LIFE08 ENV/IT/436

PROJECT ACT

ADAPTING TO CLIMATE CHANGE IN TIME

HEALTH VULNERABILITY TO CLIMATE CHANGE: ASSESSMENT AND SUGGESTED ADAPTATION MEASURES FOR NO-HEALTH SECTORS

JESSICA TUSCANO

Rome July 2010

ISPRA Institute for Environmental Protection and Research

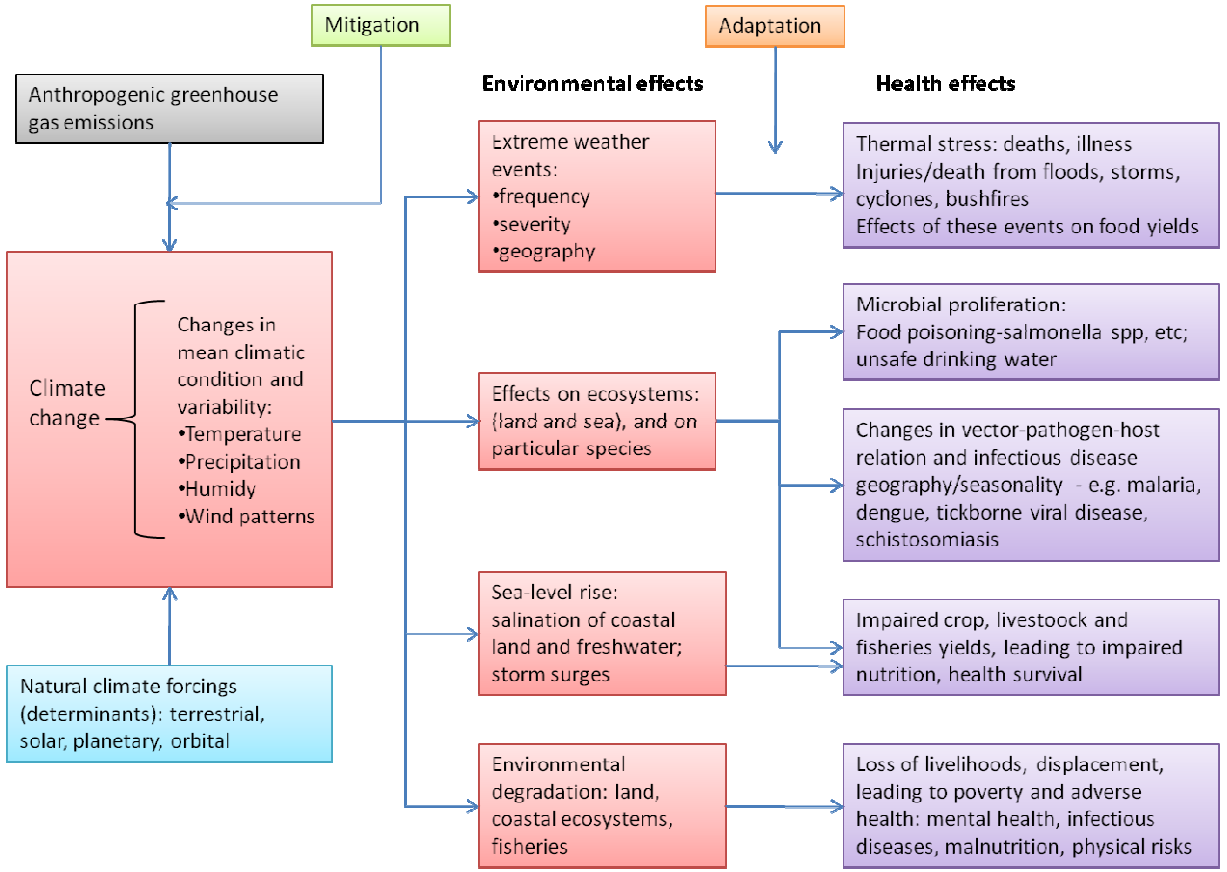
ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

HOW CLIMATE CHANGE AFFECT HEALTH

Environmental consequences of climate change, observed and expected, will affect human health both **directly (e.g. effects of thermal stress or direct injuries from floods) and indirectly through increased risk of climate-sensitive diseases (e.g. water-related or vector borne diseases)** mediated by changes in water-,air-, food quality and quantity, agriculture practices, ecosystems, and living environment . This direct and indirect exposures can cause death, disability, and suffering.

