United Nations Framework Convention on Climate Change

CGE TRAINING MATERAILS ON VULNERABILITY AND ADAPTATION ASSESSMENT

Human health

Content

I. Climate change and Health

II. Links between environment and health

III. Climate resilient health systems

IV. Methods and tools for health vulnerability assessment

V. Estimating future potential health impacts due to climate change

VI. Adaptation

VII. Current distribution of climate-sensitive health outcomes

Objectives

The objectives of this module are to:

- To enhance the capacity of national experts to work with their ministry of health, other health systems organizations, and universities to conduct a health vulnerability and adaptation assessment
- To generate recommended adaptation interventions
- To estimate the current and potential future burdens of climate-sensitive health outcomes

Climate Change and Health

- The current trends in climatic change have already demonstrated impacts on human populations and have the potential to become a significant threat to public health.
- Individuals and communities will need to adapt to these changed environmental circumstances to avoid adverse consequences

Training Documents and Materials

- The CGE Training Materials For Vulnerability And Adaptation Assessment; Chapter 8 Human Health, form the basis for this workshop and provide extensive resources for use by participating countries
- In support, the following document is used to assist with the practical components of the V&A assessment for health:

Climate Change, Vulnerability And Health:
A Guide To Assessing And Addressing The Health Impacts 2015

Jeff Spickett, Dianne Katscherian, Helen Brown
WHO Collaborating Centre for Environmental Health Impact Assessment,
Curtin University, Western Australia

- Tables from the guide will be used throughout the workshop
- The Guide can be downloaded from: http://ehia.curtin.edu.au/publications/climate-change-health-publications.cfm

Environmental Impacts on Health

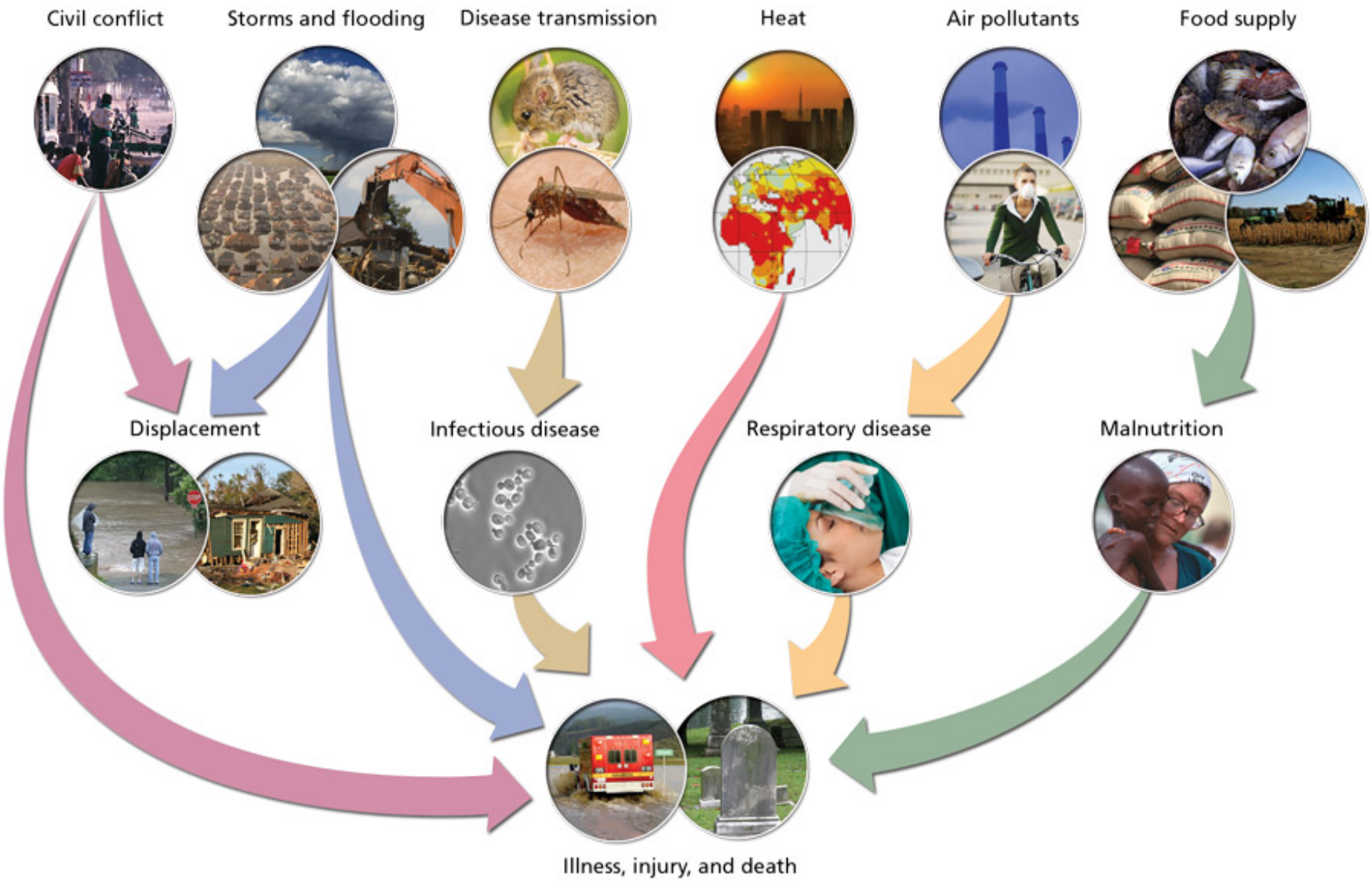
- Factors such as where we live, the state of our environment, genetics, our income and education level, and our relationships with friends and family all have considerable impacts on health
- Many of these factors combine together to further affect the health of individuals and communities
- The World Health Organisation has indicated that the links between the environment and health, including quality of life, are determined by physical, chemical, biological, social, and psychological factors in the environment
- Many of these are not under our direct personal control

Environmental Impacts on Health

- The WHO estimates that currently, 24% of the global disease burden and 23% of all deaths can be attributed to environmental factors.
  - Among children 0–14 years of age, the proportion of deaths attributed to the environment can be as high as 36%.
- Diseases with the largest burden attributable to modifiable environmental factors include: diarrhoea; lower respiratory infections; unintentional injuries; and malaria.
  - Diarrhoea. 94% is attributable to environment, and associated with risk factors such as unsafe drinking-water and poor sanitation and hygiene.
  - Lower respiratory infections. Associated with indoor air predominantly from household solid fuel use, second-hand tobacco smoke, and outdoor air pollution.
    - 20% of cases in developed countries, and 42% in developing countries
  - Unintentional injuries. 44% due to workplace hazards, radiation and industrial accidents.
  - Malaria. 42% associated with policies and practices regarding land use, deforestation, water resource management, settlement siting and modified house design, e.g. drainage.

Source: WHO 2006. Preventing disease through healthy environments

Health Impacts Associated with Environmental Changes



Sourced: www.climatecommunication.org

Climate Change and Health

- We are all familiar with these types of impacts and have been managing them for many years
- Climate change will alter the way we experience these impacts

Determinants of Health and Climate Change

- The Determinants of Health are the factors which may give rise to positive or negative health outcomes
- The following groups categorises the factors/determinants that may impact on human health from climate change and result in a range of health outcomes/impacts:
  - Direct effects of extreme climate events:
    - Physical hazards
  - Indirect effects of climate change:
    - Environmental
    - Ecological
    - Socio-economic
    - Psychosocial
    - Lifestyle
    - Technological
    - Services
    - Infrastructure
    - Other

Activity: The determinants of health

- Review Table 1 and consider the examples
- Identify any that you think are important for your country
- Highlight those that may not as yet have been considered in the context of climate change **and health** for your country
- Discuss in groups, the value of considering at least two of these factors
- Consider the sectors involved in implementing these factors
- Briefly report to whole group on your discussion

Table 1: Checklist of health determinants

Examples of effects	Sectors
Direct Effects of Extreme Climate Events	
1. Physical hazards associated with extreme climate events	
Indirect Effects of Climate Change	
2. Environmental • Air quality • Water quality • Soil quality • Food contamination • Pathogens • Vector-borne disease factors /Vermin • Broader environmental issues (CO_2 emissions) • Food Production—crops and animals • Visual amenities (green space, coastline)	
3. Ecological • Loss of habitat • Impacts on plant diseases, pests, weeds • Physical changes to land—coastline, rivers, erosion, landslides • Changes to groundwater levels • Flora and fauna—change in distribution	
4. Socio-economic • Employment • Occupational health and safety • Social networks • Local business • Economic issues • Crime • Housing • Population changes	
5. Psychosocial • Mental health—control over life, stress, anxiety • Community well-being • Social conflict	
6. Lifestyle • Exercise • Diet • Health behaviour • Alcohol/drugs	
7. Technological • Accidents (mechanical, chemical, etc.) • Fire, explosions • Waste treatment	
8. Services • Resource availability • Access to emergency services • Routine access to health services (primary/secondary) • Routine access to other services (schools, shops, transport)	
9. Infrastructure • Energy • Transport • Telecommunication • Water • Waste	
10. Add other determinants as required	

Projected Climate Changes in Latin America

- Broadly the projected changes in temperature, rainfall and sea levels include:
  - Increased temperatures for the next century of between 0.2 and 2ºC (if emissions of greenhouse gases do not continue to rise significantly), or between 2 and 6ºC (if they do). It is highly certain that there will be warming during summer months, and some areas will be characterised by hot and cold waves;
  - Changing in rainfall patterns. Examples of predictions from the climate models for some Latin American countries include:
    - Nicaragua: a decrease in rainfall of around 30%;
    - Brazil: a small increase in rainfall in southern areas;
    - Mexico: increases in rainfall in the northwest;
    - Costa Rica: a decrease in rainfall along the west coast of 25% and a small increase along the east coast; and
  - Rising sea levels. As with global predictions, sea levels are expected to rise by 0.11 to 0.77m by 2100.

Source: Department for International Development at: http://www.bvsde.paho.org/bvsacd/cd16/12latinamerica.pdf

Climate Change and Health in Latin America

- Impacts to development include:
  - Water availability (from glacier loss) affecting crop and livestock production and freshwater availability
  - Disruptions to fisheries
  - Pressure on forestry
  - Pressure within urban and coastal environments
    - Approximately 75% of populations live in urban areas
    - 60% in coastal areas
- Impacts to health include:
  - Changes in prevalence of vector- and water-borne disease (including malaria, dengue, cholera and salmonella)
  - Risks from storms and hurricanes
  - Increased risks from flooding in low lying areas
- The poor are particularly vulnerable

Climate Change and Health in Sao Paulo

- The Sao Paulo metropolitan area in south eastern Brazil is currently facing a severe water crisis
- As a megacity with over 20 million people, Sao Paulo is particularly exposed to the effects of extreme weather events
- This region receives most of its precipitation from October to March
- In the last four years, there have been growing shortfalls in precipitation to the reservoirs
- 2014 saw the worst since at least 1961, but has been followed by another dry year
- Additionally, daily records of high temperatures have increased evapotranspiration, accelerating drought conditions
- It is thought that these conditions have arisen from changes in atmospheric circulation that block the passage of cold fronts that cause precipitation
- These blocking mechanisms favour dry conditions in regions of the planet, including Sao Paulo

Source: The Conversation at https://theconversation.com/megacity-drought-sao-paulo-withers-after-dry-wet-season-42799

Climate Change and Health in Sao Paulo

An aerial view of the Atibainha dam, part of the Cantareira reservoir, during the drought in Nazare Paulista, Sao Paulo state November 2014. Photograph: Nacho Doce/Reuters

Reservoir levels for dams and reservoirs that provide water in Sao Paulo state are at historic lows. Source: Nacho Doce/Reuters

Climate Change and Health in Sao Paulo

Rationing

- In the Sao Paulo metropolitan region, the main water supply system, which provides water for about 8.8 million inhabitants, reached critical levels in early 2015.
- It had only 5% storage of its 1.3 billion cubic meter capacity on January 2015 and 15% at the end of the rainy season in March 2015.
- Water pressure in the pipes has been reduced to force conservation
- This has cut off running water to millions of customers for hours or days
- Isolated rain showers have occurred and the desperate population, particularly in poor districts, has stored the rainwater in open containers and buckets to save it for the days of water shortage.
- Others have drilled through their basement floors to extract water leaving open wells.
- A ration mandate could leave residents without access to water for a few days a week.

Climate Change and Health in Sao Paulo

Filling at a public tap: water rationing has turned off regular water services at some homes. Source: Roosevelt Cassio/Reuters

Climate Change and Health in Sao Paulo

Health outcomes

- Many families have been storing water wherever they can, thus providing more breeding grounds than usual for mosquitoes.
- Consequently, the entire state of Sao Paulo, with a population of 40 million, is undergoing a deadly dengue fever outbreak.
- The virus, which is spread by mosquitoes and is predominantly an urban disease, resulted in 132 deaths across Brazil in the first 12 weeks of the year, compared with 102 during the same period in 2014.
- Confirmed cases in São Paulo have been greater:
  - 20,764 through April 11, 2015
  - 7,126 in the same period last year.

Climate Change in the Caribbean

- The climate change trends in the region until 2100 include:
  - Sea levels likely to continue to rise on average around the small islands of the Caribbean Sea. The increase will probably follow the global average.
  - All Caribbean islands are very likely to warm. The warming is likely to be somewhat smaller than the global annual mean warming in all seasons
  - Summer rainfall is very likely to decrease in the vicinity of the Greater Antilles but changes elsewhere and in winter are uncertain
  - It is likely that intense tropical cyclone activity will increase (but tracks and the global distribution are uncertain)
  - Short term variability in rainfall patterns (e.g. as caused by ENSO events) will likely continue. The prevailing warmer conditions may make the convection associated with the short lived events more intense

Climate Change and Health in the Caribbean

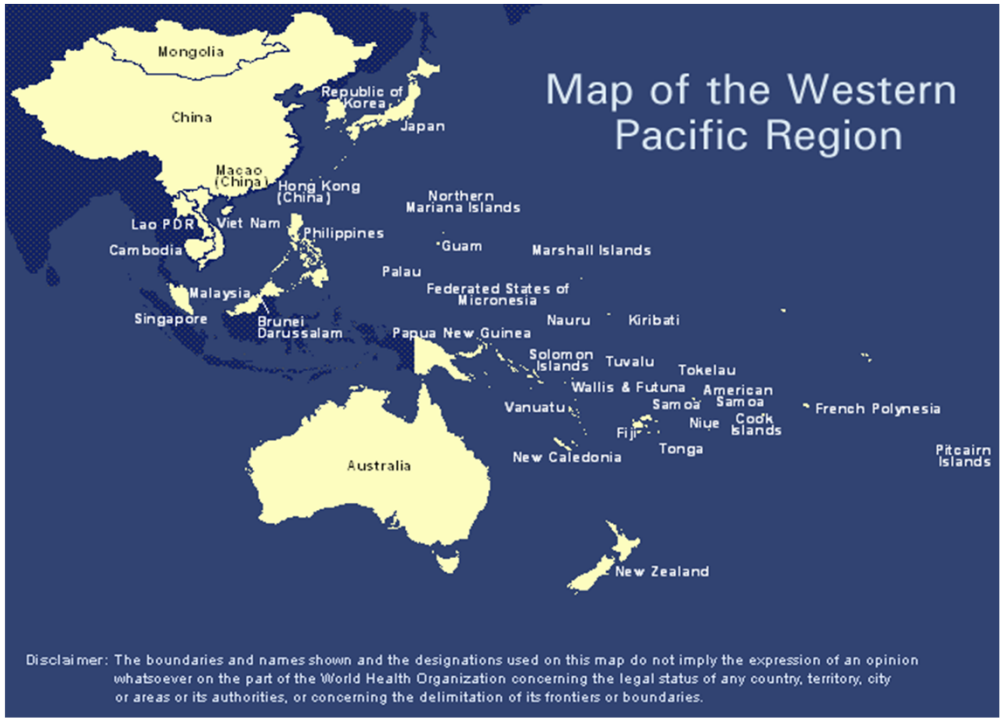
- The 51 global Small Island Developing States (SIDS) in the regions of the Caribbean, the Pacific and Africa, Indian Ocean, Mediterranean and South China Sea (AIMS) have similar characteristics that make them vulnerable to climate change:
  - Productive sectors heavily dependent on their limited natural resource base (e.g., agriculture, forestry, fishing, tourism)
  - Susceptibility to the vagaries of international trade
  - High transportation and communication costs
  - Serious vulnerability to extreme climate events and other natural disasters
  - Scarce land resources.
  - Increasing pressures on coastal and marine environments and resources
  - Small domestic markets
  - Limited ability to develop economies of scale
  - High import content (especially of strategic imports such as food and fuel)
  - Limited economic diversification possibilities
  - Limited extent to which domestic competition policy can be applied
  - Dependence on a narrow range of export products
  - Inability to influence international prices
  - Uncertainties of supply due to remoteness or insularity
  - Shifting rainfall patterns and cyclones, typhoons and hurricanes

