Climate Change and Health

A Concept Paper by the GTZ Health Section and Taskforce Climate Change

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1. Introduction
Climate change has become a tangible reality. Developing countries and especially the poor within these countries will suffer most from the accelerating and deepening impacts. Following the report of the UN Intergovernmental Panel on Climate Change (IPCC), the global mean land and sea surface temperature has already increased by 0.6°C since the initiation of fossil fuel consumption, most notably during the last 30 years. It will increase by a further 1.4 to 5.8°C until the year 2100. Global warming has already led to severe impacts on human and natural systems. Those will further intensify as emissions continue to rise. Among the main consequences as identified by the IPCC (2007) are:

- Hundreds of million people will face additional water shortage. Between 75 and 250 million could face additional water stress as early as in 2020 in Africa alone.
- Health-related risks of millions of people are increasing due to heat-waves, flooding, storm, wildfires, droughts and the geographical expansion of infectious diseases such as malaria or dengue fever.
- 20-30% of all plant and animal species will be under threat of extinction at 1.5-2.5°C global mean temperature rise.
- Towards the end of the 21st century, projected sea-level rise will affect low-lying coastal areas and small island states. Millions of people will be affected by constant flooding.
- A decrease of 10-30% in precipitation is expected for the already arid regions of the temperate zone, while an increase of precipitation and risk of flooding are expected for other regions.

The Health Sector will be among the sectors most severely affected by these predicted impact. Examples of direct links between climate change impacts and health are an increase and geographical shift of disease outbreaks, intrusion of vectors and germs into water supply through flooding, and the intensification of heat waves in cities. Indirectly, decreasing agricultural production leading to increased risk of food security and malnutrition as well as an increase of extreme weather events triggered by climate change severely threaten peoples’ health and resistance to diseases.

Therefore, adaptation to climate change within this sector is becoming increasingly important. Poor population groups are the most vulnerable and will be the most affected. Thus, adaptation to climate change is of utmost importance in the context of poverty alleviation. In consequence, climate change gains highest interest within the field of international development cooperation. First attempts and pilot measures are already under way, and international alertness to this topic is constantly growing. At the same time, the health sector offers some possibilities to mitigate climate change by reducing the greenhouse gases produced in this sector, e.g. by applying energy efficiency and using renewable energy in hospitals. This is an important issue in the international debate. However, it is more relevant to industrialised countries, because they are the main producers of greenhouse gases and will therefore not be discussed in detail in this paper. Nevertheless, one health-related intervention of relevance for mitigating climate change is frequently overlooked: the shaping of demographics. As population growth is one of the principal independent variables determining climate change, and as a series of biomedical and educational measures proved to contain population growth, the relation of demographics and climate change should be further analysed in order to consider possible related interventions.
The impacts of climate change on and vulnerability in the health sector are the central topic of this paper. Probable changes in climate and resulting threats for human health will be discussed. Adaptive measures will be proposed, and resulting interventions areas for German Technical Cooperation will be explored. Furthermore, the role of the world population size as a key independent variable will be discussed. The annex to this paper gives an overview of existing initiatives on climate change and health and relevant institutions involved in this topic.
2. Impacts of Climate Change and Vulnerability in the Health Sector

2.1. Impact of Climate Change on Health

The following section will outline the main impacts of climate change on the health sector. Climate change will affect some of the most fundamental pre-requisites for good health: Clean air and water, sufficient food and water, freedom from diseases and adequate shelter (WHO 2008b).

**Extreme air temperature and air pollution are hazardous to health**

Heat causes disease directly by overheating the body, eventually enhanced by insufficient influx of water. It can lead to cardio-vascular distress and finally to cardiac failure. It has been estimated that more than 70,000 excess deaths were recorded in the extreme heat of summer 2003 in Europe (Robine et al 2008). It is very likely that such extreme temperatures will become the norm by the second half of this century. In addition, rising temperatures will increase levels of air pollutants such as ground-level ozone, most particularly in bigger towns and megacities which are already polluted. Water born diseases and air born diseases will become more widespread due to the increased survival of vectors and germs in a warmer environment. The prototype of such an infection is malaria.