Diagram of pathways by witch climate change affects health

(Source: Anthony J McMichael, Rosalie E Woodruff, Simon Hales, 2006 [1] Adapted by ISPRA)



Differences in impacts of climate hazards are determined by many factors including the **severity of the hazard**, **the population exposed** and **the coping capacity of individuals and community**.

Risk management should focus **both** on **risk** (e.g. probability of occurrence) **and vulnerability** (environmental, socio-economic etc), otherwise the adopted measures may loose their efficiency on prevent adverse impacts.

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

[1] Anthony J McMichael, Rosalie E Woodruff, Simon Hales, 2006. Climate change and human health: present and future risks. Lancet 2006; 367: 859–69

POPULATION VULNERABILITY TO CLIMATE CHANGE

In general, **the vulnerability of a population to a health risk depends on** :

- *the local environment stability and quality,*
- *the effectiveness of multidisciplinary governance,*
- *the quality of the public health infrastructure and social services,*
- *the access to relevant local information on extreme weather threats*.

Some population groups need a special attention because of their special vulnerability : **children, pregnant women, elderly , disabled people, people temporarily or permanently living in community such as residential homes or with low socio economic status** are generally more susceptible to adverse health effects, **specially for heat and weather-related illness and death, vector borne and zoonotic disease, waterborne and food borne illnesses**.

Understanding a population's capacity to adapt to new climate conditions is essential to reinforce adaptation measures to reduce adverse social and health impacts.
Population health and welfare are not only a responsibility of the health sector but of all the sectors that can create through effective actions a healthier environment. It is required and necessary the **cooperation among public health action and other sectors** commitment.

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

Health Impact Assessment: concepts and available methodologies in climate change scenarios

Health Impact Assessment (HIA) has been defined as "a combination of procedures, methods and tools by which a policy, program or project may be judged as to its potential effects on the health of a population, and the distribution of those effects within the population"
Health impact assessment of climate change should be carried out by health experts and is useful as **policy tools** to identify :

✓ the **climate change problem** (concerns of vulnerable groups) and its context also in order to prioritize actions,

✓to describe **the current situation** (health burdens and risks) and whereas possible, predict future impacts,

✓to **identify key partners and governance issues** (e.g. available information) including research needs for the assessment.

Examples of models that already provide quantitative measures of future risks are:
•***Ecological studies***: used to **quantify the relationships between exposure and response for a range of climate-sensitive diseases**. Exposure is defined at population level rather than individual level.
•***Time–series methods:*** have been **developed to estimate the proportion of disease in a population that is attributable to weather**: the day-to-day or week-to-week variation in exposure to weather.

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

Health Impact Assessment:
concepts and available methodologies in climate change scenarios

Building scenarios is a method to estimate the potential impact of climate change on specific health outcomes.
Scenarios do not predict future, but they usually provide:

- **Plausible and simplified descriptions of how the future may develop** based on a coherent consistent set of assumptions about driving forces and key relationships;
- **Hypothetical sequences of events** constructed to focus attention on causal processes and decision points;
- **Descriptions of alternative images of the future**, created from mental maps or models.

E.g. ***Climate scenarios*** *:* are plausible representations of future climate that have been constructed for use in investigating the potential impact of climate change. Many national climate scenarios have been specifically constructed for national impact assessment.

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

Health Impact Assessment:
concepts and available methodologies in climate change scenarios

Health impact assessment and risk assessment methodologies need **several data and models** and need **expensive and time-consuming epidemiological studies**.

Since the inter-correlation between health and climate changes is already known, the **precautionary approach** could be used to eliminate or further reduce potential damages, using all the relevant information from other sector , crossing environmental (or other) data with those of the population.

However precautionary principle and the actuality of a changing environment requires a proactive attitude from all sectors. Indeed many of climate and environmental determinants of health fall outside areas of direct action and governance of the health sector.

To understand the efficiency of preventive measures already in place much of available information in several sectors could be used in order to mitigate the impact of climate changes on human health and to facilitate ad-hoc improvement of the coping capacity.

Efficiency of cross cutting and multi-sector prevention measures is depending also from awareness of health issues in other sector policies since earliest stages of any vulnerability assessments and strategy planning.

ISPRA
Istituto Superiore per la Protezione
e la Ricerca Ambientale

Developing information to assess health vulnerability to climate change

Direct effects of heat and heat-waves

- Heat waves are likely to become more common and severe.
- High temperatures cause heat stroke, heat exhaustion, heat syncope and heat cramps.
- Particular population group can be specially vulnerable such as those with heart problems, asthma, the elderly, the very young and the homeless.

Among most quoted epidemiological method for estimating the impact of temperature on mortality are time–series studies of daily mortality. Quantifying temperature-related mortality requires daily counts of deaths, ideally grouped by cause of death, and temperature measured at a similar temporal and geographical resolution.