Source: UNEP. Climate Change in the Caribbean and the Challenge of Adaptation at: http://www.pnuma.org/deat1/pdf/Climate_Change_in_the_Caribbean_Final_LOW20oct.pdf

Climate Change and Health in the Caribbean

- Identified threats to health in the Caribbean include:
  - insect- and rodent-borne diseases, such as dengue,
  - leptospirosis,
  - malaria and yellow fever;
  - water-borne diseases, including schistosomiasis, cryptosporidium and cholera;
  - food-borne diseases, including diarrhoea, food poisoning, salmonellosis and typhoid;
  - respiratory diseases, including asthma, bronchitis and respiratory allergies and infections; and
  - malnutrition resulting from food production or distribution disruptions

Climate change and health in Pacific Island Countries



- V&A assessments for health were undertaken across countries in the Western Pacific
- Climate-sensitive health risks were identified

Climate change and health in Pacific Island Countries

Climate change in the Pacific

Climate change-related phenomena in the Pacific

- Increasing air temperatures
- Altered rainfall patterns
- Accelerating sea-level rise
- Changing ocean salinity & acidity
- Altered frequency and/or severity of extreme weather events (including extreme heat, floods, storms and associated phenomena)

Potential pathways for health impacts of climate change in the Pacific

- Direct exposures
  - storms, floods, inundation, extreme heat
- Indirect exposures
  - compromised safety and/or supply of food, water & clean air
  - potential loss of land & livelihoods
  - potential for population displacement
  - altered disease exposure risk (e.g. due to spread of vectors/ hosts, population movement/ overcrowding)
  - compromised health systems
- Social disruption
- Detrimental impacts on economic and human development

Potential health effects of climate change in Pacific island countries

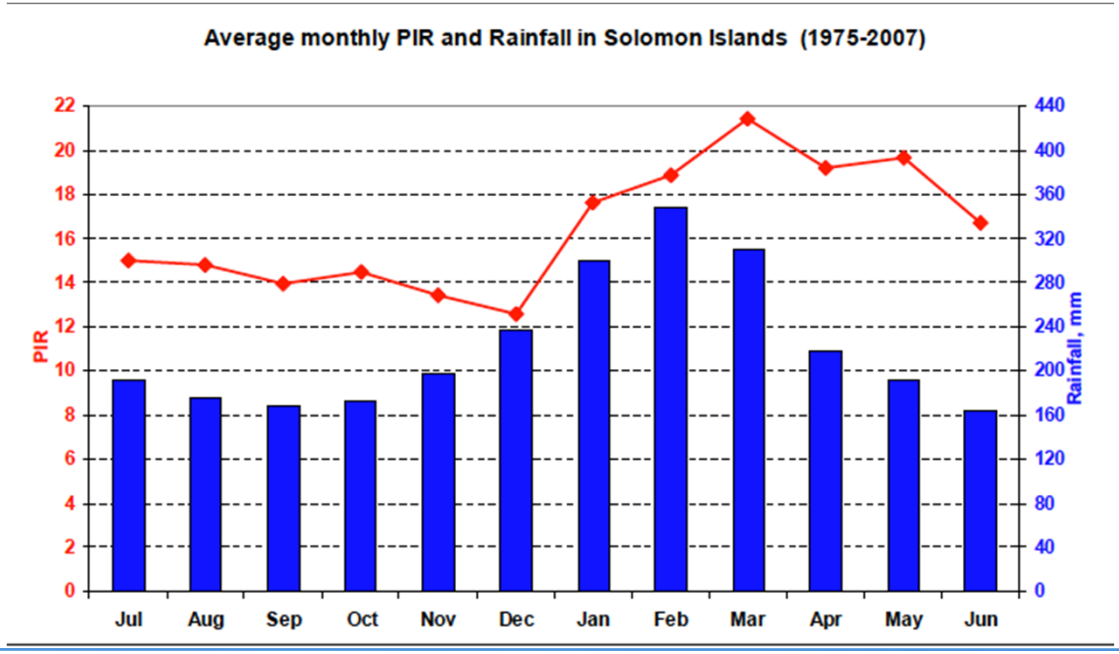
- Increasing incidence of vector-borne disease & zoonoses
- Water insecurity & increasing incidence of water-borne diseases
- Increasing risk of food-borne diseases (including ciguatera)
- Malnutrition (including increasing dependence on imported foodstuffs)
- Increasing morbidity and mortality due to non-communicable diseases
- Traumatic injuries and deaths
- Increasing risk of mental health disorders
- Disruption to health services

Health impacts of climate change in the Pacific

Source: McIver L, Woodward A, Davies S, Tibwe T and Iddings S 2014 Assessment of the Health Impacts of Climate Change in Kiribati

The Solomon Islands

- Malaria is currently a key health concern as well as an “important obstacle to development” (2009 Annual Report on the Performance of the Health Sector for Solomon Islands)
- Relationship between malaria incidence and rainfall in the Solomon Islands has been shown (See Table below)
- Rainfall is projected to increase with more extreme rainfall events expected



Source: Abawi Y, Dutta S, Tahani L et al. 2009 Relationship between El Niño-Southern Oscillation and the incidence of malaria in the Solomon Islands

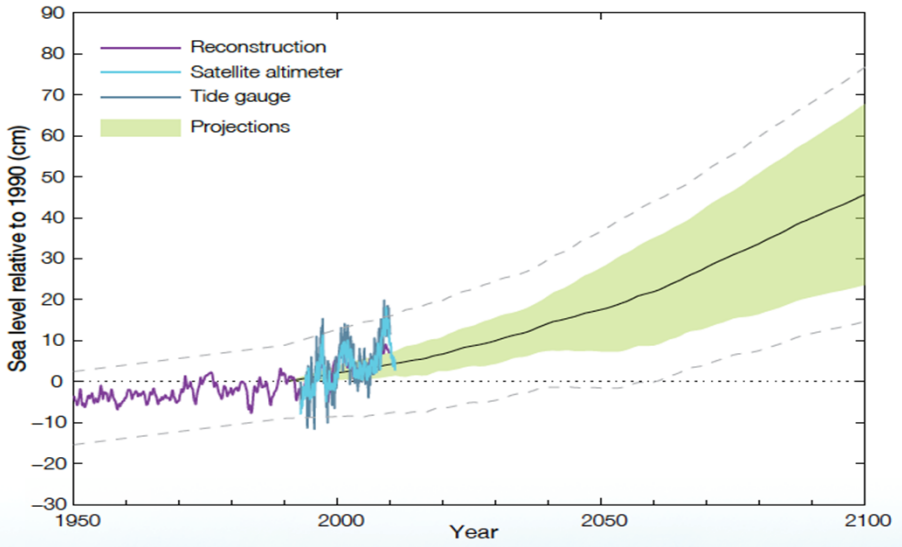
Solomon Islands

- Other identified climate-sensitive health risks include:

Health issue	**Risk category**
Vector-borne diseases Respiratory diseases	Extreme
Water-borne diseases Malnutrition Non-communicable diseases (eg. obesity, diabetes) Food-borne diseases Other infections and/or re-emerging diseases* Traumatic injuries and deaths	High
Circulatory disease Mental health issues Temperature-related illnesses Eye, ear and skin conditions	Medium
Sexually transmitted infections	Low

Vanuatu

- The climate change phenomena of particular relevance for Vanuatu include:
  - Altered rainfall patterns
    - Most climate models predict drier dry seasons and wetter wet seasons for Vanuatu, as well as more “extreme/high” rainfall events.
  - Less frequent but more intense cyclones
  - Sea-level rise
    - The recent rate of sea-level rise in Vanuatu has been between 4.7 and 6 millimetres per year and is expected to continue to 2030.



Source: Pacific Climate Change Science Program. 2011. *Current and Future Climate of Vanuatu*

Vanuatu

Health issue	Risk category
Water-borne diseases Food-borne diseases	Extreme
Vector-borne diseases Malnutrition Non-communicable diseases Temperature-related illnesses Occupation-related illnesses	High
Respiratory infections Skin conditions Eye diseases Mental health disorders Traumatic injuries and deaths	Medium

Vanuatu

- Severe Tropical Cyclone Pam – Category 5 – March 13-14 2015
  - One of the country's worst natural disasters
  - Winds up to 250 km/h with peak at 270km/h
  - 11 people killed
  - UNICEF reported at least 132,000 people were impacted including 54,000 children
  - 90 percent of the buildings were affected and the hospitals, schools and water supply were either compromised or destroyed

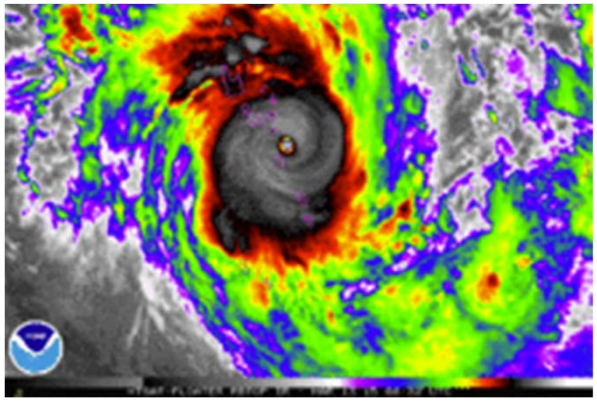


Photo: UNICEF Pacific

Vanuatu – 3 months on

- People are demonstrating their resilience and are rebuilding
- Aid agencies such as Red Cross working with worst affected communities
- Recovery operations will take several years
- Activities support low lying, outer island atoll communities:
  - Focus on training communities in safe shelter awareness
  - Enhancement of early warning and disaster preparedness through community trainings, contingency planning and the restocking of emergency supplies
- Acknowledged that people are experienced in managing water shortages during the dry season
- However, an estimated 68 per cent of rainwater harvesting catchment structures were broken, 70 per cent of wells were contaminated, and piped water systems damaged.
  - Recovery activities also includes a focus on water and sanitation support including the rehabilitation of rainwater harvesting systems and latrines, the provision of water tanks and promotion of good hygiene practices to curb the spread of disease

Vanuatu – 3 months on

A cyclone-damaged home with a tarpaulin covering its roof.

Source: Siobhan McDonnell, CC BY-NC-ND

Reprinted from The Conversation 18 June 2015

Other Climate-sensitive Health Risks in the Pacific

Country	Highest priority climate-sensitive health risks
Federated States of Micronesia	Water- and mosquito-borne diseases, malnutrition
Fiji	Dengue fever, typhoid fever, leptospirosis, diarrhoeal disease
Kiribati	Food (safety, security, food-borne diseases), water (safety, security, water-borne diseases) and vector-borne diseases
Nauru	Air quality, food security, non-communicable diseases
Palau	Vector-borne diseases (dengue), zoonoses (leptospirosis), food security, malnutrition and non-communicable diseases
Republic of the Marshall Islands	Food-, water- and vector-borne (dengue) diseases, respiratory diseases, malnutrition
Solomon Islands	Vector-borne diseases (malaria), respiratory diseases
Tonga	Diarrhoeal diseases, vector-borne diseases (dengue), food security/nutrition, non-communicable diseases, injuries and deaths from extreme weather events
Vanuatu	Food- and water-borne diseases

Source: McIver,L. Presentation. The health impacts of climate change in the South Pacific

Climate Change and health in the Asia Region

IPCC summary of observed changes in extreme events and severe climate anomalies

Country/Region Heatwaves	Key trend	Reference
Mongolia	Heatwave duration has increased by 8 to 18 days in last 40 years; coldwave duration has shortened by 13.3 days	Batima et al., 2005a
China	Increase in frequency of short duration heatwaves in recent decade, increasing warmer days and nights in recent decades	Zhai et al., 1999; Zhai and Pan, 2003
Korea	Increasing frequency of extreme maximum temperatures with higher values in 1980s and 1990s; decrease in frequency of record low temperatures during 1958 to 2001	Ryoo et al., 2004
India	Frequency of hot days and multiple-day heatwave has increased in past century; increase in deaths due to heat stress in recent years	De and Mukhopadhyay, 1998; Lal, 2003
South-East Asia	Increase in hot days and warm nights and decrease in cold days and nights between 1961 and 1998	Manton et al., 2001; Cruz et al., 2006; Tran et al., 2005

Climate Change and health in the Asia Region

Country/Region	Key trend	Reference
Intense Rains and Floods		
China	Increasing frequency of extreme rains in western and southern parts including Changjiang river, and decrease in northern regions; more floods in Changjiang river in past decade; more frequent floods in North-East China since 1990s; more intense summer rains in East China; severe flood in 1999; seven-fold increase in frequency of floods since 1950s	Zhai et al., 1999; Ding and Pan, 2002; Zhai and Pan, 2003; Zhai, 2004
South Asia	Serious and recurrent floods in Bangladesh, Nepal and north-east states of India during 2002, 2003 and 2004; a record 944 mm of rainfall in Mumbai, India on 26 to 27 July 2005 led to loss of over 1,000 lives with loss of more than US$250 million; floods in Surat, Barmer and in Srinagar during summer monsoon season of 2006; 17 May 2003 floods in southern province of Sri Lanka were triggered by 730 mm rain	India Meteorological Department, 2002 to 2006; Dartmouth Flood Observatory, 2003.
South-East Asia	Increased occurrence of extreme rains causing flash floods in Vietnam; landslides and floods in 1990 and 2004 in the Philippines, and floods in Cambodia in 2000	FAO/WFP, 2000; Environment News Service, 2002; FAO, 2004a; Cruz et al., 2006; Tran et al., 2005

Climate Change and health in the Asia Region

Country/Region Droughts	Key trend	Reference
Mongolia	Increase in frequency and intensity of droughts in recent years; droughts in 1999 to 2002 affected 70% of grassland and killed 12 million livestock	Batima, 2003; Natsagdorj et al., 2005
China	Increase in area affected by drought has exceeded 6.7 Mha since 2000 in Beijing, Hebei Province, Shanxi Province, Inner Mongolia and North China; increase in dust storm affected area	Chen et al., 2001; Yoshino, 2000, 2002; Zhou, 2003
South Asia	50% of droughts associated with El Niño; consecutive droughts in 1999 and 2000 in Pakistan and N-W India led to sharp decline in watertables; consecutive droughts between 2000 and 2002 caused crop failures, mass starvation and affected ~11 million people in Orissa; droughts in N-E India during summer monsoon of 2006	Webster et al., 1998; Lal, 2003; India Meteorological Department, 2006
South-East Asia	Droughts normally associated with ENSO years in Myanmar, Laos, Philippines, Indonesia and Vietnam; droughts in 1997 to 98 caused massive crop failures and water shortages and forest fires in various parts of Philippines, Laos and Indonesia	Duong, 2000; Kelly and Adger, 2000; Glantz, 2001; PAGASA, 2001