**Flood, droughts and contaminated water raise risk of disease**

Increased climate variability and shifting rainfall patterns, increased rates of evapotranspiration and melting glaciers, combined with population and economic growth, are expected to increase the number of people living in water stressed areas from about 1.5 billion in 1990 to 3-6 billion by 2050 (Arnell 2004). Salt water intrusion caused by sea level rise will further reinforce this disastrous trend. Too much water, in the form of flooding, causes contamination of fresh water supplies. The water might carry vectors (notably mosquito larvae and snails transmitting schistosomiasis), germs (e.g. vibrio cholerae, shigellae, and salmonellae) and toxic substances. The threat will be enhanced by the fact that the water will be warmer which allows a larger variety of vectors and germs to survive. This phenomenon may result in diarrheal and other diseases (e.g. schistosomiasis).

**Climate impacts on agriculture can cause increasing malnutrition and water scarcity**

Increasing temperatures and climate variability as well as extreme climatic events (e.g. torrential rainfall and droughts) and sea level rise are expected to reduce crop yields or even lead to partially or total crop loss in many regions. This effect is likely to be more harmful in tropical and subtropical climate zones already struggling with the scarcity of water and food. By 2020, in some African countries, yields from rain-fed agriculture could be reduced by up to 50% (IPCC 2007). This is likely to worsen malnutrition in developing countries, which currently causes 3.5 million deaths each year (Black 2008). To a certain degree, soil will become more polluted and will transmit more diseases (e.g. helminths).

**Climate Change brings new challenges to the control of infectious diseases**

Rising temperatures will allow a wide range of vectors and germs to invade higher altitude and up to now ‘moderate’ climate zones. In particular, malaria and dengue fever will be able to affect populations in highland areas in the tropics, and in up to now ‘moderate’ climatic zones further in the North and South of the planet. Some specific germs as meningococci causing meningitis may actually benefit from drought as they are more easily transmitted in hot and dry air. It is assumed that none of the vectors and germs finding a livelihood in new geographical settings will be entirely new to humanity. Notwithstanding, they will encounter populations which are neither mentally nor immunologically adapted to this threat. These populations will have to be supported by health staff without any previous experience related
to the invading diseases. From such a perspective, they are ‘functionally new diseases’, and have the potential to cause considerable damage.

**Vector epidemiology and human health**

Vector related diseases account for nearly 17% of the worldwide burden of disease (Townson et al. 2005). Climate-sensitive diseases are among the largest global killers. In Africa, diarrhoea, malaria and protein-energy malnutrition alone caused more than 3.3 million deaths in 2002, which accounts for 29% of the total death toll (World Health Organization).

In a recent study, a 16-18% increase of person-months of exposure to malaria attributable to global warming and climate change was estimated for Africa (Hammerich et al. 2002). The calculation assumed that there was no population growth.

**A more extreme and variable climate can destroy homes, communities and lives**

The expected increase in frequency and intensity of flooding and storms will provoke physical trauma and exhaustion. It results in the destruction of homes, medical facilities and other important services. Gradually rising sea level, combined with stronger storms surges, are likely to lead to more frequent and intense coastal flooding. In addition, sea level rise can lead to mass displacements of populations with all resulting health threats (including mental disease) and conflict potential. In the long term, the pressure building up on natural, economic and social systems that are already under stress poses a great risk. In the end, the discrepancy between the populations’ needs and available resources (aggravated by climate change) might not only provoke internal unrest among vulnerable and exposed groups, it might even lead to international conflicts with all their devastating consequences. Peoples’ health will be one of the aspects severely threatened if these scenarios will become reality.

**Extreme weather events and human health**

37% of the natural disasters in the year 2007 occurred in Asia and accounted for 90% of all victims. Floods were the most frequent natural disasters between 1992-2001 (43 %) killing almost 100,000 people and affecting over 1.2 billion people (ICRC 2006). An annual growth rate of 8.4% was observed for hydrological disasters, mainly floods, in the period 2000 to 2007 (Scheuern et al. 2007). Europe witnessed in the same time span 65 disasters. This accounted for 27% of the world’s economic damages from natural disasters, but concerned only 1% of the world’s total disaster victims. Floods in the United Kingdom affected more than 370,000 people (ibid).