- *Indicator of maximum and minimum temperatures (day and night temperature) and their time series are very important in monitoring the probability of heat related problem. Increasing temperatures directly raise body temperature, and increased humidity slows cooling of the body by decreasing sweat evaporation. Nighttime (minimum) temperatures are important to track for public health effects, because physiologic recovery from daytime heat is hampered if temperatures during the night do not decrease sufficiently.*
- *Apparent temperature, the heat index, which combines humidity and temperature, is important in looking at mortality effects.*

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

Developing information to assess health vulnerability to climate change

Influence of temperature on air quality

- Climate change may increase summer episodes of photochemical smog due to increased temperatures.
- Respiratory disorders may be exacerbated by warming-induced increases in ground-level ozone.
- Ground-level ozone can damage lung tissue, and is especially harmful for people affected by allergies, asthma and other chronic lung diseases.
- Concentration of pollutants interact with pollen enhancing risk of allergic crisis.

Many studies have been undertaken that quantify the relationship between air pollutants and health outcomes, mortality and morbidity, in a variety of populations. Among them two mayor health assessment were conducted in Italy based on collaborative project between APAT-ISPRA and WHO[1] .

- *The indicator suggested is O_3 daily average concentration. The daily maximum 8-hour average concentration for a given day is the highest of the 24 possible 8-hour averages computed for that day. EU target value set for the protection of human health is 120 microgram O3/m3 daily maximum 8-hourly average, not to be exceeded more than 25 times a calendar year*
- *Air mass stagnation events, which increase O3 production and will increase in frequency as weather conditions favorable to heat waves increase, is another important indicator. Air stagnation days can exacerbate the effects of existing air pollution.*

1 WHO – Europe. 2006 Health Impact of PM_{10} in 13 Italian Cities.
WHO- Europe. 2002 Health Impact Assessment of Air Pollution in the eight major Italian Cities

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

Developing information to assess health vulnerability to climate change

Artemisia vulgaris, Author : H.Zell

Thermal anomalies, pollens and allergy risk

- Pollen phenology is changing in response to observed climate change, especially in central Europe and at a wide range of elevations.
- Earlier onset and extension of the allergenic pollen season are likely to affect some allergenic disease.
- Climate changes particularly affect species that bloom in late winter and spring. Many specific studies have actually highlighted in the last few years a growing anticipation in the blooming period of many allergenic plant species and families.
- Changes in weather patterns (e.g. intense urban windy storm) may facilitate so called "pollen thunderstorm", a sudden release of large quantity of pollens and allergenic microgranules from physical cracking of pollens .

- *Monitoring anomalies in pollen season or in pollen loads (if available or through modelling) and distribution (above all in public location like schools and urban green) like the presence of specific allergenic species like ragweed, could be useful to support healthy urban green planning, land measures and appropriate seasonal medical treatment of allergies.*

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

Developing information to assess health vulnerability to climate change

Climate change and vector borne disease

- Vectors, such as mosquito, flies or ticks, are sensitive to external temperature and humidity.
- Climate change may alter the distribution of vector species (increasing or decreasing) depending on whether conditions are favourable or unfavourable for their breeding places (such as vegetation, host or water availability) and their reproductive cycle.
- Temperature can also influence the reproduction and maturation rate of the infective agent within the vector organism and the survival rate of the vector organism, influencing disease transmission.
- Some vectors may transmit many important infectious diseases. Transmission requires that the reservoir host, a competent vector and the pathogen be all present in an area at the same time and in adequate numbers to maintain transmission.
- Future changes in tick-host habitats and human-tick contacts may be important for disease transmission. An increased risk of localised outbreaks is possible due to climate change but only if suitable vectors are present in sufficient numbers.
- Western Countries, including Italy and other EU Countries , with presence of the mosquito vector *Aedes aegypti* and the emerging vector *A. albopictus* are considered at risk for viral diseases such as West Nile Fever, Dengue and Chikungunja.

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

Developing information to assess health vulnerability to climate change

Climate change and vector borne disease

Climate effects on vector-borne disease should be analysed as a whole, combining climate data with concurrent measurements of the vectorial capacity[1] and infection rate of vectors, abundance and infection rate of reservoir hosts (if any) and eventual health effects on humans.

Most studies centre on analysing patterns of presence versus absence, which are relatively more robust and less data-intensive. The correlation between climatic variables and the distribution of vectors may be analysed using either explicitly statistical techniques or semi-quantitative climate-matching methods such as the CLIMEX model (see http://www.climatemodel.com/climAppl.htm).