Climate Change and health in the Asia Region

Country/Region Cyclones/Typhoons	Key trend	Reference
Philippines	On an average, 20 cyclones cross the Philippines Area of Responsibility with about 8 to 9 landfall each year; with an increase of 4.2 in the frequency of cyclones entering PAR during the period 1990 to 2003	PAGASA, 2001
China	Number and intensity of strong cyclones increased since 1950s; 21 extreme storm surges in 1950 to 2004 of which 14 occurred during 1986 to 2004	Fan and Li, 2005
South Asia	Frequency of monsoon depressions and cyclones formation in Bay of Bengal and Arabian Sea on the decline since 1970 but intensity is increasing causing severe floods in terms of damages to life and property	Lal, 2001, 2003

Climate Change and health in the Asia Region

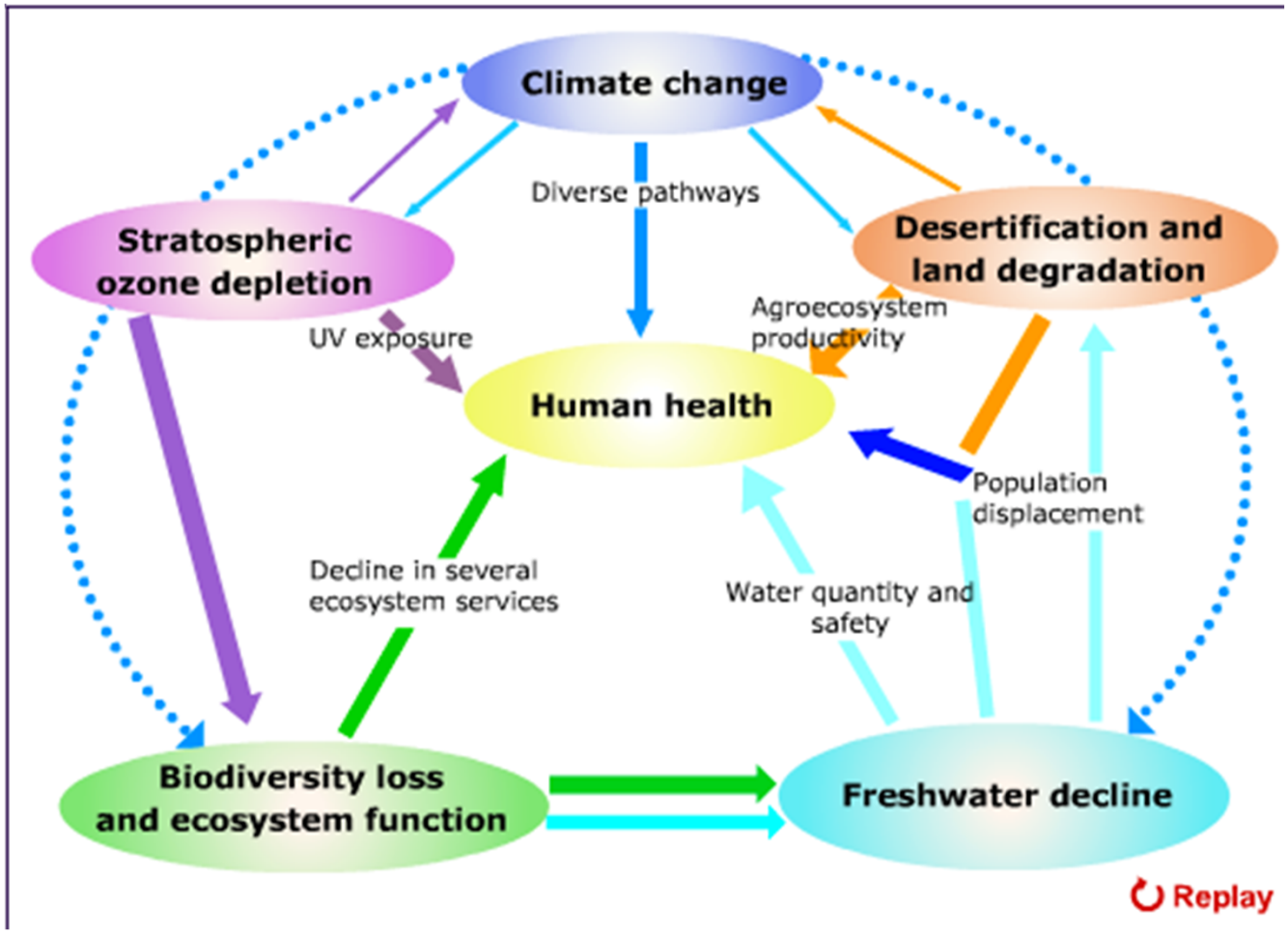
- Densely populated Southeast Asian island states such as Taiwan, Hong Kong, Japan and the Philippines are likely to face more intense climate events in future
- Vulnerability arises due to their large populations and exposure of land to storm surges and sea-level rises (Verisk Maplecroft, 2015)
- Typhoons in the region may be less frequent, but become more intense
  - Typhoon Haiyan killed 6,300 people in the Philippines in 2013
- China is "high risk" due to increased industrial, domestic and agricultural competition for water, and some northern parts of the country have experienced reductions in rainfall
- Of key importance in the Asia region are the direct impacts of climate change on urban areas

Climate Change and health in the Asia Region

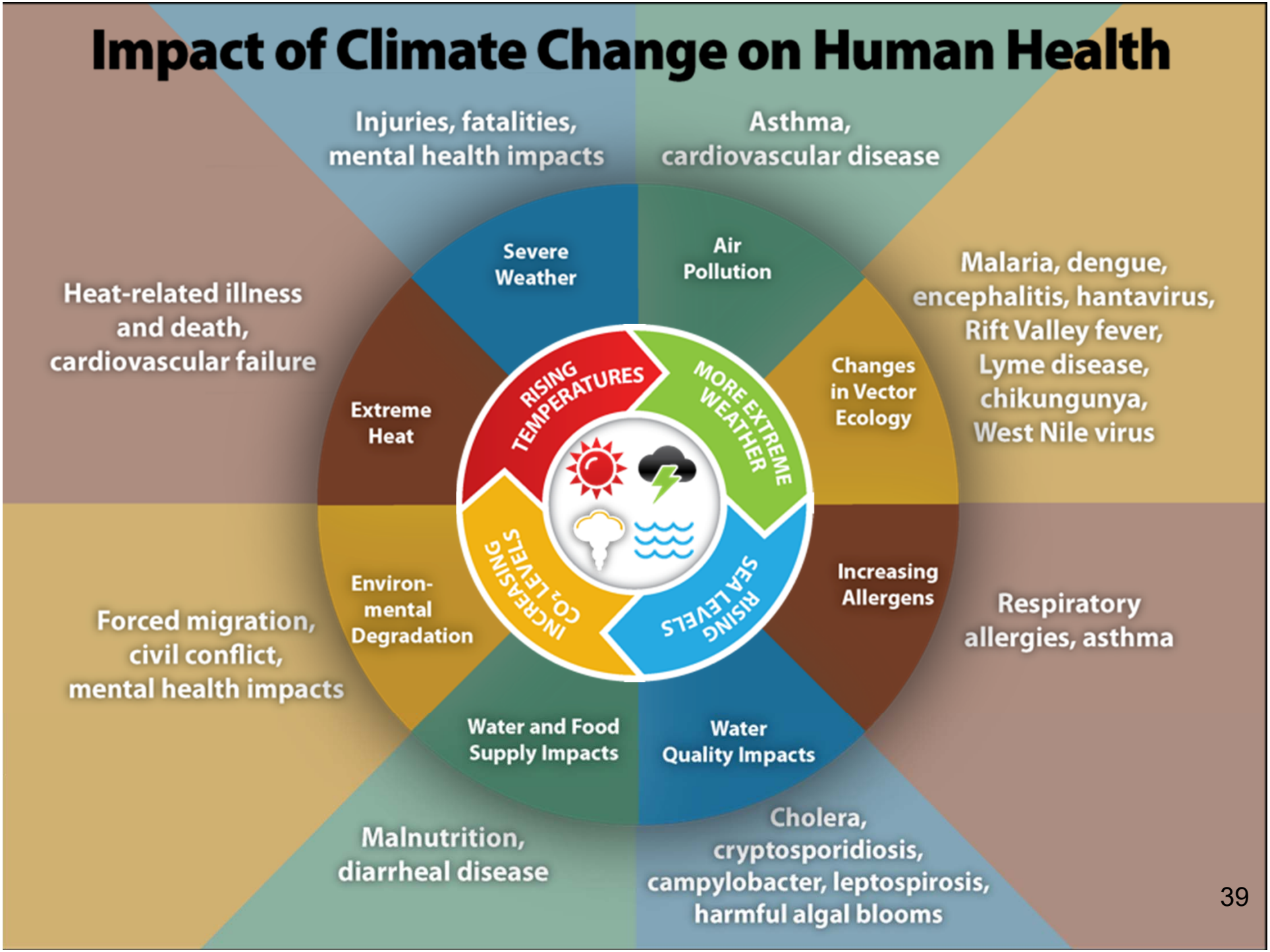
- Urbanization alters local environments that can result in local environmental stresses:
  - urban heat islands (higher temperatures, particularly at night, in comparison to outlying rural locations)
  - local flooding
  - Air quality
- Many people in the region depend on natural resources for their food, shelter and income
- Changes to agricultural practices will have significant effects particularly on the poor

Impact of climate change on human health

Some impacts of climate change and their interrelation with human health can be summarised as:



Source: who.int


Impact of Climate Change on Human Health
Injuries, fatalities, mental health impacts
Asthma, cardiovascular disease
Heat-related illness and death, cardiovascular failure
Malaria, dengue, encephalitis, hantavirus, Rift Valley fever, Lyme disease, chikungunya, West Nile virus
Forced migration, civil conflict, mental health impacts
Respiratory allergies, asthma
Malnutrition, diarrheal disease
Cholera, cryptosporidiosis, campylobacter, leptospirosis, harmful algal blooms
Severe Weather
Air Pollution
Extreme Heat
Changes in Vector Ecology
Environ-mental Degradation
Increasing Allergens
Water and Food Supply Impacts
Water Quality Impacts
RISING TEMPERATURES
MORE EXTREME WEATHER
INCREASING CO2 LEVELS
RISING SEA LEVELS

Climate Change and Health

- Three kinds of health impacts from global climate change have been identified:
  - Relatively direct (primary), usually caused by the frequency and intensity of weather extremes such as:
    - heat, drought, and heavy rain
  - Consequences (secondary) of environmental change and ecological disruption in response to climatic changes such as:
    - changes in the geographic range and incidence of infectious diseases (e.g., water-, food- and vector-borne diseases) and
    - health outcomes associated with poor air quality (e.g., high concentrations of ozone and aeroallergens)
  - Consequences (tertiary) that occur when populations are demoralised and displaced due to climate change induced:
    - economic dislocation,
    - environmental decline and conflict situations including traumatic, infectious, nutritional, psychological and other health consequences or disruptions to health and social services

Flooding: Direct Health Effects (Primary)

Causes	Health Implications
Stream flow velocity; topographic land features; absence of warning; rapid speed of flood onset; deep flood waters; landslides; risk behaviour; fast flowing waters carrying boulders and fallen tress	Drowning Injuries
Contact with water	Respiratory diseases; shock; hypothermia; cardiac arrest
Contact with polluted water	Wound infections; dermatitis; conjunctivitis; gastrointestinal illness; ear, nose and throat infections; possible serious waterborne disease
Increase of physical and emotional stress	Increase of susceptibility to psychosocial disturbances and cardiovascular incidents

Flooding: Indirect Health Effects (Secondary)

Causes	Health Implications
Damage to water supply systems; sewage and sewage disposal damage; insufficient supply of drinking water; insufficient water supply for washing	Possible waterborne infections (enterogenic *E.coli*, shigella, hepatitis A, Leptospirosis, giardiasis, campylobacter), dermatitis and conjunctivitis
Disruption of transport systems	Food shortage; disruption of emergency response
Underground pipe disruption; dislodgement of storage tanks; overflow of toxic waste sites; release of chemicals; rupture of gasoline storage tanks may lead to fires	Potential acute or chronic effects of chemical pollution
Standing waters; heavy rainfalls; expanded range of vector habitats	Vector borne diseases
Rodent and other pest migration	Possible diseases cause by rodents or other pests

Flooding: Indirect Health Effects (Tertiary)

Causes	Health Implications
Clean-up activities following floods	Electrocutions; injuries; lacerations; skin punctures
Disruption of social networks; loss of property, jobs and family members and friends	Possible psychosocial disturbances
Destruction of primary food products	Food shortage
Damage to health services; disruption of “normal” health service activities	Decrease of “normal” health care services, insufficient access to health care

Other impacts to health from environmental changes

1. Impacts to Health from Heat

- The human body maintains body temperature in ambient temperatures not exceeding 32 degrees C.
- Above this temperature, heat lost through the skin and sweating.
- Heat-related illness occurs when the body unable to adequately cool.
- Minimum ambient temperatures are also important
  - Difficulties cooling when minimum temperatures greater than 22 degrees C
- High humidity reduces effectiveness of sweating and increases the risk of heat-related illness at any given temperature.

Impacts to Health from Increased Temperatures

- Direct impacts to health:
  - **Heat cramps** – muscular pains and spasms.
  - **Heat exhaustion** – body fluids are lost through heavy sweating
  - **Heat stroke** – is life threatening.
- Indirect impacts:
  - Range of areas that can potentially be affected with gradual and extreme temperature increases
  - Includes impacts on ecosystems, water, food, disease carrying vectors, lifestyle, community resilience

Impacts from humidity - Relative Atmospheric temperature (°C)

Humidity(%)\Temperature	26	28	30	32	34	36	38	40	42	44
0%	25	27	28	30	32	33	35	36	37	38
10%	25	27	28	30	32	33	35	37	39	41
20%	26	27	28	30	32	34	37	39	42	46
30%	26	27	29	31	33	36	39	43	47	52
40%	26	28	30	32	35	39	43	48	54	60
50%	27	28	31	34	38	43	49	55	62	
60%	27	29	33	37	42	48	55	62		
70%	27	31	35	40	47	54	63			
80%	28	32	38	44	52	61				
90%	28	34	41	49	58					
100%	28	36	44	56						

At an apparent temperature, (T_a) of:

32–40 Heat cramps or heat exhaustion possible
41–54 Heat cramps or heat exhaustion likely, heat stroke possible
54–more Heat stroke highly likely

Exposure to full sunshine can increase the heat index value by up to 8°C

Health Impacts of Storms and Floods

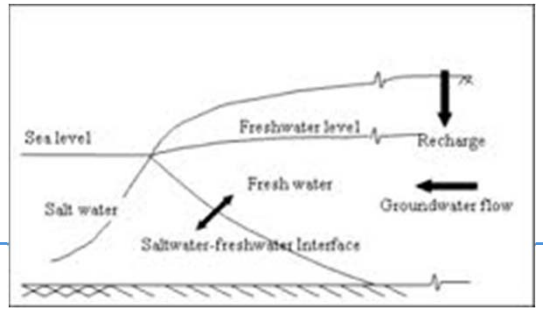
- Immediate deaths and injuries
- Nonspecific increases in mortality
- Infectious diseases – leptospirosis, hepatitis, diarrheal, respiratory, and vector-borne diseases
- Exposure to toxic substances
- Mental health effects
- Indirect effects
- Increased demands on health systems

Drinking Water Supply

- Drying climate causes:
  - Changes to land cover and run off patterns (erosion)
  - Increased bushfire risk
  - Increased sediment, nutrient and debris
- Flooding can also affect drinking water supplies
  - Coastal intrusion
  - Contamination

Drinking Water Supply

- Reduction in flows to dams and groundwater aquifers
- Increased evaporation from surface water storages
- Salt water intrusion into coastal aquifers
- Acidification of susceptible inland aquifers
- Increased risk from:
  - Nutrient and chemical contaminant concentrations
  - Toxic algal bloom formation