The 1997 river floods in central Europe left over 200,000 homeless, and over 100 casualties were reported (Haines et al. 2006). Over 50% of food crises have their source in natural disasters. Climate change is projected to increase the percentage of the population of Mali at risk of hunger from 34% to between 64% and 72% by the 2050s (Cohen et al. 2008). Heat waves in Orissa and Andra Pradesh (India) in 1998 and 2003 caused an estimated 2,000 and 3,000 deaths, respectively. The 2003 heat wave in Europe caused excess mortality of over 35,000 people over 2 weeks in August, an estimated 15,000 deaths in France alone (Fouillet et al. 2006).
2.2. Who is at risk? Population, Health and Vulnerability

Climate change affects all regions of the world, but the resulting health risk to human populations vary greatly, depending on where and how people live. The poorest populations are most vulnerable to climate-sensitive diseases. Climate-related health risks are often greater for poor individuals within any population. Climate change and associated development patterns threaten to widen existing health inequalities between and within populations. Women, children and elderly people in developing countries are particularly vulnerable to death and illness following extreme weather events. Small Island Developing States (SIDS) and other low lying coastal regions are particularly vulnerable to tropical storms and salinization of water and agricultural land from sea level rise. Mountain populations are at increased risk of water scarcity, glacier lake outbreak, floods and land slides and infectious disease (WHO 2008b).

Urbanization and human health

The percentage of the world population living in urban settings will increase from 50% today to 70% in 2050.

Today, 70% of the urban developing country populations live in slum like conditions (McMichael et al 2006).

In some cities urban heat island effects have been observed as measuring up to 5-11°C warmer than surrounding non urban areas (Confalonieri & McMichael 2007; Patz et al 2005).

Over 20 million people were affected by the 2005 floods in Mumbai. About 15,000 cases of fever, diarrhoea, skin diseases or injuries were treated over 26 days, and 310 deaths with leptospirosis were recorded (Kshirsagar et al 2006).

The State Department in Brazil reports over 40,000 affected and 54 deaths in the recent 2007 Dengue outbreak in Rio de Janeiro (International Federation of Red Cross and Red Crescent Societies 2008).

Climate impacts are fostered by growth, accumulation and migration of populations. Continuous population growth will expose more and more people to the effects of climate change. The growth takes place in settings already seriously threatened: in low income countries, and more particularly, in those countries’ megacities. Megacities create their own local climate and environment. Urban heat islands become much hotter than the surrounding areas. Air pollution reaches outstanding levels and is exacerbated by urban low ozone layers. In addition, the – often to be observed – absence of functional water and sanitations systems affects people more seriously than in a rural environment. Finally, megacities tend to grow next to rivers and/or the seaside. Hence, they are continuously at risk of flooding. In many cases, the lack of access to health care and the lacking quality of care will additionally contribute to this challenge. In crisis and in emergency cases, services are even more likely to become overstretched and unable to cope.

The population growth in megacities is not only caused by a positive balance between birth and mortality, it is reinforced by internal migration from rural to urban areas. The evolving living conditions characterised by a high population density, increasing environmental stress and occasional climate-related disasters might cause mental disturbances and civil unrest. It causes external migration from South to North. Such migration again facilitates the spread of vectors and germs (as HIV or mycobacterium tuberculosis), and it creates new vulnerable population groups exposed to poor shelter, precarious hygiene conditions and social disconnection.
Demography as key determinant

The demographic element of anticipated population growth is one of the key independent variables when describing scenarios related to climate change. By 2050, the global population is estimated to grow from a current 6.2 billion to 8 billion people (DSW 2005). If current trends continued, this would lead through both rising energy consumption and through deforestation to an increase of greenhouse gas production by 70% (Shi 2001).

