Improving operation and maintenance of existing water treatment plants 10. Capacity building for integrating climate change in planning, designing of infrastructure, conflict management, and land-water zoning for water management institutions 11. Monitoring the effluent quality of wastewater treatment plant 12. Baseline study of water situation in project area prior to project implementation 13. Developing eco-specific adaptive knowledge (including indigenous knowledge) 14. Conducting impact and adaptation research on water resources quantity and quality 15. Groundwater quality monitoring

Task Force	Priority Actions
Occupational Health and Related Disease	1. Preventive programs to reduce heat stress in outdoor environments (Heat stress prevention program) composing of 6 major steps including: Recognizing and Avoiding Heat stress, Heat stress risk assessment factor, Measures for evaluating heat stress, Controlling heat stress, Workplace responsibilities regarding heat stress, Evaluating program effectiveness 2. Providing safety and health guidelines for outdoor workers in hot environments on subjects like: Dangers of heat exposure,Suitable leaving time, Time to see a doctor, Importance of the status of water in bodies , Importance of drinking water and water loss, Training to avoid high-calorie food , hot tea and coffee, Learning approaches in the prevention of heat stress 3. Including programs related to heat stress training, occupational health jobs in open areas including: a. Awareness about the risks posed by climate change on occupational health b. Practicing and rehearsal exercises to decrease the dangers c. Training on the proper use of personal protective equipment 4. Studies needed: a. To classify occupational groups based on vulnerability and heavy jobs b. On suitable heat stress index corresponding to Iran's climate 5. Providing standards for outdoor working weather conditions 6. Field study and validation current models to choose a best fitted prediction model in Iran 7. Recording any symptoms of heat-related complications (Registry of outcome) 8. Programs to increase health status of outdoor workers 9. Avoid using non-native and un-acclimated 10. Reducing 20% of the work time for females 11. A national diseases registration system and the effects of climate change and adverse weather conditions 12. Generalizing and increasing units covering HSE 13. Planning to establish a balance between inflation and rising wages 14. Schedules for periodic health tests 15. Evaluating and predicting heat tolerance time, separately for male and female in different age groups

Task Force	Priority Actions
Non -Communicable diseases including Cardiovascular Mortality	1. Strengthening the health infrastructures 2. Improving the availability and accessibility of the specialized and diagnostic health services with focus on at risk population with a reasonable cost 3. Improving public awareness with regard to climate change and NCDs 4. Enhancing the knowledge and skills of health workers to deal with climate change adverse effects on health conditions of the population 5. Interventions to reduce CVD individual risk factors (smoking, overweight, physical in activity…) in the community with focus on most vulnerable provinces 6. Establishing early warning system and response plan for heat waves especially ahead of heat waves occurrence most probably in June and Julys with reference threshold 95^{th} temperature of provinces 7. Establishing proactive and reactive measures in case of emergency conditions to protect population against extreme weather events 8. Establishing specific protective measures for elderlies, pregnant women, children and marginalized people 9. Improving the NCDs surveillance system with regard to climate change 10. Strengthening applied researches on climate – NCDs relationships

Task Force	Priority Actions
Nutrition and Food insecurity including Food-borne diseases	11. Providing proper food baskets for all, especially vulnerable groups in at risk areas; 12. Providing, and promoting accessibility of strategic food commodities for all segments of the population and all parts of the country, particularly in at risk areas; 13. Strengthening programs supportive of nutritionally vulnerable individuals/groups (targeted subsidies, safety nets, etc.) for households aiming at promoting direct access to nutritious and safe foods; 14. Institutionalizing inter-sectoral cooperation for food and nutrition policy -and program- planning, especially in crises; 15. Acquiring the support of politicians and senior managers for strengthening the system of controlling food-borne diseases; 16. Providing proper food baskets for all, especially vulnerable groups in at risk areas 17. Providing, and promoting accessibility of strategic food commodities for all segments of the population and all parts of the country, particularly in at risk areas; 18. Strengthening programs supportive of nutritionally vulnerable individuals/groups (targeted subsidies, safety nets, etc.) for households aiming at promoting direct access to nutritious and safe foods; 19. Institutionalizing inter-sectoral cooperation for food and nutrition policy -and program- planning, especially in crises; 20. Acquiring the support of politicians and senior managers for strengthening the system of controlling food-borne diseases; 21. Establishing and developing nutrition counseling unit in PHC system 22. Exploiting modern agricultural practices for adaptation to adverse effects of climate change; 23. Designing an efficient food quality control system in crises, especially climate-related ones; 24. Strengthening the laboratory network in both public and private sectors, for proper diagnosis of food-borne diseases; 25. Providing safe piped water for all urban and rural areas of the country