- *Surveillance data for human cases of vector borne infectious diseases and disease vectors and reservoirs, are recommended indicators. The assessment of the arthropod diffusion risk is a priority in preventing vector-transmitted diseases, both endemic and recently introduced. This is possible through:*

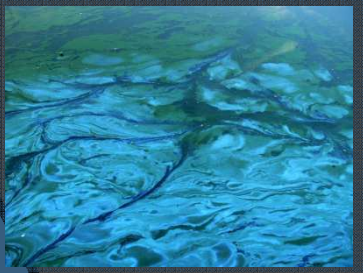
  - *geo-referenced and quantitative knowledge of the species and of the environmental reservoirs of infection identifying and locating vector arthropod populations, both autochthonous and allochthonous, involved in the transmission of: plasmodes (Anopheline mosquitoes), leishmanias (Phelbotomes), arboviruses (tiger mosquito and ticks), filarials (tiger mosquito), rickettsias and bacteria (ticks); and*
  - *constant monitoring of the dynamics of vector species populations and of possible reservoirs with respect to the progress of climate events*
  - *efficiency of eco-compatible biological methods that control the vector.*

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

1) measurement of the efficiency of vector borne disease transmission (N° of infected bite daily received by a single host)

Developing information to assess health vulnerability to climate change

Climate change and Harmful algae blooms (HABs)



Author: **Lamiot**

- Blue-green algae (photosynthetic microscopic bacteria) occur naturally in freshwater as well as marine environments. When conditions are optimal can quickly multiply into a bloom more often in warmer months.
- **Toxic blooms (HABs)** occur when algal species produce neurotoxins, usually when stressed or dying. Many studies suggested increased temperatures and salinity stratification resulting from climate change combined with human activities (nutrient runoff), are important factors related to the increase of HABs.
- **Exposure to the blue-green algae may occur by ingestion, dermal contact, and aspiration or inhalation and** can cause **eye and skin irritation, vomiting and stomach cramps, diarrhoea, fever, headache, pains in muscles and joints, and weakness.**
- Risks to people may occur in **recreational water**, or from the **use of drinking water that uses a surface water source in which a blue-green algae bloom is present.** When HABs occur in water supply systems a specific treatment is needed since rupturing of the algal cells can release their toxins, and treatment may not be entirely effective in removing toxins.
- Seawater warming can therefore contribute to increasing cases of sea food contamination such as for instance ciguatera, an intoxication caused by ciguatoxin (toxin produced in particular by the microalgae *Gambierdiscus toxicus*).
- **Information campaign for the population and early warning systems are key preventive measures. Health impact assessment will rely on recorded cases and outbreaks.**

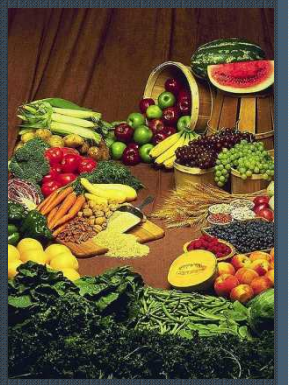
Potential exposure indicators include monitoring intensity, frequency, duration and distribution of HABs , ad hoc monitoring of water supply system and HABs recorded cases.

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

Developing information to assess health vulnerability to climate change

Climate change and increased risk of waterborne and foodborne diseases:

Food safety



- Climate change can potentially influence food safety and occurrence of food borne diseases. Epidemiological studies were conducted to describe and quantify the effect that environmental temperature has on foodborne diseases[1].

- Cases of food poisoning can be related to meteorological conditions of unexpected heat that can increase bacterial replication. Some cases can also be associated to extreme climate events since rain and inundations can favour the spread of pathogens.

- Increased risk of food contamination by infesting species (flies, rodents and cockroaches) is also temperature sensitive. It is probable that in temperate countries, the quantity of flies and other infesting species will increase during the summer months and there will be an early appearance in spring.

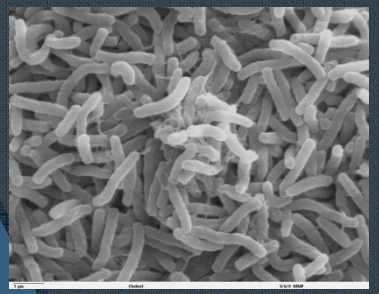
- Microscopic filamentous fungi can develop on a large variety of plants and can lead to the production of highly toxic chemical substances, commonly called mycotoxins. The colonization and diffusion of fungi are favoured by environmental conditions and nutritional components, as well as other factors such as attacks by infesting insects.