At the same time, this will increase the already existing stress on natural and human resources and eventually further accelerate climate change. Thus, the shaping of demographics may be seen as an endeavour for mitigation climate change and its impacts. However, in order to consider related interventions further research will be needed.
3. Adaptation to Climate Change in the Health Sector

The following reflections will distinguish three types of interventions: Some interventions are likely to improve morbidity and mortality considerably, but they do not depend on health-related advice. Such interventions are linked for instance to the fields of infrastructure investments, socio-economic or development planning or natural resources management (e.g. the construction of dykes, the development of adaptation strategies or the integration of climate risk aspect into planning processes). These interventions will not be discussed further. Others will benefit from health-related advice, or they might even require a leading role of health experts. Both these latter types will be presented.

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<tr>
<th>Potentially leading role of health-related advice</th>
<th>Potentially supporting role of health related advice</th>
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<tr>
<td>Improve surveillance of disease</td>
<td>Combined alert systems</td>
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<td>Preventative control of intruding vectors and germs</td>
<td>Disaster risk management</td>
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<td>Staff training</td>
<td>Design of ‘healthy cities’</td>
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<td>Behaviour change amongst communities and vulnerable groups</td>
<td>Improve Water and sanitation systems</td>
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<td>Social and health security systems</td>
<td>Combat of malnutrition</td>
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<td>Integration of health into other sectors</td>
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Table 1: Health-related activities to adapt to climate change

Addressing climate change and vulnerability in the health sector requires strengthening of planning systems and placing more emphasis on preventative approaches to health rather than curative measures. Furthermore, it requires a multi-sectoral approach, for example to ensure an effective early warning system and food security policy as well as adequate sanitation and water supply.

The health sector can take a leading role in the following activities: As a first step, surveillance of disease should be improved in order to identify outbreaks and take preventative action. Adapted preventive disease control programmes will have to deal comprehensively with diseases emerging in a new geographical context. Staff will have to be systematically trained for the new challenges. Communities and vulnerable groups have to receive the necessary information and education in order to adapt their behaviour in the case of heat waves and other threats. Furthermore, the development of social and health security systems can improve the social protection in case of illness. These adaptive measures should be spearheaded by the health sector.

In addition, the health sector can take a supporting role for some interventions by providing health-related advice: Combined alert systems should be considered in order to inform simultaneously the population and all involved services on heat waves, peaks of air pollution or disease outbreaks. Effective disaster risk management measures can help to reduce casualties in case of extreme weather events. Urban planners will have to reflect upon greener and cooler cities, and about the adaptation of water supply and sanitation systems. The improvement of water and sanitation networks leads to the prevention of disease outbreaks associated with flooding or drought. Finally, food security interventions will have to consider their role in avoiding disease and the support potential offered by health services. In all these cases, the interaction of the various disciplines involved with the health sector promises synergy.
World Health Organisation: The Roll-Back Malaria Initiative
This initiative has been developing a Malaria Early Warning System (MEWS) in order to identify populations at risk of malaria epidemics and help co-ordinate preventive and responsive interventions. The framework for MEWS makes use of climatic data, local environmental factors, population movements, vulnerability assessments, surveillance of malaria morbidity and other health indicators.

It suggests the use of a simple three flag warning system with responses based on each level of risk, using indicators and threshold diagnostics. There is an opportunity for this system to work closely with Famine Early Warning Systems (FEWS), and to be extended to cover other climate-related diseases including river valley fever (a virus affecting livestock), and meningitis (DFID 2004)
4. Consequences for German Technical Cooperation

Climate change poses a severe threat to humanity. It is thus of utmost importance for the entire field of international development cooperation. In logical consequence, interventions to mitigate and adapt to climate change are increasing. Despite the specific vulnerability of the health sector to climate change, the interaction between both intervention areas is still limited (albeit in rapid progress). This observation is the more lamentable as health expertise offers promising approaches especially to adapt to climate change and to a lesser extend to mitigate climate change. This holds for the global development framework as for the context of German Technical Cooperation (GTZ). However, this paper composed by the two concerned sections “Environment and Climate” and “Health” can be regarded as a first step towards combined interventions. In addition, GTZ has gathered first experiences by advising the government of Tunisia to develop a national adaptation strategy for the health sector.