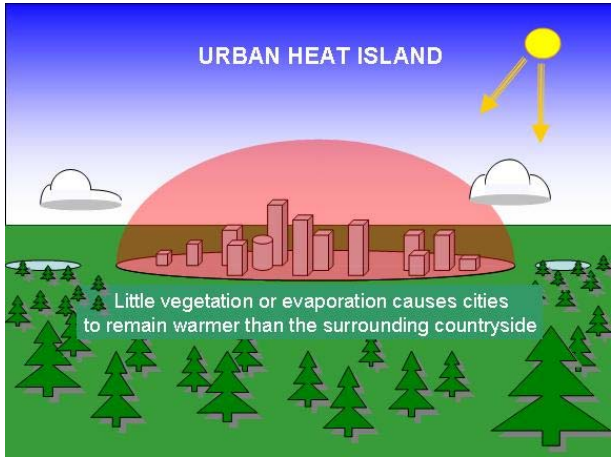


Air Quality

- Weather has a major role in the development, transport, dispersion and deposition of air pollutants.
- Air pollution episodes often associated with stationary or slowly moving air masses.
- Air pollutants and fine particulate matter may change in response to climate change

Air Quality

- Airflow on edges of high-pressure system can transport ozone precursors. Ozone levels increasing in many areas
- An increase in fire events will mean increased toxic gases and particulates
- Changes in wind pattern may increase long-range transport of air pollutants
- Weather patterns can enhance urban “heat islands” which can lead to elevated pollution levels



Potential health Impacts – air quality

- Ozone – pneumonia, COPD, asthma, allergic rhinitis and others – premature mortality
- Particulate matter (PM) – known to affect morbidity and mortality
- Toxic gases and PM from fires contribute to acute and chronic respiratory illness. Evidence from 1997 Indonesia fires – trans-boundary impacts
- Wind blown dust (respirable particles, trace elements from desert regions can affect populations in remote areas. Evidence that mortality is increased in days after a dust storm

A fire in a tropical peat forest on Sumatra in Indonesia

Mosquito-borne-disease: Environmental changes

Distribution of vectors will change arising from:

- Increasing temperature
- Changing rainfall
  - Increase or decrease
  - Seasonality
- Cyclones, flooding
- Changes in animal host/reservoir populations
- Rising sea levels
- Extreme tides
- Loss of coastal margins

Mosquito-borne-disease: Human factors

Location of population
- Geographic location
- Proximity to water bodies

Urban environment
- Peri-domestic breeding

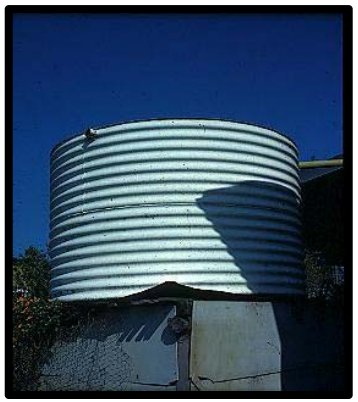
Mobility of population
- Arrival of infected people
  - International
  - Interstate
  - Intrastate

Living standards
- Insect screens, air conditioning
- Social/political breakdown

Mosquito-borne-disease: Water management

Breeding is also influenced by:

- Water hoarding/storage
  - Rainwater tanks
  - Uncovered containers
- Dams
- Irrigation
- Groundwater recharge



Food Security – Production on Land

Food Production

- Loss of soil fertility, erosion and salinization
  - Changes in crop yields and protein levels (+/-)
  - Effects on feed intakes and animal reproduction
  - Changes to pests, weeds and diseases
  - Changes to use of agrochemicals

- Dietary and nutritional changes

Food Security – Fisheries Production

Oceanic and Coastal fisheries

- Coastal circulation patterns can affect:
  - Nutrient supply
  - Lagoon flushing
  - Coastal erosion
  - Ocean acidity and coral bleaching
  - Decline in productivity

Food Security -Food Safety

- Food borne Disease (Food Poisoning)
  - May increase proliferation of bacterial pathogens including Salmonella, Campylobacter and Listeria spp.
  - May increase mycotoxins and aflatoxins in seafood

Social Impacts

Lifestyle/behavioural

- Increased temperatures
  - Increases in crime - particularly involving aggression,
  - Accidents - workplace and traffic,
  - Decline in physical health
  - Hot nights cause sleep deprivation
  - Recreational opportunities - changes to exercise patterns,
  - Changes in alcohol consumption,
  - Stress
  - Lack of cold water – reduced ability to cool down

Social Impacts

- Mental Health
  - Anxiety and depression
  - Post Traumatic Stress Disorder
  - Insecurity
  - Grief
  - Stress, self harm and possible suicide
  - Drug and alcohol misuse
  - Impacts on individuals, communities
  - Loss of social cohesion
  - Dislocation
  - Specific impacts on children, women and elderly

Social Impacts

Economic

- Loss of income and/or assets,
- Reduction of goods and services,
- Higher costs of insurance, food, water, energy
- Financial strain for Governments and others
- Impacts on provision of health services.

Known and Projected Risks to Health from Climate Change

- Research is now finding that extreme weather events grow exponentially with even small changes in global temperature
- Gradual changes will exacerbate existing risks

- The latest IPCC report (2014) identified risks to health and wellbeing as:
  i. Risk of death, injury, ill-health, or disrupted livelihoods in low-lying coastal zones and small island developing states and other small islands, due to storm surges, coastal flooding, and sea level rise.
  ii. Risk of severe ill-health and disrupted livelihoods for large urban populations due to inland flooding in some regions.
  iii. Systemic risks due to extreme weather events leading to breakdown of infrastructure networks and critical services such as electricity, water supply, and health and emergency services.
  iv. Risk of mortality and morbidity during periods of extreme heat, particularly for vulnerable urban populations and those working outdoors in urban or rural areas.

Risks to Health from Climate Change

- IPCC report (2014) risks to health and wellbeing continued:
  v. Risk of food insecurity and the breakdown of food systems linked to warming, drought, flooding, and precipitation variability and extremes, particularly for poorer populations in urban and rural settings.
  vi. Risk of loss of rural livelihoods and income due to insufficient access to drinking and irrigation water and reduced agricultural productivity, particularly for farmers and pastoralists with minimal capital in semi-arid regions.
  vii. Risk of loss of marine and coastal ecosystems, biodiversity, and the ecosystem goods, functions, and services they provide for coastal livelihoods, especially for fishing communities in the tropics and the Arctic.
  viii. Risk of loss of terrestrial and inland water ecosystems, biodiversity, and the ecosystem goods, functions, and services they provide for livelihoods.

Projected Climate Changes on Health in Africa

- Climate change may increase the burden of a range of climate-relevant health outcomes
- Currently insufficient data is available to assess trends in incidence
- Effects on existing health vulnerabilities due to:
  - insufficient access to safe water and improved sanitation,
  - food insecurity
  - limited access to health care and education
- Highland areas, especially in East Africa, could experience increased malaria epidemics
  - Parasite prevalence rates in children >5 years of age are highest in poorer populations and rural areas
  - Factors increasing vulnerability include:
    - living in housing with little mosquito protection
    - limited access to appropriate health care facilities

Projected Climate Changes on Health in Africa

- Increased burden of meningococcal meningitis due to its strong seasonality and associations with weather and climate variability
- Frequency of leishmaniasis epidemics (protozoan parasites transmitted by sand flies) in sub-Saharan Africa is changing, with spatial spread to peri-urban areas and to adjacent geographic regions from changing rainfall patterns
- The burden of malnutrition is expected to increase, with the highest toll in children

What's crucially different about Climate Change?

- Unusual length of time for change and global nature of climate change
- Exposure–control paradigm or randomised control trials do not apply
- Number of determinants of health affected
- Scale, complexity and levels of uncertainty
- Different Locations

  → Different impacts and different adaptations required

Health sector needs to:

- Collaborate with 'unusual' sectors, disciplines & people
- Develop new approaches & tools

- WHO and others in the health sector have recognised the importance of these collaborations and the need for flexibility regarding the tools and methods to use

Climate Resilient Health System

- Important to develop and establish resilient health systems:
  - Governance and policy
  - Capacity development
  - Information and early warning systems
  - Service delivery
  - Essential products and technologies
  - Financing

- Health component of National Adaptation Plans (H-NAP) is the main process at the national level to increase health systems resilience

Methods and tools for health vulnerability assessments

- Health component of National Adaptation Plans (H-NAP) is the main process at the national level to increase health systems resilience

- WHO guidance available for:
  a) Conducting V&A assessments
  b) Conducting a H-NAP
  c) Health indicators and their management strategies
  d) Developing early warning systems
  e) Estimating the costs of adaptation
  f) Conducting health impact assessments (HIA)
  g) Gender mainstreaming

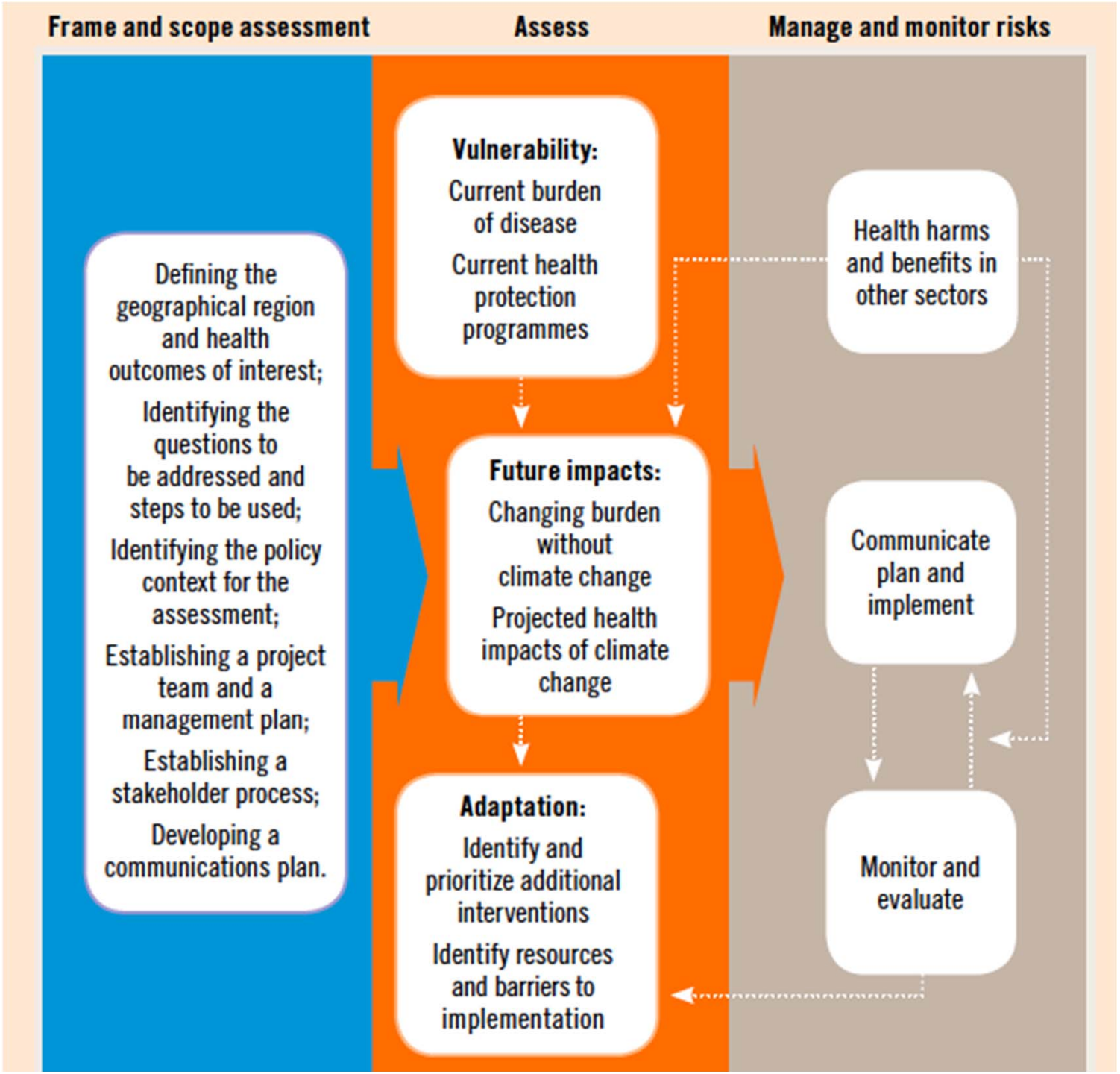
Vulnerability Assessments

- The British Foreign Office published a new report in July 2015 entitled *Climate Change: A Risk Assessment*
  - *http://www.csap.cam.ac.uk/media/uploads/files/1/climate-change--a-risk-assessment-v9-spreads.pdf*
- This report urges a dramatic change in attitude towards climate change among governments and that nations should:
  - Assess the risks of climate change in the same way they do risks to national security or public health.
  - These risk assessments should involve a wide range of experts.
  - The risk assessment body should report to the highest level of government.

Health Impact Assessment

- Health Impact Assessment initiated worldwide to facilitate assessment of health issues in new proposals
- The World Health Organization (WHO) defines Health Impact Assessment as:
  - "*a combination of procedures or methods by which a policy, programme or project may be judged as to the effects it may have on the health of a population.*"
- The aim of HIA is :

  "To enhance the potentially **beneficial** health effects of a policy, program or proposal and to mitigate potentially **negative** health risks and costs"
- Is a process incorporating **predictive** and **evaluative** elements.
- Can be incorporated into current impact assessment procedures


Frame and scope assessment
Assess
Manage and monitor risks
Defining the geographical region and health outcomes of interest;
Identifying the questions to be addressed and steps to be used;
Identifying the policy context for the assessment;
Establishing a project team and a management plan;
Establishing a stakeholder process;
Developing a communications plan.
Vulnerability:
Current burden of disease
Current health protection programmes
Future impacts:
Changing burden without climate change
Projected health impacts of climate change
Adaptation:
Identify and prioritize additional interventions
Identify resources and barriers to implementation
Health harms and benefits in other sectors
Communicate plan and implement
Monitor and evaluate

Health Impact Assessment of climate changes

- The *Climate Change, Vulnerability and Health: A guide to assessing and addressing the health impacts* document was developed using a Health Impact Assessment (HIA) framework

- This Guide provides details on all components of the assessment including:
  - Descriptions of activities to be undertaken
  - Working tables for each step (with examples)
  - Handouts for people from other sectors to ensure everyone has similar minimum levels of knowledge