- Seafood can also be contaminated by enteric bacteria and viruses that can survive water treatment plants, especially if there is a contaminated overflow that can occur during floods.

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

[1](CASHh report - *Climate Change and Adaptation Strategies for Human Health in Europe*)

Developing information to assess health vulnerability to climate change



Climate change and increased risk of waterborne and foodborne diseases:

Food safety

- During flood lack of water for hygiene use in emergency will also facilitate orofaecal transmission diseases.
- The chemical security of waters and food during long periods of drought is also worth considering.
- A higher concentration of chemical pollutants in waters used for human consumption is assumed (since a water shortage is followed by a poor dilution effect).
- Vegetable infestation and temperature increases both lead to a higher use of pesticides (which have an increased degradation with higher temperatures) and a more frequent utilization of new chemicals compounds.
- Adaptation measure should regard also review of food and water monitoring and control for pathogens and chemicals under critical condition of extreme weather events.

The suggested indicators include monitoring of food samples to reveal possible contamination by fungi, mould and pathogens (e.g. salmonella, campylobacter, V. vulnificus e V. cholera, micotoxins), as well as tracking outbreaks of food borne diseases in the population to manage and prevent other possible contamination. .

It is suggested to monitor any increase in the use of pesticides or in the presence of samples of food contaminated by chemicals, as well as the presence of acute toxic disorders in farmers or workers.

(CASHh report - *Climate Change and Adaptation Strategies for Human Health in Europe*)

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

Developing information to assess health vulnerability to climate change

Climate change and increased risk of waterborne and foodborne diseases: Water borne diseases

- Climate change is likely to affect water quality and quantity in Europe, and hence the risk of contamination of public and private water supplies.
- Heavy rainfall could lead to failure in a wastewater-treatment plant and cause contamination of surface or coastal water if the sewers are used as storm drains.
- Heavy rainfall could lead to agricultural runoff contaminated with livestock faeces into surface water, which reaches the public water supply or direct contact with humans.
- Diseases such as cholera and salmonella, which are transmitted through contaminated food or water, could become more widespread because of increased flooding.
- Both extreme rainfall and droughts can increase the total microbial loads in freshwater and have implications for water quality and outbreaks of diseases.

Epidemiological assessment should be used to quantify risks. Time–series methods can quantify association between variation (daily, weekly or monthly) in diarrhoea outcomes and environmental temperature.

An appropriate environmental monitoring plan acting as early warning system may anticipate health risk.

- *Suggested indicators are the n° of contaminated water samples (chemical and biological), the N° of period with intermitted water supply and the incidence of outbreaks of water related diseases (water borne, foodborne, hygiene behavior).*

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

Developing information to assess health vulnerability to climate change

Author: Peterdownunder

Climate change and increased risk of waterborne and foodborne diseases: Water borne diseases

- Changes in the distribution of rainfall may increase drought risk.
- Drought could lead to a failure of the domestic water supply, resulting in a need for other methods of water delivery.
- Drought could substantially affect water resources and sanitation in situations where water supply is effectively reduced. This could lead to an increased concentration of pathogenic organisms in raw water supplies
- Health consequences include diseases resulting from lack of water. In particular, this increases the risk of orofaecal (primarily diarrheal) diseases and water-washed diseases (such as trachoma and scabies).
- Another concern is the use of unsafe new sources of water (such as untreated waste water) for human activities such as irrigation. These practices lead to an increased risk of infectious diseases by use of food contaminated by unsafe water.
- Access to sufficient water for the elderly, disabled and other vulnerable groups would be a concern. Localized water shortages may be particularly important .

The indicators suggested are : Length and severity of drought periods and the number of contaminated water and food samples by chemicals.

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

Developing information to assess health vulnerability to climate change

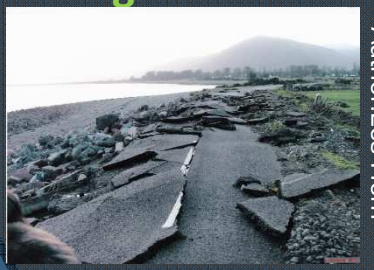

Author: Neil Kennedy

Disaster management in extreme weather events

- Climate change is likely to increase the risk of mortality and injuries from wind storm, flash floods and coastal flooding.
- The elderly, disabled, children, women, ethnic minorities and those on low income are more vulnerable and need special consideration.
- Coastal flooding related to sea-level rise could affect large populations causing flooding, land loss, salinisation of ground water and the destruction of residential houses and infrastructures including water supply and sanitation networks, desalinisation plans and health infrastructures.
- The non fatal effects of natural disasters include: physical injury; increases in respiratory and diarrhoeal diseases; increased risk of water-related diseases; exposure to dangerous chemicals or pathogens released from storage sites and waste disposal flood waters.
- Property loss and social disruption may increase the risk of depression and mental health problems.
- Substantial indirect health impact can also occur because of damage to the local infrastructure and services (such as damage to hospitals and roads) and population displacement.

