



Global Health

Climate Change and Public Health

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The world is changing – unsettlingly quickly, and largely as a result of human activity. The effects of climate change can already be felt today, and natural disasters are common events. Climate change greatly affects our health. Accordingly, it is important not only to reduce greenhouse gases, but also to prepare for the weather- and climate change-related consequences, and adapt to them. A climate-resilient health policy will be necessary.

“Number of Heat-Related Deaths Rises” – “Asian Tiger Mosquito Advances North”

The discussion about climate change is no longer simply limited to avoiding climate-damaging greenhouse gases and the sustainable transformation of our societies in a post-fossil fuel age. As the headlines in German newspapers in the summer of 2018, which broke heat records, indicate, German society too must prepare for weather- and climate change-related consequences, which previously belonged to the unpleasant effects of long-distance travels or catastrophe reporting from developing countries.

From a global perspective, the discussion about the massive changes in ecosystems caused by climate change is not new. It is undisputed that the present economic development model used since industrialisation greatly pollutes the air, the seas, and the environment. Scarcely anyone questions the notion that this production and consumption model is not sustainable and, in the long term, will lead to huge losses in biodiversity and rapid warming of the earth’s atmosphere. The complexity of the interrelationships amongst and for the Earth’s ecosystems make the consequences of climate change difficult to assess. Nevertheless, even today, immense effects are noticeable. The increase in natural disasters, heat waves, and irregular precipitation in a great many parts of the world can already be indisputably attributed to the consequences of climate change. While the measures agreed upon to reduce greenhouse gases (mitigation) still remain insufficient, societies all over

the world must also adapt to the huge challenges of dealing with climate change (adaptation). This also includes strengthening the resilience of public infrastructures.

The following overview is therefore intended to raise awareness, especially in Germany, of the fact that critical infrastructures, among them our healthcare system, require preparation for the strains – already discernible today – that the consequences of climate change will bring. A forward-looking and rationally assessing public discussion is urgently needed in Germany too – especially because the country is among the regions of the world which, according to all known scenarios, will (still) remain the least affected by the direct consequences of climate change in the coming decades. However, Germany will be unable to avoid the indirect consequences, nor will it be able to avoid its global responsibilities.

The following analysis is focussed on the international concept of “public health”, because this concept is wider than the German term “*öffentliches Gesundheitswesen*”, and because it better represents the health care system’s links to society as a whole. Furthermore, medium- and long-term climate changes are the focus of this analysis; short-term weather phenomena shall not be considered. And there is one further preliminary observation to be made: adaptations to climate change, particularly changes between warm and cold periods, have significantly advanced the biological and cultural evolution of *Homo sapiens*. However, since the



industrial revolution, these largely natural processes of change have been increasingly shaped and accelerated by man-made emissions of fossil greenhouse gases (Anthropocene age). The steadily rising concentration of such gases reinforces the natural greenhouse effect of the Earth's lower and middle atmosphere. Even a minimal rise in average global temperatures can have significant – although regionally disparate – effects on conditions of temperature and humidity. And this sets off an entire cascade of changes to ecosystems and societal systems. The consequences for one of the cascade levels – the health care system – is the subject of this article.

Especially those regions that already experience regular weather-related and geological disasters today can do little to counter them.

The relationships between global and regional climate change, changes in ecosystems, and their direct and indirect effects on public health are by no means clear. Whether a change in climate results in an increased incidence of a particular disease, for example, is usually a very complex question. As with many climate-related phenomena (such as migration), cause and effect¹ cannot be simply determined, neither theoretically nor empirically (the so-called attribution problem). This also makes it difficult to produce reliable forecasts concerning the respective effects, or to mobilise politicians and society in favour of preventative measures. Below, global findings shall first be related, and in the final portion, we shall focus on the situation in Germany.

Impacts of Climate Change on Human Health

The effects of short-term weather-related changes on individual human health are comparatively

well researched. However, there are significant knowledge gaps regarding the mid- and long-term effects on the physical, psychological, and social health of humans – a phenomenon that is familiar in the area of climate research under the term “slow onset” and applies to other negative effects of climate change. A distinction must also be made between *direct* and *indirect* effects of climate on health:

- *Direct effects* on the human body, but also on social associations, are triggered by extreme temperatures such as heat waves and cold fronts, and by extreme weather conditions, such as hail, storms, severe precipitation, floods, and landslides.
- *Indirect health effects* arise in the mid- to long-term as a result of adverse changes to environmental conditions which in turn occur as a consequence of climate change. These range from an increased proportion of biological allergens and pathogens, to a greater incidence of vector- or water-borne diseases, to a systematic degradation of potable water, air quality, and sources of nutrition.