Adaptation in the Health Sector in Tunisia

Tunisia identified three sectors most vulnerable to climate change impacts: Agriculture, Tourism and Health. In 2007 it has started to develop an adaptation strategy for the health sector supported by GTZ and a consulting consortium. Currently, the strategy contains four strategic axes:

1. Survey/control and prevention of diseases, related to variability of climate (health information system, vector diseases, functionally new diseases, risk management, etc.).
2. Strengthening of inter-sector cooperation (quality of water, information sharing, identification of roles, institutional setup, legal aspects, networking, etc.).
3. Research and development in the area of climate variability and health (international cooperation, implementation oriented research, etc.).
4. Awareness raising / education towards a preventive behaviour (role of NGOs and administration at all intervention levels, etc.)

Further, the strategy contains two cross-cutting axes:
1. Accompanying measures at legal and institutional level.
2. Strengthening of health structures at regional and local level.

All sector adaptation strategies are being developed in a participatory coordination process aiming at involving all stakeholders of the concerned sector as well as other relevant sectors to gain high acceptance and identification and ownership with the strategy.

In addition to the sector strategies, a multi-sectoral early warning system is currently being developed. The health sector will be part of this system.

The following reflection will be guided by options evolving from the four business areas covered by GTZ:

Programmes and projects executed on behalf of the German Ministry for Development and Economic Cooperation should scrutinise in which context the inclusion of a health component into a climate change intervention (and vice versa) seems appropriate in a given setting. In the best of all cases, this consideration should take place in the planning phase. A good starting point for this could be the Climate Proofing tool currently being developed by...
the climate taskforce of GTZ. A likely core element might be the development of sector-related national mitigation and adaptation strategies. In doing so, GTZ can build upon experience in supporting the formulation of adaptation strategies in other sectors, e.g. water and tourism. The continuous dialogue between all GTZ sections involved (including those at headquarters) should be fostered, and approaches should be harmonised. The elaboration of bi- or multisectoral ‘health and climate projects’ might be considered. The available body of evidence should be analysed and strengthened. GTZ should sharpen its national and international profile in this domain.

Other German Ministries involved in this cross-sectoral topic are obviously the Ministry of Health and Social Protection and the Ministry of Environment, Protection of Nature and Nuclear Safety. Apart from implementing practical adaptation measures in the health sector, both Ministries might have a particular interest in research. The interaction of climate change and health can still be considered as a terra incognita. A deeper understanding of actual and future consequences has a large potential to shape policies. GTZ thereby can take the role of facilitating and tailoring research according to decision makers information needs. Such research might best be conducted in international networks as stimulated by the EU Framework Programme for Research and Development.

Producers of contraceptive drugs and devices, producers of anti-infectious drugs and construction companies involved in city design are three examples of candidates for Public-Private Partnerships in the given context. Further analysis and consecutive concept development might help to stimulate respective interest.

The degree to which GTZ International Services will be asked to assist in interventions related to climate change and health remains – for the moment being – unclear. It can be anticipated, though, that a deeper understanding of the upcoming challenges and their potential to erode the well-being of large populations and entire countries will lead to an ever increasing demand from international institutions and national governments.
Annex 1: Linkages to other initiatives and programmers

a. Interventions

**Water, sanitation and hygiene**

The promotion of sanitary facilities should go hand in hand with instructions related to their utilization and basic hygiene. Sanitary facilities should be separated for female and male users.