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

Developing information to assess health vulnerability to climate change


Author:Les Horn

Disaster management in extreme weather events

➢The total health impact of a disaster is underestimate, because injuries and secondary effects are poorly reported and communicated.

➢Current vulnerability to weather disasters needs to be described in terms of total and age-specific mortality and morbidity.

Epidemiological studies of flood events can be undertaken in relation to the following outcomes to compare incidence in the pre- and post-flooding situations:

- injuries
- infectious diseases, especially skin, gastrointestinal and respiratory infections; and
- mental disorders: increases in common anxiety and depression disorders.

Routine surveillance may provide data on episodes of infectious disease both before and after a flood.

- *As indicators in this area of concern it's suggested to provide hazard maps weighted on population for all kind of event that have probability to happen (floods/sludge, landslides, storm surges, sea level rise, droughts). Hazard maps can also be obtained by simply overlapping spatial maps of areas at risk with maps of population living in the area of interest.*
- *Another indicator should be the number of events (flash floods/ sludge, landslide, intense rainfall, windstorm or storm surges) occurring in the area of interest .*
- *Other useful indicator suggested to monitor extreme impacts and preparedness are the number of people requiring medical assistance/ hospitalization(physical injuries and post traumatic stress disorders), N° of deaths and N° request of damage restore of socio -economic activities (crops, tourism, schools, hospitals, etc) and residential damages.*

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

URBAN VULNERABILITY TO CLIMATE CHANGE

Urban environment and urban population are more vulnerable to the two major determinants of climate change such as thermal anomalies and changes in weather patterns, because:

1)Urban areas concentrate people and buildings into a relatively small area, then even a relatively contained weather event (storm, intense rain, heat wave, air stagnation) or increased risk factors (increase number of vectors carrying diseases such as mosquitoes) can affect a large number of people

2)Urban people show a high dependence from stability and performance of water and energy distribution, common infrastructures and services such as transportation systems to move people and goods, communication systems, sewers and waste removal systems.

3)Urban economy may largely rely on touristic resort and economic activities very depending from stability of environmental systems and climate variables such as quality of bathing waters and coastal environment, local food safety and production, weather and seasonal patterns .

4)Urban and suburban areas host several crucial health and social services (such as hospitals, residential homes, schools and kindergarten) and a large variety of vulnerable groups (such as elderly, children, economically disadvantaged communities, disabled) . Increased risk of climate-sensitive diseases will result in a heavy social financial burden.

5)Urban built environment elements (e.g. asphalt, and other hard surfaces; combined sewers; high concentration of people; poor maintenance of green areas; etc) enhance *per se* vulnerability to climate and weather hazards of health relevance.

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

CLIMATE AND HEALTH: Adaptations measures in urban area

Urban vulnerabilities to extremes weather events

Cities peculiarity that appear to interact with changing climate to exacerbate risks and increase vulnerability:

- **ASPHALT, CONCRETE AND OTHER HARD SURFACES**:
  - ❖absorb sun radiation, favouring the urban heat island effect, which exacerbates heat waves and puts pressure on electricity generation and distribution systems;
  - ❖prevent absorption of rainfall, creating runoff that carries pollution to local water bodies;
  - ❖can cause overwhelming of stormwater systems during heavy precipitation events.
- **COMBINED SEWERS CARRYING BOTH STORMWATER AND SEWAGE**:
  - ❖wash of untreated pollutants into local water bodies as a consequence of overflows caused by protracted or intense precipitation.
- **CONCENTRATION OF PEOPLE IN URBAN CENTRES**:
  - ❖puts pressure on vegetation and green spaces, worsening heat island effects, stormwater runoff, pollution and social pressure;
  - ❖creates a large demand for water, straining local water supplies and making them more susceptible to water shortages in drought conditions.
- **CENTRALIZED POWER SOURCES, LONGER DISTRIBUTION LINES, INTERCONNECTED GRID**:
  - ❖increase vulnerability to blackouts when electricity demands are high and when storms occur.
- **URBAN SPRAWL AND COMPETITION FOR BUILDING SITES**:
  - ❖lead to construction in vulnerable areas such as floodplains or steep slopes.