Task Force	Priority Actions
Disaster Managment	1. Inter-sectoral, all- hydro-climatic hazards, whole-health approach in Climate Change health impacts management (CCHIM) *Priority programs*: Development and implementation of CCHIM framework with an inter - sectoral, all- hydro-climatic hazard, whole-health approach; continuation of related training and national conferences on an annual basis with contribution of other sectors; 2. Integrating hydro-climatic hazards risk management into the development and implementation of sustainable development strategies within the poverty reduction strategy, policy, planning and budgeting *Priority program*: Development and ratification of the integration program; 3. Consider passive defense principles in all CCHIM policy making and planning under different climate change scenarios Priority programs: Expand health system infrastructures and resources based on passive defense principles for all hydro-climatic hazards; 4. Mainstream disaster risk reduction and climate change adaptation into processes such as policy development, social-economic development plans, budget allocation and governance; and in particular among other sectors, the environment, agriculture, water resource, energy, health and education, poverty reduction, land use and urbanization, public infrastructure and housing*;* *Priority programs*: Community risk assessment with a focus on organizational vulnerability and capacity; profiling health disaster risks produced by other sectors such as construction, industry, hydrometeorology, and informing the related policy makers and administrators; action plan for proactive approach of health system to disaster risk reduction; active contribution in NDMO's specialized taskforces in addition to HMST; enhancement of early warning system in health system with focusing on Flood, drought and cyclones; enhancement of disaster risk perception throughout the community and other sectors; including a community-based disaster risk management module in the integration program of CCHIM to the PHC network with focusing on flood, drought and cyclones; enhancement of NGOs with a CCHIM orientation; 5. Build a comprehensive, balanced and dynamic organizational structure inside MOH&ME so that it is able to use full-scale capacities of all internal and external stakeholders for mitigation and adaptation of climate change *Priority programs*: Modify and ratify CCHIM organizational chart in MOH&ME; conduct annual evaluation of HMST; strengthen specialized committees of HMST through enhancement of participatory mechanisms; 6. Maintain a high standard of structural and non-structural safety in construction and retrofitting health facilities from health houses to referral hospitals so that they are resistant to the chief destructive hydro-climatic hazards by focusing on floods, landslides and storms *Priority programs*: Conduct periodic vulnerability assessment of health facilities based on different climate change scenarios; reconstruct or retrofit vulnerable facilities based on different climate change scenarios; standardize non-structural components of health facilities with respect to disaster resilience; 7. Conduct regular disaster exercises, based on dynamic readiness assessment of health system based on different climate change scenarios by focusing on flood, cyclone and storms *Priority program*: Design, control and evaluate regular disaster exercises based on bi-annual plans from the local to the district, provincial and national levels with special focus on flood, storms and cyclone; 8. Develop an effective coordination mechanism in the prevention, preparedness and recovery phases and an effective command system in the response phase by focusing on flood, cyclone, heat waves and storms *Priority programs*: Activate specialized committees of HMST; implement training programs with a focus on teamwork at the community and organizational levels; 9. Conduct Climate variable Information System (CIS) for both response and developmental phases for all- hydro-climatic hazards approaches *Priority programs*: Develop necessary databases using geographic information systems (GIS) with clear levels of access authorization; conduct surveillance of

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