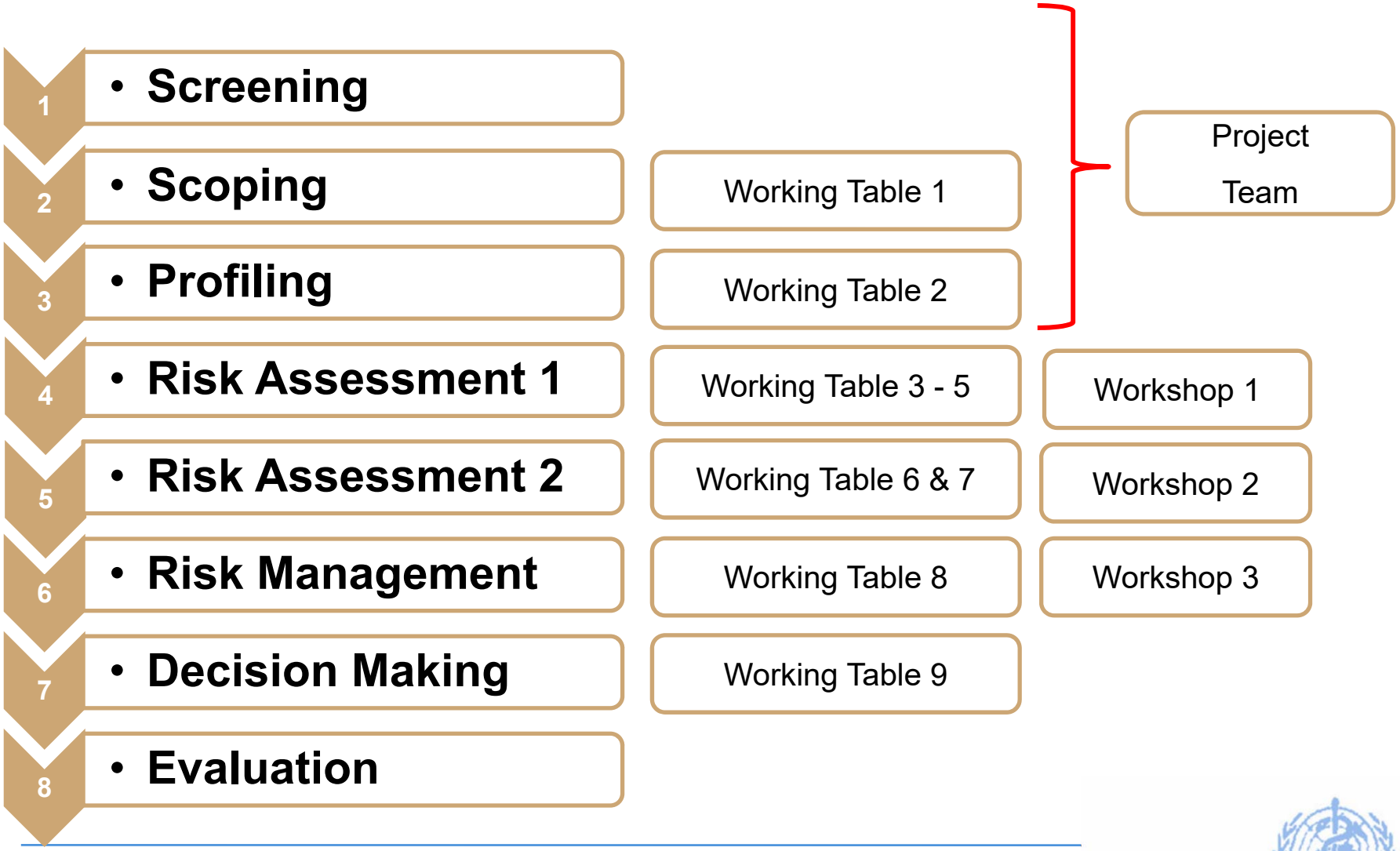
The Health Impact Assessment Process

- Health Impact Assessment is a tool used to:
  - Apply existing knowledge about health to specific social and community contexts
  - Identify potential inequalities and vulnerabilities within communities
  - Provide information about health issues to stakeholders
  - Develop evidence-based recommendations to decision-makers to help them make choices about alternatives and improvements to prevent disease/injury and to actively promote health

The Health Impact Assessment Process

- The process has underlying principles and values of:
  - Sustainability
  - Equity
  - Democracy
  - Ethical use of evidence
  - Promotion of health
- These should be applied in any vulnerability and adaptation assessments for human health

HIA Framework for Climate Change Vulnerability and Adaptation Assessment



WORLD HEALTH ORGANISATION

- The framework assumes that the initial components will be undertaken by a Project Team that will be responsible for the management of the overall process
- These initial components include the following stages:
  - Screening
  - Scoping
  - Profiling

1. • **Screening**
2. • **Scoping**
3. • **Profiling**
4. • **Risk Assessment 1**
5. • **Risk Assessment 2**
6. • **Risk Management**
7. • **Decision Making**
8. • **Evaluation**

Are there significant health impacts of climate change that need to be managed?

Screening

- The aim of screening is to determine whether an assessment is required
- For climate change, it is clear that there is the potential for widespread and significant potential effects on human health wherever human populations exist.
- The Screening step entails a consideration by the organisation or agency that is proposing to undertake the process to:
  - Identify key climate variables that may impact, or are already impacting, the environment
  - Identify risks to health that may be emerging
  - Identify potentially affected communities and vulnerable groups
  - Provide briefing explanations to decision makers to secure their support and commitment

1. • **Screening**
2. • **Scoping**
3. • **Profiling**
4. • **Risk Assessment 1**
5. • **Risk Assessment 2**
6. • **Risk Management**
7. • **Decision Making**
8. • **Evaluation**

Project Team

Select Year

Communication Strategy, Stakeholder Engagement Strategy

Working Table 1

Scoping

- The scoping step establishes and identifies the key concepts of the project including;
  - clear administrative procedures;
  - a preliminary consideration of links between climate change and determinants of health and;
  - factors affecting vulnerability to climate-related health effects.
- This step includes:
  - the establishment of the Project Team within the health sector but may include representatives from other sectors
  - Terms of Reference for the team's activities
  - development of a communication strategy
  - development of a stakeholder engagement strategy
- Links between health and other sectors need to be established
- Requires communication and consultation.

Links with other sectors

Transport

Energy

Business

Agriculture

HEALTH

Development

Industry

Planning

Water

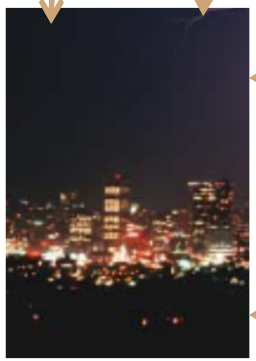
Transport

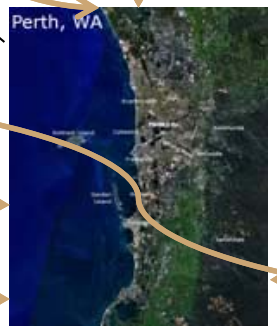
Energy

Business

Agriculture

HEALTH





Development

Industry

Planning

Water

Activity: Working Table 1 - Stakeholder Engagement Strategy for Project Team

Issues for Consideration	Potential Responses
Who should take responsibility for consultation?	
Who are the key stakeholders / representatives from relevant sectors.	
Vulnerable groups – assessment of needs and consultation with.	
Utilisation of consultation outcomes	
Timeframes for consultation and communication	

1. • **Screening**
2. • **Scoping**
3. • **Profiling**
4. • **Risk Assessment 1**
5. • **Risk Assessment 2**
6. • **Risk Management**
7. • **Decision Making**
8. • **Evaluation**

Profile of Climate Change, the Population and Biophysical Environment of the Region

Working Table 2

Working Table 2- Developing a Climate Scenario

Scenario Requirements	
• Obtain climate data for the selected timeframe from a range of sources including the IPCC and meteorological sources • Choose relevant year and particular projection for the assessment	
Climate Variables	**Local Data**
Expected average temperature increases Increases in the number of days over 35°C (or x°C) Identify specific regions if necessary	
Rainfall changes Seasonal changes across regions	
Sea-level increases by x cm	
Extreme Weather Events	

Developing a climate scenario

- To start the discussion with a wide range of sectors and individuals, we need to develop a scenario for a future timeframe
- Using Working Table 2:
  - Briefly consider the climate attributes of your country or a component thereof if it has various regions
  - Think about what might be needed to inform your stakeholders about potential changes for a specific timeframe in the future
  - Make notes on the worksheet on what to include

Understanding the Biophysical Environment

- The basic characteristics of the natural and built environment should be described including:
  - The topography,
  - Identification of specific features and areas of human habitation
  - Descriptions of populated areas that are currently or potentially more vulnerable to climate changes
  - Identification of environments conducive to exacerbating or inducing certain health impacts (e.g. vulnerability of low-lying coastal areas to sea-level increase or urban areas to extreme heat)
- Information about these environments can be obtained from relevant government departments and other agencies.
- It is important to provide stakeholders and assessment participants with:
  - Descriptions of the locations under consideration
  - Locations and proximities of human settlements
  - Appropriate maps

Understanding Communities

- Risks to the health of a population depend on factors such as:
  - population density,
  - individual characteristics such as age and gender,
  - the level of economic development,
  - food availability,
  - income level and distribution,
  - local environmental conditions,
- Distribution of these factors is not normally consistent across regions and may also vary with time.
- To identify vulnerable groups an understanding of basic population demographics is required such as:
  - age distribution
  - life expectancy

Understanding Health Status

- Health data are needed on the leading causes of morbidity and mortality, and trends over the past few decades, along with information on the geographic extent
  - The ministry of health, hospitals, and similar sources can provide data on disease incidence and prevalence, including
    - WHO Global Health Observatory (GHO)
    - WHO regional offices
    - OFDA/CRED Emergency Disasters database (EM-DAT)
- Information on existing climate-sensitive diseases such as malaria and asthma, should be compiled.
- The quality and availability of health care is also important.
- Results can be used to develop vulnerability maps for regions and/or communities

Estimating the current burden of climate-sensitive health outcomes

Understanding the climate and potential changes to health:

- Weather and climate data are needed to determine the extent to which weather variables is associated with the health outcomes
- Types of analyses will include:
  - Episodes or event analyses, such as heatwaves or cyclones
  - Incidence of climate sensitive diseases
  - Time series analyses, such as the associations between temperature and mortality or morbidity
  - Seasonality analyses, such as of aero-allergens
  - Changes in the geographic distribution, such as of vector-borne diseases

Vulnerability

- The IPCC defines vulnerability as:
  "the degree to which a system is susceptible to or unable to cope with, adverse effects of climate change".

- Vulnerability is strongly linked to the principle of equity.

- An understanding of vulnerability helps to ensure that adaptation strategies target vulnerable groups and reduces potential inequities with respect to the health burden of climate change.

Understanding Vulnerability

- Exposure, sensitivity and adaptive capacity are the three fundamental elements that contribute to overall vulnerability.
- It is critical that the Project Team and stakeholders have a shared understanding of these elements.
- Exposure:
  - Any condition which provides an opportunity for individuals or communities to be subject to agents that may result in harm to human health. The agents include climate variables such as extreme events or health determinants affected by climate. The extent of exposure is affected by the magnitude and frequency of the agent.
- Sensitivity:
  - The degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise)

Understanding Vulnerability

- Adaptive Capacity:
  - The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences

- The pathway between a climate variable and the subsequent health impact often involves multiple steps and vulnerability can manifest at any point on that pathway.
- Analysis of each step along the pathway of these three elements allows a logical determination of vulnerability and subsequent development of adaptive measures that aim to decrease vulnerability.
  - Example, vulnerability to health effects of heat-waves can stem from:
    - differences in exposure patterns based on occupational and social variables,
    - the sensitivity of individuals to extreme heat,
    - the capacity of the energy sector to meet peak demand during heat-waves,
    - differences in community and individual capacity to implement adaptation strategies.

Understanding Vulnerability

- There are multiple factors that affect the three main elements of vulnerability.
- Vulnerability should also be considered in terms of regional, economic, social and infrastructure aspects.
- An early understanding of the elements influencing vulnerability highlights the importance of collaboration between multiple sectors and helps to inform the communication and stakeholder engagement strategies.

Vulnerability and Adaptation Assessments for Health

- The *Climate Change, Vulnerability and Health: A Guide to Assessing and Addressing the Health Impacts* recommends that consultation for the next stages of the process is undertaken in collaboration with stakeholders from multiple sectors in a series of three workshops

1. • **Screening**
2. • **Scoping**
3. • **Profiling**
4. • **Risk Assessment 1**
5. • **Risk Assessment 2**
6. • **Risk Management**
7. • **Decision Making**
8. • **Evaluation**

Hazards,

Health Impacts and Vulnerability

Workshop 1

Working Table 3 - 5

Workshop One

Workshop One: Identifying Health Impacts

- The first workshop is typically held over a day and includes stakeholders from a broad range of sectors, including: health, emergency services, environment, indigenous affairs, planning, housing, commerce and development, water, energy, transport, community and cultural services, education, fisheries, agriculture and any others of relevance.

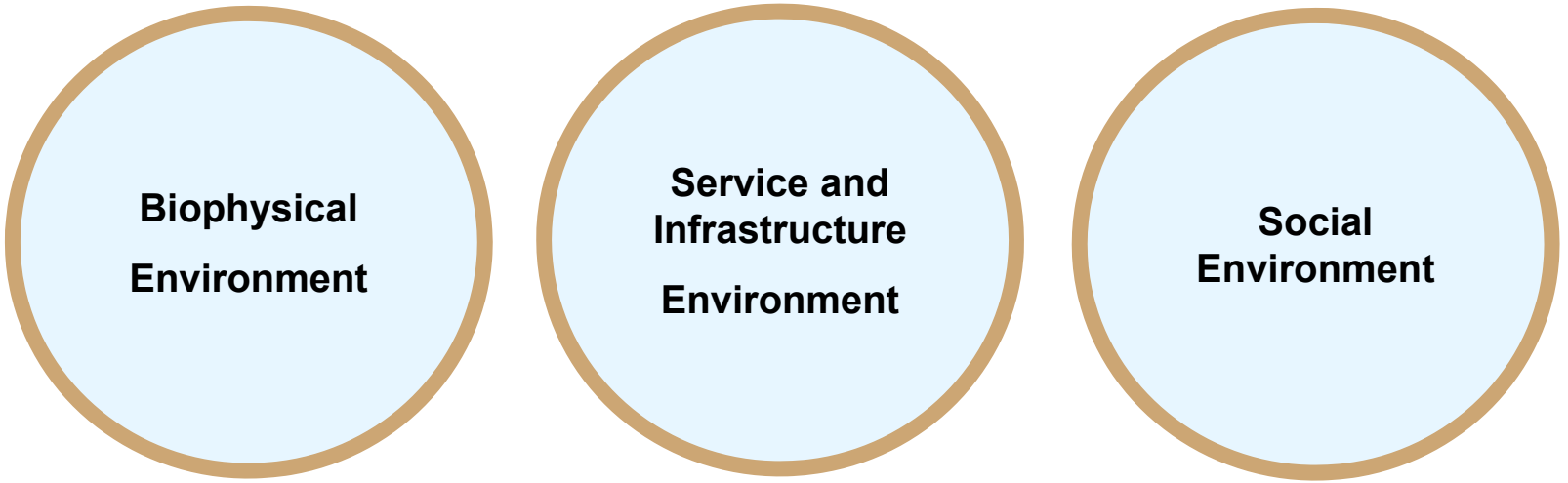
- The aims of this workshop are to:
  - Engage with representatives from key sectors
  - Determine the influence that predicted climate changes could have on determinants of health
  - Identify the potential impacts to health that occur as result of these influences
  - Consider the effectiveness of current management practices and their limitations
  - Compile information on available data and evidence sources, and
  - Identify potential uncertainties in collected information
-

Workshop One:

- The workshop has three components:
  - Identification of the biophysical, service and infrastructure and social changes to the location from the potential climate changes and the associated hazards,
  - Identification of the potential health impacts from these hazards,
  - Consideration of current management practices

Workshop 1

Categories to Guide Formation of Participant Groups



Determinants of Health

- Environmental
- Ecological
- Technological

- Services
- Infrastructure
- Socio-economic

- Psychosocial
- Lifestyle

Participant Expertise Required

Working Table 3 - Climate Variables and their Influence on Health-Related Hazards

Climate Variable	Relevant Health-Related Hazards		
	Biophysical Environment	Service and Infrastructure Environment	Social Environment
Gradual Changes			
Temperature increase	Ground-level ozone likely to increase with higher summer temperatures		
Change in rainfall		Increased stress on water infrastructure	Changes in behaviour and requirements for local mosquito control
Sea-level change			
Extreme Events			
Heatwaves		Stress on health services and infrastructure such as power, water distribution, roads and rail Damage to wide-range infrastructure & property e.g. contamination of water supplies	
Droughts	Direct health effects, reductions in air quality, impact on food production		Changes in behaviour to avoid heat impacts Economic losses Psychosocial impacts – stress
Bushfires			
Flooding			
Storms			
Cyclones			
Landslides			
Other			

Activity: Identification of Health Related Hazards

- Form three groups with expertise in one of the following areas:
  - Biophysical environment
  - Service and Infrastructure Environment
  - Social environment

- Discuss and complete within Working Table 3 for your countries:
  - At one or two examples in each section for the gradual changes
  - One or two examples for the climate variables of relevance for extreme events

- Provide brief feedback to the whole group on your examples

Identification of Health Impacts

- The outcomes of the consultation on climate related hazards are used as the basis for understanding potential health impacts.
- The potential hazards identified in Working Table 3 by the Biophysical, Service and Infrastructure and Social expert groups are transferred to the corresponding Working Table 4 for each category (Working Tables 4.1, 4.2, 4.3).
- The direct and indirect health impacts are identified and the factors influencing vulnerability to each health effect are discussed.
- The key elements of exposure, sensitivity and adaptive capacity, as well as the suggested categories (regional, economic, social and infrastructure) are used to guide the discussion.