Outlined below are *five effects* that present the main causes of a globally increasing strain on public (and private) health systems. The local intensity of these effects depends largely on local climate conditions and socio-economic circumstances. For instance, the regions that already experience regular weather-related and geological disasters today generally have only a weak infrastructure (e.g. without direct access to hospitals and with insufficient transport routes), meaning the health problems in these areas will be exacerbated further. Coastal regions are also particularly at risk from storms and rising sea levels, as are urban areas, due to their population density. This shows how important it is to take account of the interfaces between health care provision and other areas of general interest (water, energy, food) when designing the relevant policies. These services, in turn, are embedded in overarching global developments, such as globalisation, demographic shifts, migration, and social mobility.

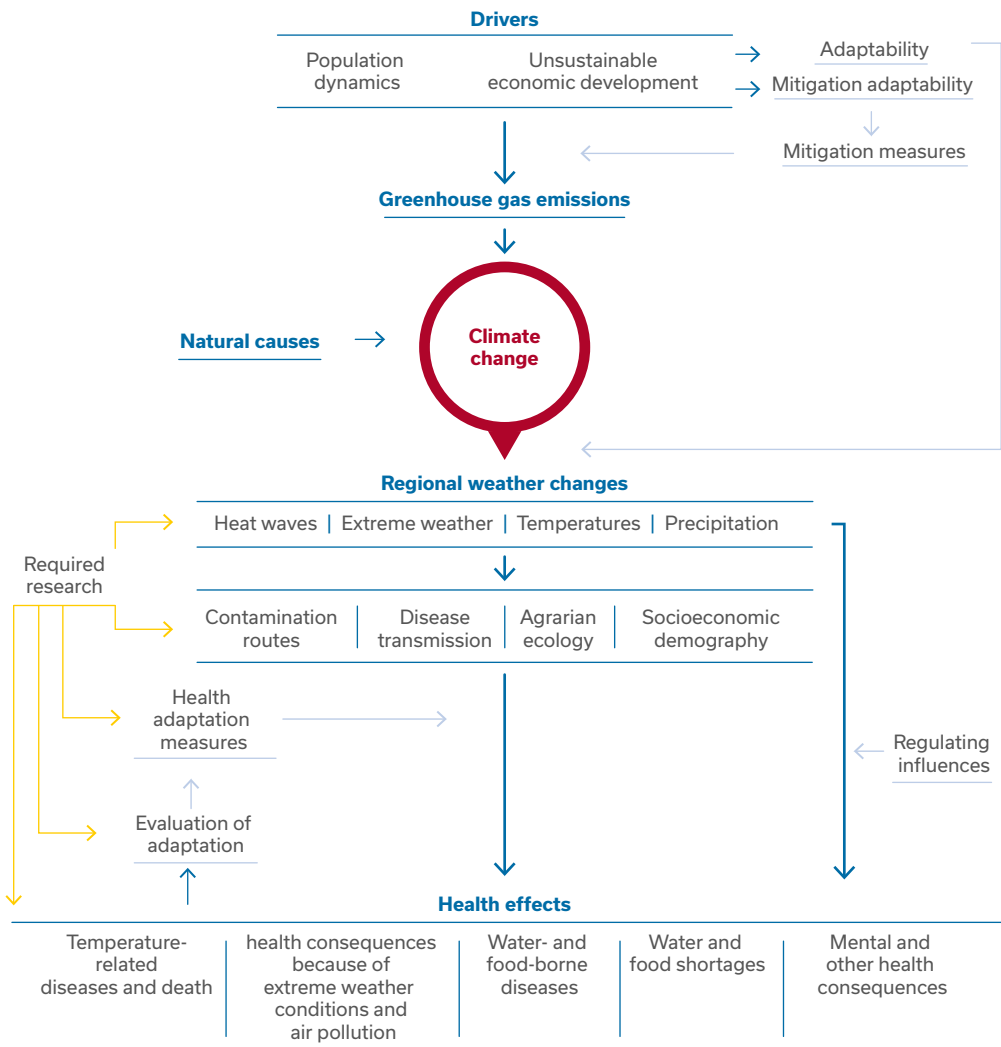
Figure 1 attempts to depict the complex interrelationships between the drivers of climate change, the consequences of that change, and the ensuing health effects on humans. There is, however, a need for further research, especially in the areas of regional weather changes, health adaptation measures, and the manifold effects on human health. Local/regional weather changes and their effects on health are the point at which adaptation measures make the most sense, and are the most effective. Mitigation focusses on slowing, reducing, or even reversing