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

CLIMATE AND HEALTH: Adaptations measures in urban area

URBAN PLANNING

✓ ***Public information on climate-related health threats and prevention***

Awareness of emerging health risk is a key tool for effective preventive measures.
Any efforts should be put in place to make individuals and vulnerable groups, stakeholders and policymakers aware about potential health effects , address specific risks associated with climate change (e.g. for the prevention of heat illness, of vector borne/food-borne disease, etc.).

Effective communication needs to be tailored to specific groups, including vulnerable populations (e.g. outdoor workers, people living in communities, social services professionals, people with chronic illness, etc.) and conducted together with public health experts.

Messages should empower people to access and use necessary health resources, leading to constructive behaviours.

Educational programme in school are highly recommended.

Information on health risks should be also part of background knowledge of environmental , climate professionals and utilities managers.

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

CLIMATE AND HEALTH: Adaptations measures in urban area

URBAN PLANNING

✓ ***Intervention to reduce heat island effects and heat related health impacts***

Cities can take various actions to address urban heat island issue.
Parks, street trees, and green roofs can help surface temperatures reduction in cities, creating at the same time more walkable, liveable communities.
Trees provide cooling shade, and can significantly reduce home energy costs. In addition, vegetation helps to improve local air quality.
An appropriate monitoring system it's welcome to support health impact assessment.

Another important way of reducing heat-related mortality is implementing a **weather-based heat-wave warning system**. In Italy, like many other European Countries, the Ministry of health is dedicating a lot of resources to the heat wave management providing information materials and supporting the national heat waves surveillance and alarm system for the 27 cities that joined the network (www.salute.gov.it) .
Integrated with proper response, emergency heat warning systems can reduce population vulnerabilities, increase resilience to future extreme events, and help identify vulnerable populations.

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

CLIMATE AND HEALTH: Adaptations measures in urban area

URBAN PLANNING

✓ ***Intervention to reduce air pollution impacts***

All efforts should be made to warrant effective air quality and ozone episodes management strengthening measures already in place for sustainability policies:

- maintaining strict regulation of air pollutants also by traffic restrictions;
- reducing exposures to combustion products (e.g. trough actions such as regulations/controls on diesel trucks, increased car fuel efficiency, etc.);
- increase community bike/ walkability together with green areas planning
- improve public transportation planning adequate number of personnel also in summer holidays period;
- Provide information to public on risky behavior such as sports/outdoor activities in hot weather.

It's important to improve and maintain effective warning systems both for air quality and ozone .

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

CLIMATE AND HEALTH: Adaptations measures in urban area

URBAN PLANNING

✓ ***Intervention to prevent impacts from increased risk of vector-borne diseases***

The primary adaptation measures for managing the spread of infectious disease are prevention programs that reduce vulnerability to infectious disease (e.g., avoiding/mitigate exposure to mosquitoes).
These include all means of preventive measures such as educational programme and public information , health surveillance and tracking systems to identify emergence of potential threats, and planning accurate sustainable vector control programme outside outbreak emergencies.

Elements of a strategy supporting public health officials include :

- Monitoring of vector density and factors influencing disease transmission and spread;
- Disseminate information and strengthen research on sustainable vector control;
- Strengthening local capacity for assessing the social, cultural, economic and environmental factors that lead to increased vector density and increased transmission of disease;

An appropriate environmental monitoring and biodiversity assessment could be helpful to anticipate outbreak occurrence.
It is also important match these actions with an effective public information on individual protective tools to be extended also to vulnerable communities like schools, residential homes etc.

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

CLIMATE AND HEALTH: Adaptations measures in urban area

URBAN PLANNING

✓ ***Intervention to reduce health impacts in disasters***

Disaster risk reduction preparedness should be part of adaptation strategies and should include:

- create preparedness plans for scenarios that are not currently planned for (e.g. major flooding by sea level rise and storm surges) also by using integrated risk map weighted on population, crucial infrastructure and economic activities;
- working cross-sector with health and emergency preparedness entities to identify and refine scenarios;
- develop and improve effective early warning systems, specially for regions that have not yet adopted it;
- improve effective protection and emergency response systems;
- improve effective coordination among alert systems and emergency personnel responding to public health emergencies.
- Improve land-use planning and zoning to avoid /protect the allocation of buildings, infrastructure and basic services (e.g. school, hospital etc.) in flood or landslide prone areas.