Working Table 4 – Health Impacts

Climate Variable	Impacts to Communities and Individuals			Vulnerability (exposure, sensitivity, adaptive capacity)				Evidence/ Uncertainties
	Relevant health-related hazards	Health Impacts		Regional	Economic	Social	Infrastructure & Services	
		Direct	Indirect					
Temperature increase								
Rainfall change								
Sea-level increa								
Extr s: Heatw es Droughts Bushfires Floods Storms Tropical cyclones Other								

Transferred from Working Table 3

Working Tables

4.1 Health Impacts – Biophysical Environment

4.2 Health Impacts – Service and Infrastructure Environment

4.3Health Impacts – Social Environment

Working Table 4 – Health Impacts

Biophysical Environment

Climate Variable	Impacts to Communities and Individuals			Vulnerability (exposure, sensitivity, adaptive capacity)				Evidence/ Uncertainties
	Relevant health-related hazards	Health Impacts		Regional	Economic	Social	Infrastructure & service	
		Direct	Indirect					
Temperature increase								
Rainfall change								
Sea-level increase								
Extreme Events: Heatwaves Droughts Bushfires Floods Storms Tropical cyclones Other								

Increase in aeroallergens

Asthma

Exposure likely to be higher in highly vegetated areas

Sensitive groups—existing respiratory conditions, including asthma.

Effect of aeroallergens is complex and uncertain.

Activity: Identification of Health Impacts

- Complete the Working Table 4.1, 4.2 or 4.3 (related to your area of expertise)
  - Transfer the hazards you have identified in Table 3
  - Consider direct and indirect health impacts for each (one or two examples)
  - Consider the specific vulnerabilities associated the these
  - Identify any uncertainties

- Briefly describe your outcomes with the whole group

Understanding Current Management Practices

- Assessment of the current management practices for the identified health hazards and impacts is required.
- This considers the likely effectiveness of the current controls, including areas for improvement, in the light of the projections.
- Identification of the sectors to be involved in the development or management of these controls can be made at this stage.

Working Table 5 - Current Management Practices and Limitations

Impact Type	Current Management Practices	Potential Limitations in Year X	Sectors
Air quality—range of respiratory effects	Air Quality Management Program Medical treatment	Air Quality Management Plan requires updating Lack of resources	Environment Health Transport

Activity: Current Management Practices and their Limitations

- In your groups, using one or two examples of health impacts, complete Working Table 5 to consider the current management practices that might be used in your country and any limitations

1. • Screening
2. • Scoping
3. • Profiling
4. • Risk Assessment 1
5. • Risk Assessment 2
6. • Risk Management
7. • Decision Making
8. • Evaluation

Risk Assessment and Risk Ranking

Workshop 2

Working Table 6 & 7

Workshop Two

Assessing Risks

- By this time, a significant amount of evidence will have been collated.
- This evidence is typically considered in a smaller workshop or focus group setting and involves an assessment of the consequences and likelihood of each health impact.
- The objectives of Workshop Two which is typically held over half a day, are to:
  - Assess the risks to public health associated with the health impacts identified in the first workshop
  - Rank health impacts according to the level of assessed risk

Assessing Risks

Risk = Consequences x Likelihood

- In the main risk assessment uses qualitative descriptions of both likelihood and consequences based on available evidence and expert opinion.
- Groups based on expertise:
  - assess risk based on available evidence and expert opinion
- Use predetermined qualitative scale
  - 5 levels of likelihood
  - 5 levels of consequences
- The agreed upon likelihood and consequence levels are entered into a risk assessment matrix to give a final level of risk
  - However, quantitative data can be used if available

Risk = Consequences x Likelihood

- List of health impacts, vulnerability & evidence from Workshop 1
- Groups based on expertise → assess risk based on available evidence and expert opinion
- Predetermined qualitative scale
  - 5 levels of likelihood
  - 5 levels of consequences
- Compare & discuss in plenary session

Likelihood	Description
Very Unlikely	May occur only in exceptional circumstances
Unlikely	Could occur at some time
Possible	Might occur at some time
Likely	Will probably occur in most circumstances
Very Likely	Is expected to occur in most circumstances

Consequence	Examples
Catastrophic	Large numbers of serious injuries, illnesses or loss of life Severe and widespread disruption to communities Long term inability to deliver essential goods and services Severe long-term reductions in quality of life Huge economic costs
Very High	Small numbers of serious injuries, illnesses or loss of life Significant, widespread disruption to communities Significant decline in delivery of essential goods and services Significant long-term decline in quality of life High economic costs
High Etc….	Small number of minor injuries or illnesses Significant disruption to some communities Significant decline in delivery of essential goods and services Significant short-term or minor long-term reduction in quality of life Moderate Economic costs

Likelihood	Health Consequence				
	Low	Medium	High	Very High	Catastrophic
Very Unlikely	Very Low	Very Low	Low	Low	Medium
Unlikely	Very Low	Low	Low	Medium	High
Possible	Low	Low	Medium	High	Very High
Likely	Low	Medium	High	Very High	Extreme
Very Likely	Medium	High	Very High	Extreme	Extreme

Working Table 6 - Risk Assessment Table

Health Impact	Consequence	Likelihood	Risk	Rationale/Further Evidence.
Health effects related to bushfires	Very High	Likely	Very High	Drier and hotter conditions in Western Australia are likely to increase risk of fires. Possible fatalities and injuries, exposure to high particulate levels, significant psychosocial and socioeconomic costs. Vulnerable groups in bushfire prone areas.

Ranking risk levels

- Ranking potential risks provides an effective means by which decision makers can:
  - compare different impacts,
  - consider potential overlaps between health impacts
  - prioritise responses
- The risk levels are ranked from highest to lowest once the levels for each impact have been determined
- The resultant list provides direction for action

Working Table 7 - Final Risk Ranking Table for Potential Health Impacts of Climate Change

Potential Health Impact	Consequence	Likelihood	Risk
Health impacts due to extreme heat	Catastrophic	Likely	Extreme
Health impacts due to bushfires	Very High	Likely	Very High
Health impacts due to flooding	Very High	Possible	High
Health impacts due to higher particulate levels	High	Possible	Medium
Impacts from harmful algal blooms	Medium	Likely	Medium
Impacts from increased chemical exposure	Very High	Very Unlikely	

Activity: Determining Risk Levels

- Consider four or five identified health impacts from your previous considerations
- Discuss the possible consequence and likelihood levels for each
- Use the results to determine a risk category for each using the risk matrix
- Complete Working Table 6
- Once the risks for each of the impacts are determined, sort them from the highest to the lowest level of risk using Working Table 7.
- Briefly report back to the whole group on your results

- Normally **all** identified health impacts would be aggregated and ranked

1. • Screening
2. • Scoping
3. • Profiling
4. • Risk Assessment 1
5. • Risk Assessment 2
6. • Risk Management
7. • Decision Making
8. • Evaluation

Adaptation Measures

Workshop 3

Working Table 8

Adaptation

- The risk management step of HIA is also referred to as adaptation, as this term is routinely used in relation to management of climate change impacts.
- All of the information from Workshop 2 and the final list of risk levels is collated.
- Descriptions of management actions for each risk level, including the level of community acceptability, helps to determine which impacts will be carried through to the final workshop.
  - For example it may be determined that subsequent steps will only consider health impacts assessed as a high or extreme risk.

Management of climate-sensitive health risks

Risk Levels	Description of Management Action
Extreme	Risks require urgent attention at the most senior level and cannot simply be accepted by the community
High	Risks are the most severe that can be accepted by the community and need planned action
Medium	Risks can be expected to be part of normal circumstances but maintained under review by appropriate sectors
Low	Risks will be maintained under review but it is expected that existing controls will be sufficient and not further action will be required to treat them unless they become more severe
Very Low	As above

United Nations Framework Convention on Climate Change

Workshop Three

Adaptation

Once all the risk assessment work has been compiled, continue on to a final adaptation workshop.

- The objectives of Workshop Three with respect to the chosen health impacts are to:
  - Review potential adaptation measures for their applicability to the communities at risk
  - Propose additional adaptation measures
  - Consider the current status of agreed adaptation measures with reference to the population and vulnerable groups
  - Establish mechanisms and responsibility for implementation of adaptation measures

Generating recommended health adaptation options

- Working with stakeholders, create a list of the widest possible range of health adaptation options
- Screen the options for those that are practical based on:
  - Technical feasibility
  - Effectiveness
  - Environmental acceptability
  - Financial feasibility (cost)
  - Social and legal acceptability
- Screen the practical options based on:
  - Technical viability
  - Financial capability
  - Human skills and institutional capacity
  - Compatibility with current policies and practice
  - Target of opportunity
- Recommend a short list of options for implementation

Adaptation

- The discussion on adaptation strategies for each health impact is guided by 8 suggested headings which are:
  - Legislative or Regulatory
  - Public Education and Communication
  - Surveillance and Monitoring
  - Ecosystem Intervention
  - Infrastructure Development
  - Technological and Engineering
  - Health Intervention
  - Research/Further Information

- Adaptations for each of these should focus on strategies that can be implemented by decision makers to reduce adverse health impacts and to improve the knowledge base for future decision-making.
- The current capacity of each potential strategy is then considered, including an outline of how this strategy could be improved and who would be involved.

Working Table 8 – Adaptation Strategies

Categories of Adaptation (Suggested)	Current Capacity A=Adequate I= Inadequate D= Developing N = Not in place	Suggestions for Implementation or Upgrading	Sectors Involved
Legislative or Regulatory			
Public Education & Communication			
Surveillance and Monitoring			
Ecosystem Intervention			
Infrastructure Development			
Technological or Engineering			
Health Intervention			
Research/ Information			

…8 categories to guide discussion

Adaptation

- Working Tables 8 (8.1 – 8.9) provided in the Guide have been developed around the Determinants of Health groups as suggestions and starting points for development of adaptation strategies; these can be modified for particular country circumstances
- The discussion on adaptation strategies for each health impact is guided by 8 main headings as shown here. These examples should focus on strategies that can be implemented by decision makers to reduce adverse health impacts and to improve the knowledge base for future decision-making.
- The current capacity of each potential strategy is then considered, including an outline of how this strategy could be improved and who would be involved.

Working Table 8 – Adaptation Strategies **Heatwaves**

Categories of Adaptation (Suggested)	Current Capacity A=Adequate I= Inadequate D= Developing N = Not in place	Suggestions for Implementation or Upgrading	Sectors Involved
Legislative or Regulatory			
Heat Event Response Plan	N	Without specific plan major heatwave presents significant risks	Extend State Emergency Plan to include Heatwaves
Public Education & Communication			Health, Emergency Services
Surveillance and Monitoring			
Ecosystem Intervention			
Infrastructure Development			
Technological or Engineering			
Health Intervention			
Research/ Information			

…about 350 potential adaptation strategies provided

Working Table 8 – Adaptation Strategies

Extreme Events

Categories of Adaptation (Suggested)	Current Capacity A=Adequate I= Inadequate D= Developing N = Not in place		Suggestions for Implementation or Upgrading	Sectors Involved
Legislative or Regulatory				
Public Education & Communication				
Surveillance and Monitoring				
Ecosystem Intervention				
Infrastructure Development				
Technological or Engineering				
Improved training programs and information on emergency management.	A	Enhance responses to rural and regional areas	Continue Development	Health Emergency Services

Working Table 8 – Adaptation Strategies

Extreme Events

Categories of Adaptation (Suggested)	Current Capacity A=Adequate I= Inadequate D= Developing N = Not in place		Suggestions for Implementation or Upgrading	Sectors Involved
Legislative or Regulatory				
Public Education & Communication		Long-term follow up is not adequate Hospital morbidity data is okay	Access to GP data Up to date environmental and population forecasts Monitoring needs upgraded as required	Health, Planning, Environment, Climate Research, Emergency Services, Insurance industry
Surveillance and	I			
Standardization of information collected after disasters to more accurately measure morbidity and mortality.				
Technological or Engineering				
Health Intervention				
Research/ Information				

Working Tables 8 – Adaptation Strategies (examples)

Working Table 8.1	Direct Physical Impacts of Extreme Events
Working Table 8.2	Direct Health Impacts of Heat Events
Working Table 8.3	Water-Borne Diseases and Water Quality
Working Table 8.4	Vector-Borne Diseases
Working Table 8.5	Air Quality and Associated Health Impacts
Working Table 8.6	Food-borne Diseases
Working Table 8.7	Food Production
Working Table 8.8	Social/Community/Lifestyle
Working Table 8.9	General Principles and Adaptation Measures

Adaptation options to reduce the health risks of climate change

Health outcome	Legislative	Technical	Education and advisory	Cultural and behavioral
Thermal stress and other extreme weather events	Planning laws, building guidelines	Urban planning, housing, public buildings, storm shelters	Early warning systems	Clothing, siesta, use of storm shelters
Vectorborne diseases	Land planning	Integrated vector control, vaccination, impregnated bed nets	Early warning systems, health education	Water storage practices, use of bed nets
Waterborne diseases	Watershed protection laws, water quality regulation, water safety plans	Pathogen screening, improved water treatment and sanitation	Boil water alerts	Washing hands and other behavior, use of pit latrines

Activity: Developing Adaptations

- In your expert group, complete one of the relevant Working Tables 8
- Consider the:
  - current capacity of some of the suggested adaptations,
  - Any suggestions that may be required to improve or upgrade the current situation
  - Identify sectors that should be involved in progression of the adaptation strategy
- Briefly report your findings to the whole group

1. • Screening
2. • Scoping
3. • Profiling
4. • Risk Assessment 1
5. • Risk Assessment 2
6. • Risk Management
7. • Decision Making
8. • Evaluation

Recommendations,

Climate Change & Health Adaptation Strategic Report

Working Table 9

Recommendations and Decision Making

- Completion of a Vulnerability Assessment and development of Adaptation strategies forms part of a response to climate change that is carried out for many locations
- Documentation would be provided to decisions makers and would include:
  - An appropriate overview of the process and the outcomes,
  - Identification of key stakeholders
  - Consideration of any important findings that might have emerged from the assessment
  - Recommendations to decision-makers on the implications of the identified health impacts on the community as a whole as well as vulnerabilities

Recommendations and Decision Making

- The recommendations to decision makers and other key stakeholders should include:
  - Strategic Direction
  - Government Responses
  - Community Involvement
  - Activities/Projects
- It is recommended that adaptation strategies are provided in a summary table with impacts ordered from the highest to lowest level of risk.
- Working Table 9 is provided as an approach that could be used to summarise the key information with respect to risk, potential actions and the responsible sectors.
- Appropriate to start with adaptations required to address the highest levels of risk

Decision Making

- With particular reference to climate change, recommendations can consider:
  - The current and potential strategic directions of the decision makers (for example inclusion in national or local responses/documentation to climate change)
  - The incorporation of the adaptations into policies and plans
  - The links that should be made with other sectors
  - The roles, responsibilities and partnerships for implementation by various bodies including Government and NGOs
  - Any barriers to implementation that may have been identified
  - Specific issues that should be addressed such as:
    - Further projects or activities to clarify current uncertainties
    - Communication and increasing knowledge within communities

Adaptation Strategies	Support Agencies
1. Legislative or Regulatory	
Heat Event Response Plan	Housing Planning Aged Care
2. (*complete for al categories of adaptation strategies*)	