climate change, which can only be achieved by drastically reducing greenhouse gas emissions.

Rising Average Temperatures

The human organism must constantly deal with climatic fluctuations in its environment. The body reacts to these external stimuli with adaptive reactions, such as sweating or shivering. Extreme changes put the body under stress. There is a close relationship between climatic conditions and human health and well-being.

Fig. 1: Interdependencies



Source: Own illustration based on WHO/UNEP 2018.

Studies show that death rates rise if there is a significant deviation – whether an increase or a decrease – from the optimal temperature for a population. The deaths are primarily due to heart and circulatory problems, especially in people with pre-existing conditions. This effect has already been observed in Europe over the last few years. However, the effects on the MENA (Middle East and North Africa) region for example are likely to be much more severe, since temperatures in summer are expected to rise to over 50 degrees Celsius.

However, higher temperatures also lead to longer and more intense flowering periods for plants, as well as extended flight periods for biological allergens, such as pollen, which will contribute to an increased incidence of allergies.

Especially worrisome is an increasing transmission rate of diseases borne by vectors, water, or food that occur especially frequently during sustained periods of warmer temperatures. This poses a great threat to those in developing countries, especially children. Diseases that have so far been limited primarily to tropical or sub-tropical regions (such as malaria and dengue fever) will change their geographical range and seasonality. The intensification and extension of warm periods will allow these diseases to appear in areas where they have previously been rare. Such diseases, which are borne by vectors (mosquitoes, ticks, etc.), present an increasing (or recurring) threat to Mediterranean and even Central European regions.

The indirect effects of increased periods of heat and drought are lower agricultural productivity and water scarcity. This worsens local food situations, and often leads to conflicts over resources and a destabilisation of local social systems.

Natural Disasters

Extreme weather-related and geological events, such as tropical cyclones, floods, heavy rainfall, landslides, tornadoes, hail, and hurricanes, immediately lead to large numbers of injuries or

even death. Even worse is the regular and systematic destruction of local infrastructure, such as access to clean potable water, food, electricity, medical facilities and shelter. This increases the infection rate of water-, vector-, and food-borne diseases, while at the same time massively worsening access to medical care.

Natural disasters result not only in shortages of food and water, but in anxiety and other psychological symptoms (such as traumas). These health consequences often go unaddressed in the context of acute disaster relief. However, the appropriate treatment of such follow-on diseases can be decisive for a population's long-term resilience.

Sea-Level Rise

A typical slow-onset phenomenon is the rise in sea levels, which is already fatal to densely populated coastal regions and island states, especially in Asia and the Pacific. The coastal infrastructure can be retained only with the greatest effort, and living space for hundreds of millions of people will gradually disappear, for instance as salt water penetrates drinking water reservoirs and fertile arable land. This leads to multiple resource shortages, which can lead to malnutrition, diseases (such as arsenic poisoning), and drinking water shortages.

Air Pollution

The accumulation of greenhouse gases, especially nitric oxides, in the lower and middle atmosphere reduces air quality, especially in heavily populated regions. The increased levels of allergens and pathogens in the air, and the pollution by industrial and automobile exhaust gases have a significant impact on human health in the surrounding area. The *accumulation* of such pollutants increases the frequency of respiratory complaints and allergies. Furthermore, warm temperatures also lead to the formation of gaseous ozone at ground-level. In turn, an increased concentration of ozone in the air can significantly impair human health.