- **Building of separate latrine for boys and girls in schools.** UNICEF [http://www.unicef.org/wes/index_3951.html](http://www.unicef.org/wes/index_3951.html)

**Adapting agriculture practices**

- **Climate management information** for rural Australia: The Australian government develops a ‘decision-support information services to help clients better manage climatic risks and opportunities particularly those associated with the El Niño - Southern Oscillation (ENSO) phenomenon’. [http://www.longpaddock.qld.gov.au/](http://www.longpaddock.qld.gov.au/)

**Health Adaptation to Climate Change**

- A joint WHO/UNDP project, funded by the Global Environment Facility [http://www.who.int/globalchange/climate/gefproject/en/index.html](http://www.who.int/globalchange/climate/gefproject/en/index.html) - working in seven countries with different health-related vulnerability to climate change: Bhutan and Kenya (highland areas), Jordan and Uzbekistan (water-stressed areas), Barbados and Fiji (low-lying developing areas), and China, the project includes **reducing the burden of climate sensitive diseases** and identifying incentives to change behaviors to **reduce long term vulnerability** to health impacts.
- WHO Regional Frameworks for health sector action in Member States to protect health from climate change: The framework aims to implement the recommendations of the 61st World Health Assembly resolution at the national level through development of a set of measures that are feasible, prioritized, and that build on existing programmes that already provide substantial protection from climate-related risks. For instance, a regional framework has been developed in the South East Asia Pacific Region: [http://www.searo.who.int/en/Section260/Section2468_14335.htm](http://www.searo.who.int/en/Section260/Section2468_14335.htm)
b. Research partners

- **Leibniz Centre for Agricultural Landscape Research** / **Leibniz-Zentrum für Agrarlandschaftsforschung** (ZALF), Müncheberg
  [http://www.zalf.de/home_zalf/gb_index.html](http://www.zalf.de/home_zalf/gb_index.html) offers a Common Research Programme ‘Sustainable Landscape Development North Central Europe – 2020’ that focuses on rural areas linking global climate change to sustainable landscape development.

- **Center for Development Research** / **Zentrum für Entwicklungsforschung** (ZEF) [http://www.zef.de/](http://www.zef.de/) - research projects include biodiversity monitoring, sustainability and restructuring of water and land use under changing climatic conditions. [http://www.zef.de/researchprojects.0.html](http://www.zef.de/researchprojects.0.html)

- **Working group for Natural Hazard and Natural Risk** / **Arbeitskreis Naturgefahren und Naturrisiken** der Deutschen Gesellschaft für Geographie (DGfG)) [http://www.giub.uni-bonn.de/AKGefahrRisiko/englisch/welcome.html](http://www.giub.uni-bonn.de/AKGefahrRisiko/englisch/welcome.html) works on analyzing temporal and spatial variability of natural hazard in order to reduce the impact, notably of floods and landslides.

- **The International Research Institute for Climate and Society**, Columbia University Earth Institute, USA [http://portal.iri.columbia.edu/portal/server.pt](http://portal.iri.columbia.edu/portal/server.pt) covers projects related to health, agriculture, water, livelihoods, and also works in collaboration with **Center for International Earth Science Information Network** (CIESIN), USA, that operates the Socioeconomic Data and Applications Center (SEDAC) providing a variety of gridded data (e.g. urban/rural distribution, water scarcity) and working in part on health-oriented projects, such as ‘Child mortality linked to disease environment in West Africa’ or ‘Energy-related air pollution’ [http://www.ciesin.org/res_apps.html#/Anchor-Environment-8574](http://www.ciesin.org/res_apps.html#/Anchor-Environment-8574)


- **The Centre on Global Change and Health**, London School of Hygiene and Tropical Medicine, UK, [http://www.lshtm.ac.uk/cgch/](http://www.lshtm.ac.uk/cgch/) pursues a variety of projects on climate change, communicable diseases, livelihoods and communities.

- **Center for Health and the Global Environment**, Harvard Medical School, USA [http://chge.med.harvard.edu/](http://chge.med.harvard.edu/) considers projects on biodiversity, marine ecosystems, sustainable agriculture, and climate change.

- **Center for Sustainability and the Global Environment** (SAGE), University of Wisconsin – Madison, [http://www.sage.wisc.edu/](http://www.sage.wisc.edu/) conducts research projects on agricultural systems, air quality, energy, environmental health, global ecosystems, land use and water resources in relation to health.

In the private sector

Annexe 2: References


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