WESTERN AUSTRALIA

STATE EMERGENCY MANAGEMENT PLAN

FOR

HEATWAVE

OCTOBER 2012

(WESTPLAN - HEATWAVE)

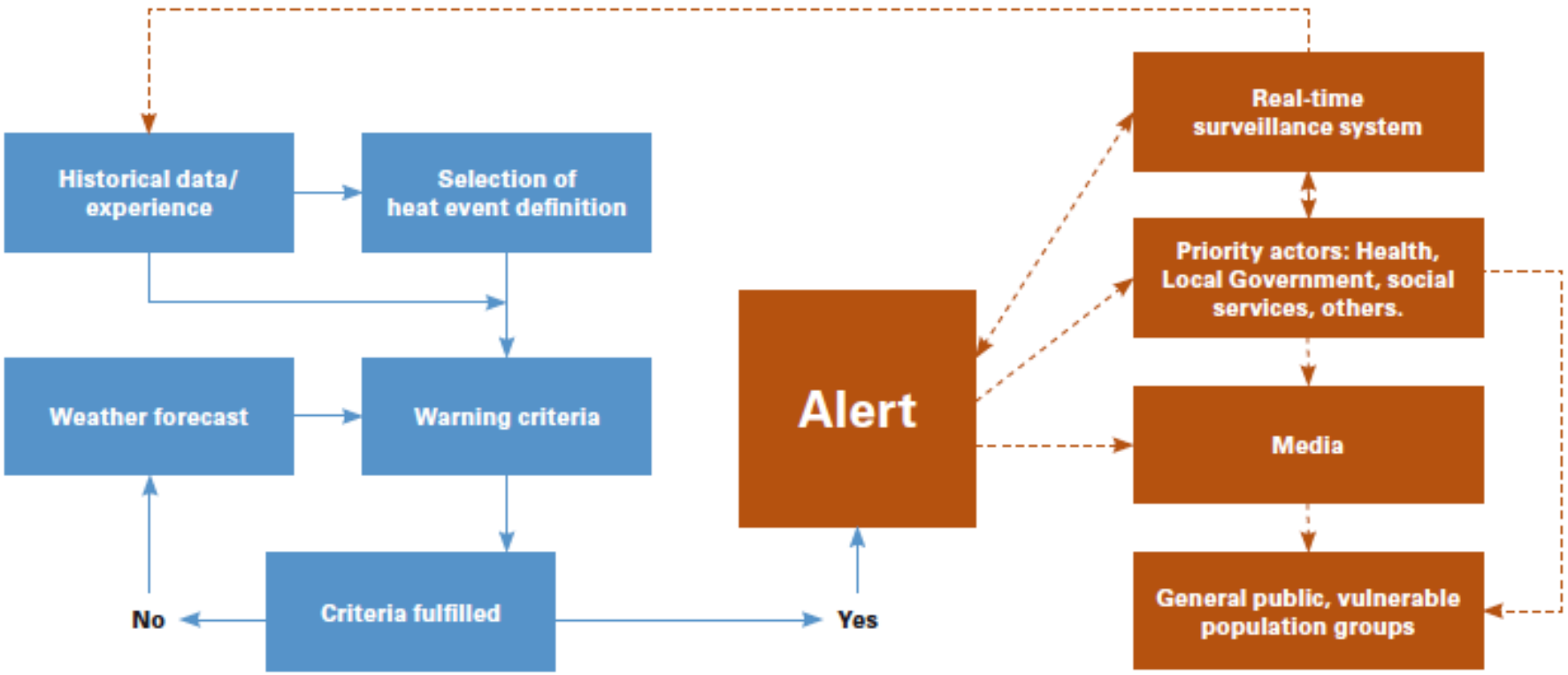
Prepared by the Disaster Preparedness Manager
Australian Department of Health

Update….. WESTPLAN HEATWAVE Oct 2012

VED AT SEMC MEETING
RESOLUTION NO: 134/2012
DATE OF APPROVAL: 4 December 2012

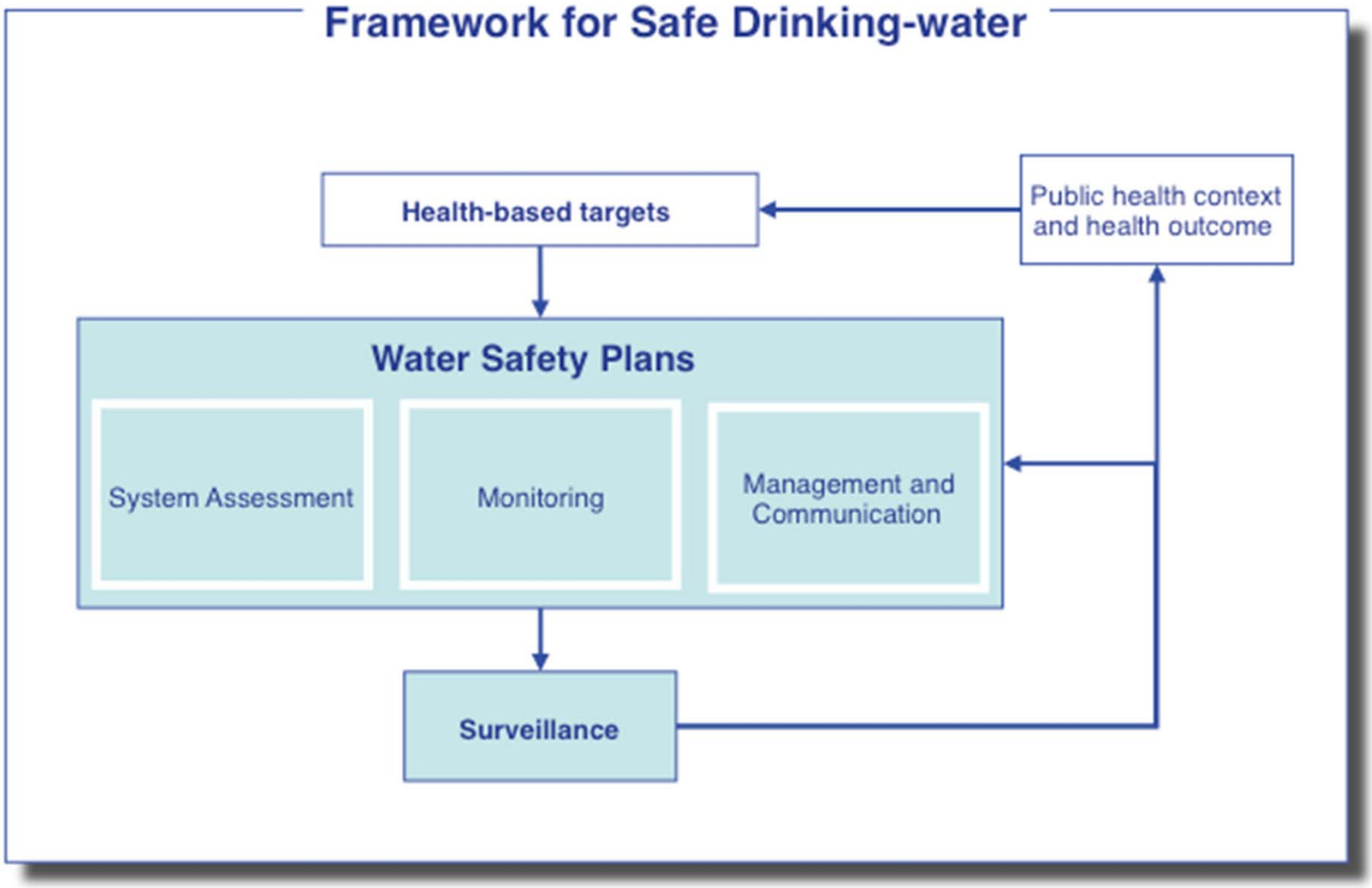
REVIEW DATE: 4 December 2017

Heatwave early warning system



The information generated by meteorological agencies needs to be connected to preventive actions by health and other sectors to form a heat-health action plan[13]

Climate resilient water safety plans



1. • Screening
2. • Scoping
3. • Profiling
4. • Risk Assessment 1
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6. • Risk Management
7. • Decision Making
8. • Evaluation

Evaluation of the Process and the Outcomes

Evaluation

- Evaluation is an important component of the overall process and includes the:
  - Process undertaken – to consider any particular problems encountered during the process or suggestions for improvement and be recorded for future reference
  - Outcomes – to consider the appropriateness of any predictions made
- Evaluations should include:
  - progress of implementation of the recommended adaptation measures, including the involvement of key stakeholders and the incorporation of health impacts of climate change into planning processes,
  - monitoring and surveillance of the health status of the potentially affected communities. It may be relevant to include new mechanisms for collection of health data that demonstrates links to climate conditions.
- Baseline indicators established during the scoping stages are used as reference for assessment of changes over time.

Further activities and information

- Global framework for climate services

- An example is *Climate services adaptation program in Africa – building resilience in disaster risk management, food security and health*. The project, funded by the Government of Norway aims to increase the resilience of people most vulnerable to the impacts of weather and climate-related hazards such as droughts and flooding and associated health risks including malnutrition, cholera and malaria. The project is developing user-driven climate services for food security, health and disaster risk reduction in Malawi and Tanzania.

Lessons learned on health adaptation

- More effective projects have a clear vision of how the adaptation project fits within country development goals and have a strong country ownership
- Multi-sectoral approaches promote effective adaptation and increase the potential for scaling up
- More effective projects have or take time to build capacity and stakeholder engagement
- Establishing and reinforcing enabling conditions across scales promotes success
- Indicators are needed for monitoring and evaluation (M&E)
- Knowledge building and supplementation of country expertise may be necessary
- Mitigation and adaptation should be addressed jointly whenever possible
- More effective projects have good design and clear management arrangements and coordination

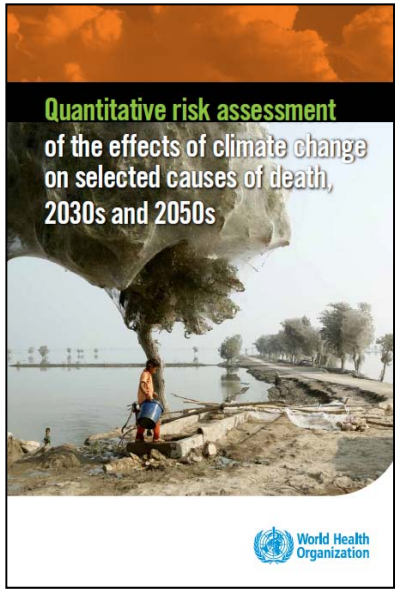
Indicators for monitoring, evaluation, and learning

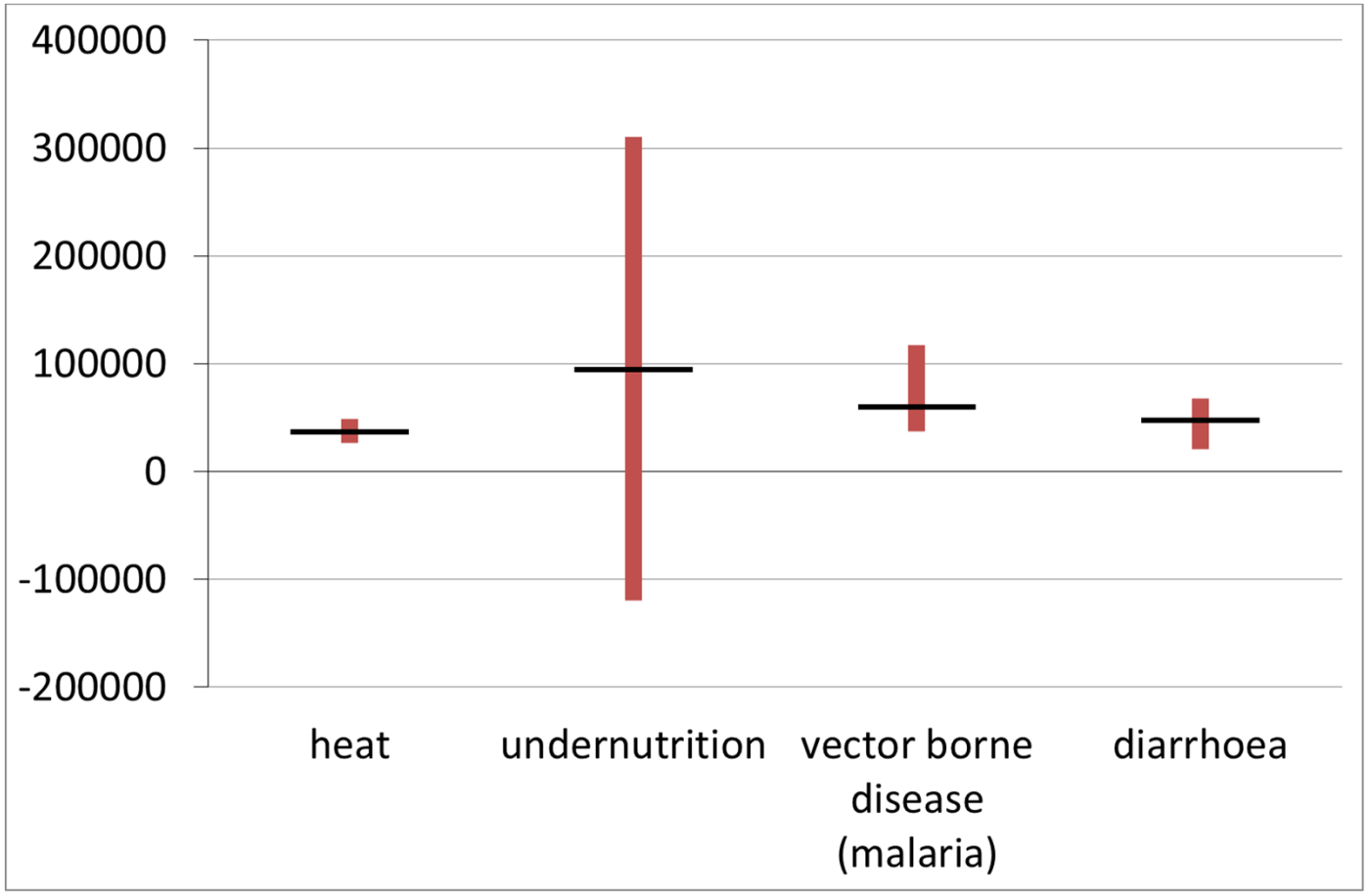
- The number and geographic distribution of cases and deaths (and trends over time) in climate-sensitive health outcomes
  - Health outcome data should be at least disaggregated by age and gender to identify high-risk population subgroups and to facilitate design of tailored interventions
- Trends in factors that increase or decrease vulnerability and exposure to the hazards associated with changing weather patterns and sea level rise
- Weather and climate variables, such as average and extreme temperature and precipitation, trends in the frequency and intensity of extreme weather and climate events, and sea level rise
  - Other environmental variables also may be useful, such as measures of soil moisture or stream flow
- The effectiveness of adaptation policies and programs, such as whether a particular option decreased the number of people at risk during a flood or increased the capacity of health care professionals to use weather and climate variables to forecast health risks
- The process of adaptation, including tracking the progress on identifying and scaling out lessons learned and best practices