Extreme weather conditions: Especially occurring during long-lasting heat waves and drought, the rising transmission rate of water- or food-borne diseases is particularly feared. [Source: © Ahmad Masood, Reuters.](#)

In 2018, the World Health Organization (WHO) forecast 250,000 additional *direct* deaths per year due to climate change, for the period between 2030 and 2050, as a result of these stress syndromes. Of these, 38,000 will be due to the elderly succumbing to heat; 48,000 due to diarrhoea; 60,000 from malaria; and 95,000 will result from child malnutrition.² If *indirect* consequences are considered, the numbers may well be much higher.

Consequences

Adaptation and Resilience of the Public Health Systems

Against the backdrop of this stress syndrome, health systems all over the world are facing the task of better adapting to the emerging risks to human health. This is an important part of the broad field of climate policy known as

“adaptation”. Organisational and financial structures of government and private health systems must be restructured to increase their *resilience* in the face of a foreseeable increase in strain. However, this challenge cannot be the responsibility of the health system alone. Urban planning processes, good governance, or the reorganisation of global value-added chains often play an equally important role.

Development policy to date has focussed primarily on establishing public health infrastructures. In the meantime, however, it has been recognised that, instead of merely tackling the symptoms, it is the underlying factors (stressors) leading to higher *health vulnerability* of societies which must be combatted. This also applies, for instance, to the causes and effects of climate change. This *additional stressor* generally affects health systems which are already today performing their duties inadequately, and

sometimes incapable of doing so at all. This occurs in many places, and for a variety of reasons: insufficient linkages of various steps in medical care (*disruption*), insufficient general medical education, inadequate social support systems, or a lack of gender equality. Effective prevention and treatment require a great deal of knowledge of specific local conditions, and must be considered in the context of further development policy measures.

Rapid urbanisation worldwide is a decisive factor here. The consequences of high settlement density in urban areas, especially in developing countries, is already exacerbating a number of negative health policy effects that will only worsen with climate change. This starts with the emergence of heat islands caused by faulty, energy-inefficient construction methods and urban planning. It continues with the location of the settlements themselves, which are often along rivers or coastal areas and are thus affected by climate change phenomena such as flooding and rising sea levels. And it ends with the installation of high-performance potable water and sewage systems, as well as communication systems, which are crucial to the prevention and control of epidemics.

Strengthening functional government structures is decisive in order to appropriately respond to the health consequences of climate change.

Climate-Related Migration

Weak or lacking statehood is one of the most important factors in insufficient health care provision all over the world. Strengthening functional government structures is decisive in order to appropriately respond to the health consequences of climate change. Unfortunately, precisely the latter is increasing the fragility of

states and societies. Shortages of food, water, and other natural resources are already laying the foundations for domestic and cross-border conflict. If already scarce resources are further reduced or completely destroyed by extreme weather or natural disasters, regional and global migration will intensify, which in turn will endanger the stability of the receiving societies. International regulations for supporting climate-related migrants must therefore become a priority. This would have immediate positive effects on the state of health (both physical and psychosocial) of those affected, and on the functionality of local health systems.

Approaches to Climate-Resilient Health Policy

Global Approaches

As mentioned above, mitigation and adaptation strategies for climate change ought ideally to go hand-in-hand, and this is also true of the health sector. Nevertheless, the focus of policy and international health research today tends to be more on *adaptation*. The reasons for this are the shorter time horizons, insufficient knowledge of the complex causal relationships, and inadequate international coordination, which frequently results in ultimately inefficient local/national measures.

In 2015, the WHO introduced its first comprehensive plan for combatting climate change and its associated health risks.³ The WHO's focus is on supporting member states as they tackle health risks arising from climate change so that resilience, capacities, and competence of local health systems can be enhanced and expanded locally to withstand these new pressures. The WHO defines *four fields of action* to raise global public awareness and promote more effective measures:

1. Building Partnerships

Responsibilities in the area of public health are already fragmented at the international level. Therefore, a platform for improved coordination amongst the various United Nations bodies is to be created in order to enhance synergy effects, and give health a higher priority in international climate diplomacy as well.

2. Raising Awareness

Despite the existential significance of the foreseeable effects of climate change, many countries lack a systematic and preventative discourse on the matter. Global and national institutions should invest more heavily in educating the public, as well as political, administrative, and economic decision-makers.