People not aware of risks can slow down the emergency operations.
Community ability to cope relies also on preventive information campaign, very important for communities such as schools, hospitals, residential homes.
High risk level areas should be kept free of intensive economic use or highly populated settlements.
Multidisciplinary communication strategy should be part of the risk disaster management and adaptation plans for extreme weather events in order to share knowledge among different actors.

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

CLIMATE AND HEALTH: Adaptations measures in urban area

WATER SUPPLY AND SANITATION SYSTEM (WSS)

The resilience of WSS is a challenging vulnerability under climate change scenarios for both technical and regulations aspects. Under extremes or adverse weather conditions water supply and sanitation systems are often hitted by extremes and might become an important source of pollution.

Water and land use management adaptation strategies should include consultation with utilities managers.

Although is well known that pollution discharge from WSS is a major health determinant for bathing and drinking water, generally water quality monitoring is not due in condition of extreme weather according to present European regulations. The recent EU Flood directive is somehow addressing the issue.

Regulations are also lacking for the safe use of new sources of water through several techniques including aquifer recharge with reclaimed water.

Due to the relevance of the issue Guidelines on Water Supply and Sanitation in extreme events are to be finalized by the Task Force on extreme Weather events within the framework o the Protocol Water and Health to the UNECE Water Convention leaded by Italy (Ministry of Environment/ISPRA) .

ISPRA
Istituto Superiore per la Protezione
e la Ricerca Ambientale

CLIMATE AND HEALTH: Adaptations measures in urban area

WATER SUPPLY AND SANITATION SYSTEM (WSS)

Recommended actions are:

- include WSS management into water and climate adaptation strategies
- provide effective water bodies monitoring during heat waves, intense rain and/or drought events;
- effective monitoring and inventories of condition and capacity of water distribution systems and treatment systems
- provide local regulations for safe use of new sources of water;
- reinforce ability of water supply with alternative techniques such as rain harvesting and/or reclaim and reuse of treated waste water

Other measures at urban and suburban level include:

- Sustainable urban drainage systems implementation.
- use of permeable surfaces (e.g. in parking lots or roads) to reduce storm water runoff, reducing the risks of flooding and pollution outflows, the risk of storm water systems overwhelming during heavy precipitation events, and increase recharging of ground aquifers;
- use of green roofs to increase on-site retention of storm water;
- increase the use of storm water retention ponds, constructed wetlands and swales providing surveillance for potential risk of increase of vector borne diseases.

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

CLIMATE AND HEALTH: Adaptations measures in urban area

INFRASTRUCTURES AND BASIC SERVICES

Strategies regarding improving adaptation to climate change for infrastructures and basic services (such as hospital, school, etc.) include:

- taking into account of the increased risks of flooding, heat waves, intense storms and storm surges, wind speed and other climate change/extreme events effects on building design and development;
- designing drainage systems and entrance thresholds at the best to cope with more intense rainfall, possibility of flooding, etc.;
- improve natural ventilation to reduce heat gain during summer/heat waves;
- using ground-floor spaces for flood compatible use, such as car parking, or raise ground floor above flood level in areas potentially vulnerable to floods;
- develop disaster management plan shared with local communities
- provide adequate green space management to mitigate allergic risk
- extend use of mosquito net in risky areas
- provide educational and information campaign for personnel and people living in community buildings.

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

CLIMATE AND HEALTH: Adaptations measures in urban area

ENERGY

Strategies referred to managing energy demand include:

- reduce vulnerability to blackouts from hydropower loss, storms and floods informing population on health threats in emergency (e.g. food contamination without refrigeration, electric shock etc) ;
- reduce urban heat and energy demand for air conditioning, specially during heat waves, increasing street trees and urban parks/green areas planning and maintenance
- decrease energy needs for cooling building by improving energy saving techniques, specially in crucial infrastructures such as schools, hospitals and residential homes providing safe indoor air quality standards

TRANSPORTATION

Adaptation to climate change of transportation sectors (public and private) and related infrastructures to mitigate injuries to people and settlements are generally shared with usual adaptation measures that here are briefly summarized :

- evaluation of the vulnerability of port facilities and associated infrastructures due to changes in water level, increased wave activity, storm surges, etc.;
- relocation of coastal road, rail lines and all the other infrastructures that could be subjected to sea-level rise, storm surges, etc.;
- retrofitting of vulnerable transportation infrastructure systems such as culverts, tunnels, bridges, subway entrances, dykes, etc.;
- ensuring that critical components, such as switch gear or substation, are above flood levels;
- ensuring the availability of alternative routes in case of disruption and/or need of evacuation.

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

Thanks for your attention!

ISPRA

Istituto Superiore per la Protezione
e la Ricerca Ambientale