Additional examples of climate sensitive disease projections

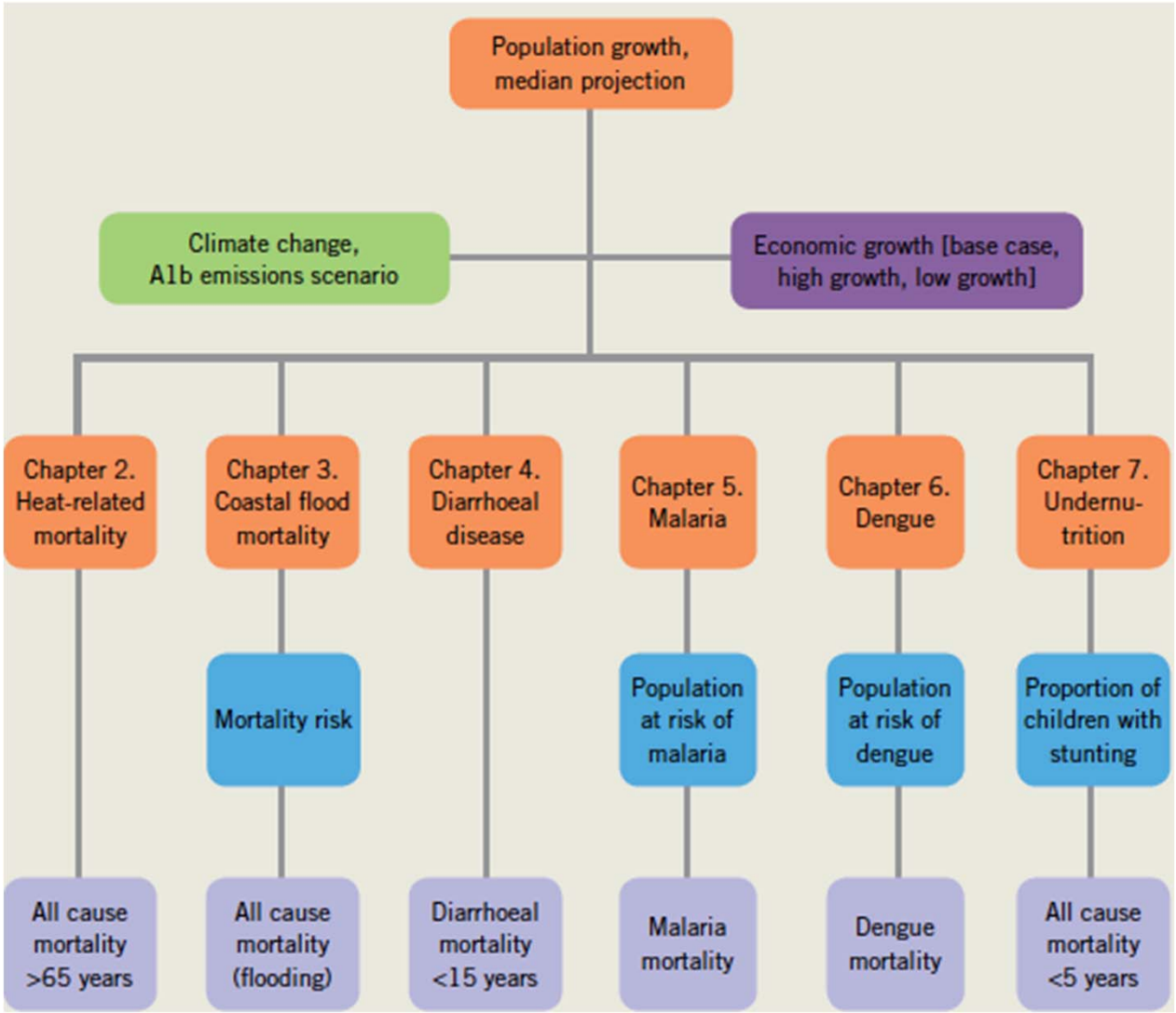
- The following slides provide information on projections and models used to determine estimates of disease risk and mortality in specific populations
- An important component of understanding risk for nations will be to build expertise within the health sector to calculate projections of the greatest risks to health on completion of the V&A assessments

Estimates of mortality due to climate change in 2030s: Approximately 250,000 excess deaths/year

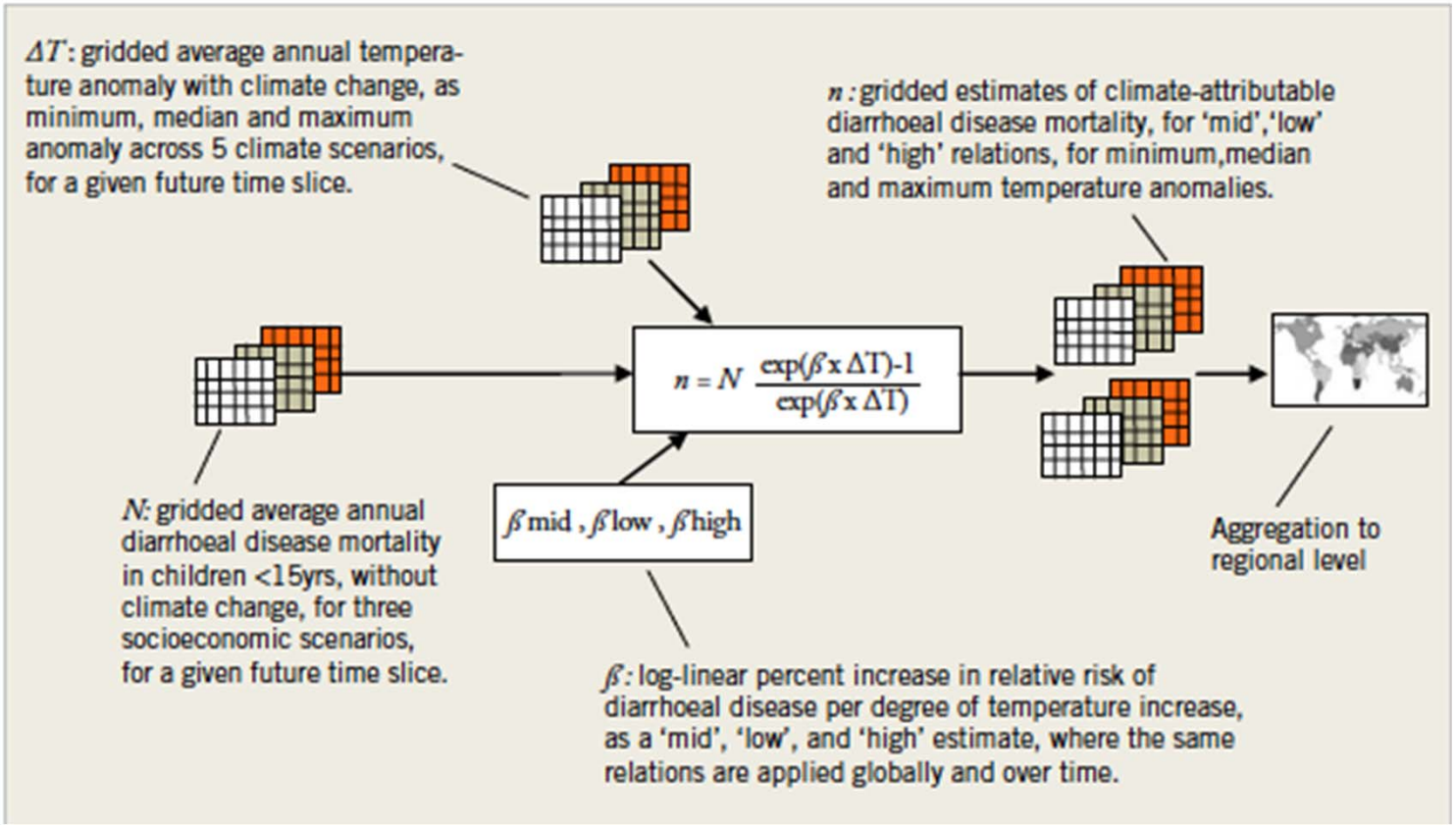




WHO models used and output metrics



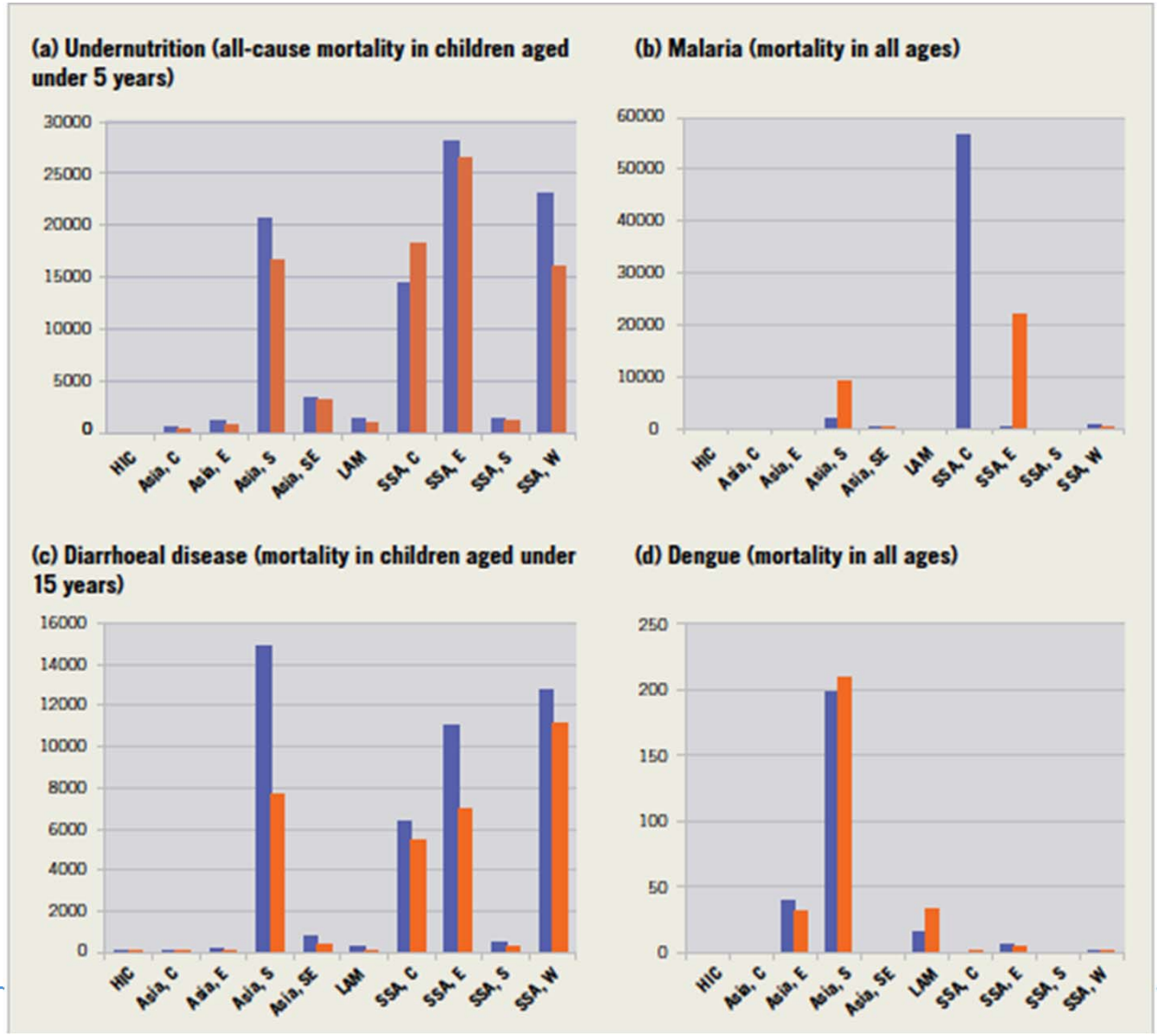
Structure of the diarrheal disease mortality model



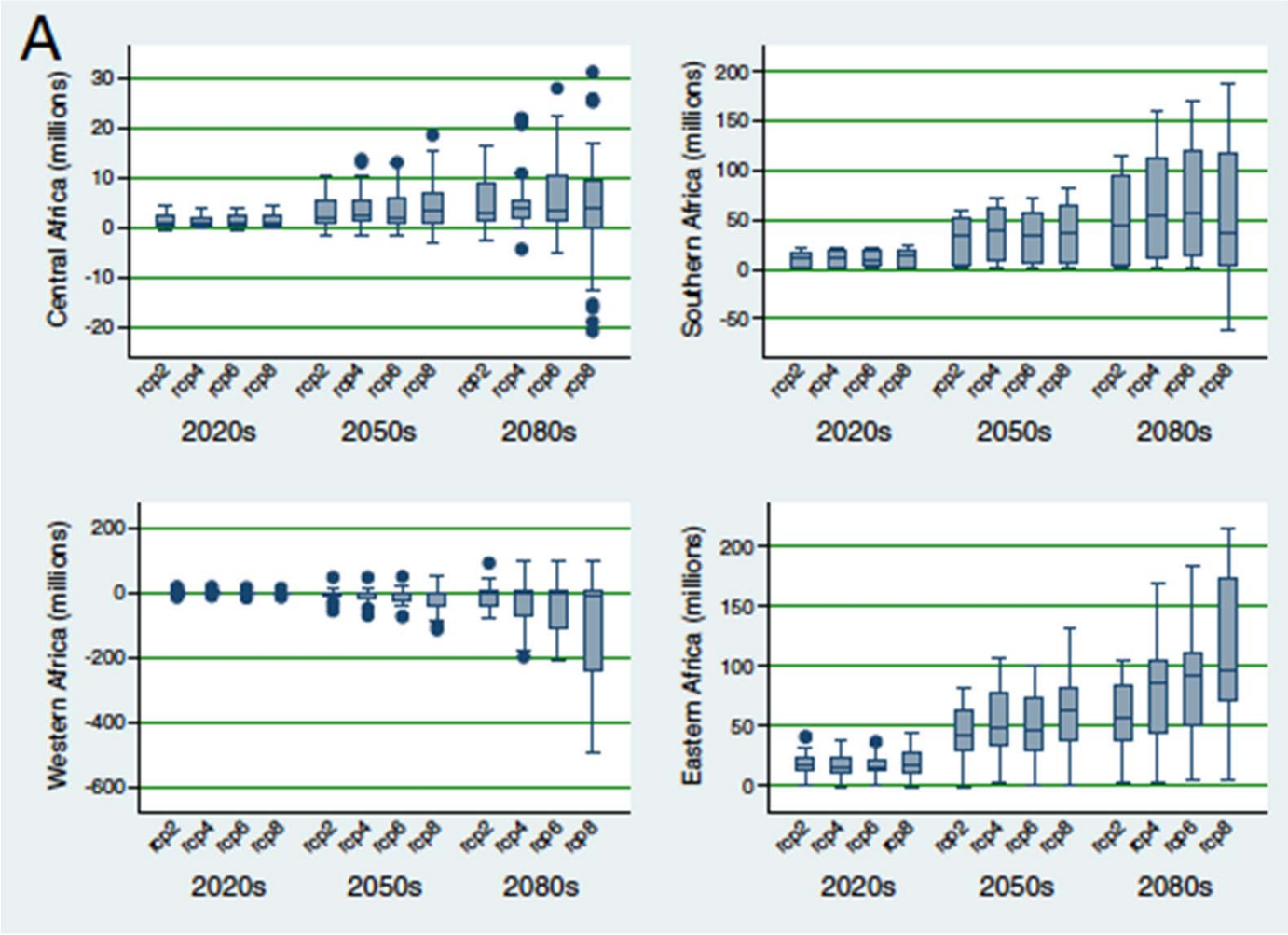
Number of additional diarrheal disease deaths globally in children 0–15 years due to climate change relative to the same future without climate change

Temperature change	2030			2050		
	Base case	High growth	Low growth	Base case	High growth	Low growth
Minimum	37 084	35 346	51 032	28 503	19 803	54 110
Median	48 115	45 770	66 463	32 954	23 359	63 442
Maximum	62 618	59 574	86 275	42 430	29 789	81 330

Estimated future annual mortality attributable to climate change and for the base case socioeconomic scenario in 2030 (blue bars) and 2050 (orange bars) by world region



Projected population at risk of malaria due to climate change



Conclusions

- The health risks of climate variability and change may be significant, particularly in low-income countries
- A variety of tools are available to conduct health vulnerability assessments and to estimate current and future burdens of climate-sensitive health outcomes
- Most of the health risks of climate change are current concerns, so there are a wide range of adaptation interventions
- Enhancing the resilience of health systems is a critical first step
- Further information about health and wellbeing impacts, vulnerability and adaptation can be obtained from the IPCC 5th Assessment Report, Chapters 11, 12 and 13. http://www.ipcc.ch/report/ar5/wg2/

Thank you