3. Enhancing Scientific Research

As mentioned above, the connections between the manifold phenomena of climate change and their direct and indirect effects on Global Health are still often unclear. The WHO thus recommends coordinated development of a global agenda and systematic monitoring of changes. Nevertheless, countries are also encouraged to each develop locally appropriate adaptation strategies.

4. Supporting the Ability of Health Care Systems to Respond to Climate Change

The core and priority of national health policies should be to enhance the capacities of local health systems by means of training and continuing education, technical advice, provision of technical and financial support, and the development of best-practice processes. Voluntary reporting on local challenges and progress by individual countries could be included in these efforts.

European Cooperation

The first European Conference on Environment and Health was initiated by the WHO as early as 1989. It stipulated that each member state of the European Union must draw up a national action plan for environment and health. Germany's is being represented by the "Aktionsprogramm Umwelt und Gesundheit" (Action Programme for Environment and Health), or APUG for short. It is a collaborative effort among ministries and federal authorities that promotes research and education on environmental, health, and consumer protection with a particular focus on children and young people. The specific fields of action range from improving communication of health risks to Europe-wide action approaches. The focus is also on promoting an environmentally, climate-, and health-conscious lifestyle among the local population.

The Situation in Germany

Against this backdrop, what is the situation in the Federal Republic of Germany? As early as 2008, the Robert-Koch-Institute (RKI) identified heat waves, floods, and increased incidence of allergens and vector-borne diseases as especially dangerous effects of climate change on health in Germany. These elements must also be considered in the context of demographic changes and with regard to the country's role as a central hub of international economic exchange. Further global interdependence, but also an increasingly ageing population represent specific factors which may amplify climate-related impacts on the health system.

Against this backdrop, the RKI cooperates closely with the German Environment Agency on preventative and acute measures to combat health risks arising from climate change in Germany. The focus is on clarifying the linkages between health and climate change, as well as on warnings and concrete information about preventative measures. Within the framework of a national action plan for Germany, the two institutions have identified the following fields of action:⁴



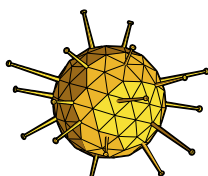
Raising awareness: Despite the existential meaning, many countries are lacking a systematic and preventative discourse on the effects of foreseeable climate changes. [Source: © Barry Malone, Reuters.](#)

1. Establishing a Health and Environment Monitoring System

The goal is to combine health and environmental monitoring in a single uniform system. This is especially relevant for the increased incidence of vector-borne pathogens and the increase in plant allergens, such as those from invasive plants and altered growth cycles.

2. Prevention and Risk Communication

As the effects of the heat waves in Europe have shown, with thousands of deaths in recent years, there is a great need for improved coordination of meteorological and climatological insights, and for their translation into concrete public health measures. The targeted addressing of specifically endangered groups, such as children and the elderly, is particularly important.





vary from region to region. Constant evaluation of existing measures is important for maintaining optimum conditions.

4. Education on Climate-Related Health Risks

Insufficient awareness of the effects of climate change on human health is largely responsible for society's greater vulnerability. For this reason, there must be comprehensive education on these interrelationships in order to strengthen the resilience and competence of the population and of the health systems.

-translated from German-

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3. Health Care

To ensure health care provision during and after extreme weather, and with regard to diseases linked to climate change, existing health care services must be adapted to local conditions. In this context, it is important to remember that climate change in Germany will have very different regional effects. For this reason, the requirements and adaptations of the health care systems will have to

- 1 Cf. Hefele, Peter/Vogel, Johannes/Lee, Eric 2016: At the Limits of Endurance – Climate Change and Resource Conflicts as Challenges to the Asia-Pacific Region, International Reports 2/2016, in: <https://bit.ly/2WnU3CU> [4 Jun 2019].
- 2 Cf. WHO 2018: Climate change and health, 1 Feb 2018, in: <https://bit.ly/2SXgflM> [22 May 2019].
- 3 Cf. WHO 2015: WHO Workplan on Climate Change and Health: Aims and Objectives: 2014–2019, Feb 2015, in: <https://bit.ly/2HwxYcA> [22 May 2019].
- 4 Cf. German Environment Agency / Robert Koch Institute 2013: Klimawandel und Gesundheit: Allgemeiner Rahmen zu Handlungsempfehlungen für Behörden und weitere Akteure in Deutschland, Mar 2013.