

MTb

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CLIMATE CHANGE AND HEALTH



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FROM DENIAL TO ACTIVISM

In 2009, the government of the Maldives held a meeting under water. Deep below the surface, President Mohamed Nasheed and his cabinet signed a document calling for global cuts in carbon emissions. The ministers spent half an hour on the sea bed, communicating with white boards and hand signals. Their plea to the world took place just before the UN climate change conference in Copenhagen in that same year. While still under water, President Nasheed's reply to the question what would happen if the summit fails was, 'We are going to die'.^[1]

In the fall of 2019, a young girl boarded a vessel setting sail for yet another UN meeting on climate change in New York. Greta Thunberg has become the symbol of young people voicing their concern about the impact of climate change on current and future generations. Some 50 years earlier, a group of concerned citizens and scientists showed the world their discontent with the way we are treating the Earth's natural resources through the publication in 1972 of *The Limits to growth: a global challenge*.^[2] Sadly enough, their message still rings true today: the global system of nature 'in which we all live cannot support present rates of economic and population growth beyond the year 2100, if that long, even with advanced technology'.

In 1993, Antony McMichael reached a similar conclusion in *Planetary Overload* (see the book review).

Last month, doctors and nurses dressed in scrubs joined the 'grief march' organised by the Extinction Rebellion movement^[3], walking the streets of London and highlighting deaths caused by air pollution. Their message was also loud and clear: climate change directly affects (human) health. Andy Haines, whom we

interviewed for this edition, emphasises that climate change should be framed as a health issue so that 'the public, politicians and policy makers get interested in the topic once they realise that it *directly* affects them and the society they live in'.

Not all of us will take to the street or sail the seas to express our concerns about climate change and its health effects. Some of us may even disagree with the 'sense of urgency' that is implied by the title of this year's annual symposium: *Climate Emergency, understanding the impact of climate change on health*. The second part of this title is what we are hoping to offer you with this edition of MTb: gaining a better understanding of the scope of climate change and its impact on human health. You are welcome to join the debate and become inspired to make a change in climate change.

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2. <https://www.clubofrome.org/report/the-limits-to-growth/>
3. <https://rebellion.earth>



Climate change and health – the bad news and the good news

We are increasingly familiar with the bad news about climate change, but is there a good news story on climate change and health?^[1] We asked Sir Andy Haines – keynote speaker at the 2019 NVTG symposium on Climate Emergency – to enlighten us on the options to address the current climate emergency and emerging issues in health aggravated by climate change. For more than three decades, Sir Andy Haines has been active on the interface of environmental change and public health, currently as Professor of Environmental Change and Public Health at the London School of Tropical Medicine and Hygiene (LSTMH). Before giving the floor to Prof

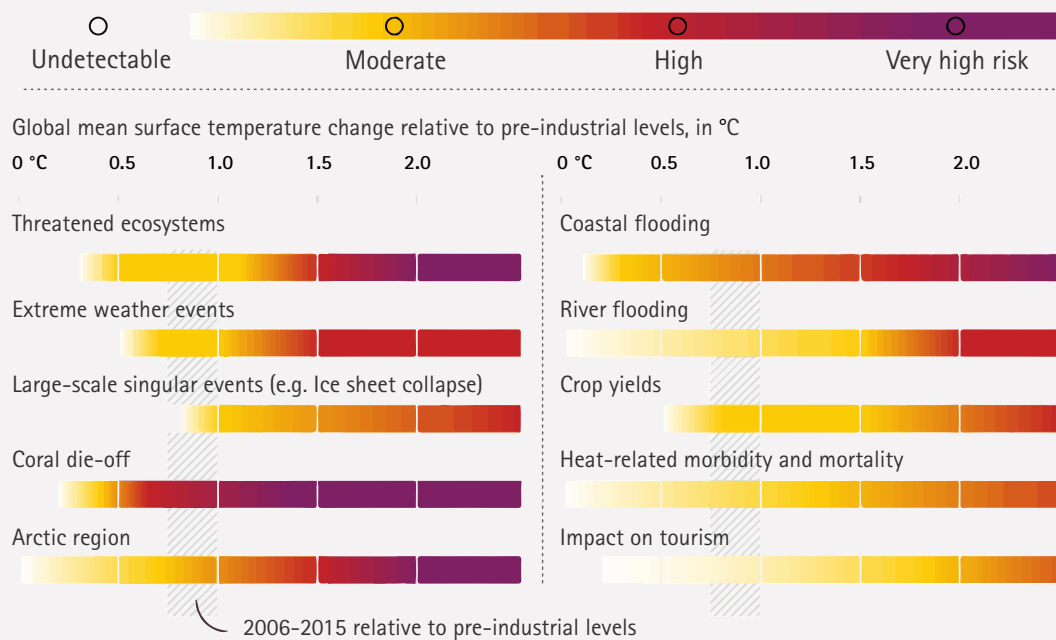
Haines, in the first two paragraphs we briefly introduce the concept of planetary health and dimensions of how climate changes are impacting on health.^[2,3,4,5,6]

THE IMPACT OF GLOBAL WARMING ON HEALTH

The Lancet Commission on planetary health defines planetary health as ‘the achievement of the highest attainable standard of health, wellbeing, and equity worldwide through judicious attention to human systems that shape the future of humanity and Earth’s natural systems that define the safe environmental limits within which humanity can flourish’.^[7] Or, to put it more simply, ‘planetary health is the health of human civilisation and the state of the natural system on which it depends’. With

these words Andy Haines introduces the concept of planetary health to an audience of scholars on the occasion of the launch of the Centre on Climate Change and Planetary Health at the LSTMH in which he talks about how we, global health professionals, have largely neglected the foundation of human health, the natural systems.^[2] We have assumed that global health would continue to improve, based on the dramatic improvements in human health we have witnessed over recent decades, like increased life expectancy and major decreases in infant and maternal mortality. These are great improvements no doubt, though they may easily be reversed if we continue neglecting to address climate change challenges. Without very rapid cuts in our current greenhouse gas emissions,

UN IPCC 1.5 °C Special Report (2018)



(Graphic: The Guardian)

FIG. 1: Source: UN IPCC, 2018 special report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways.

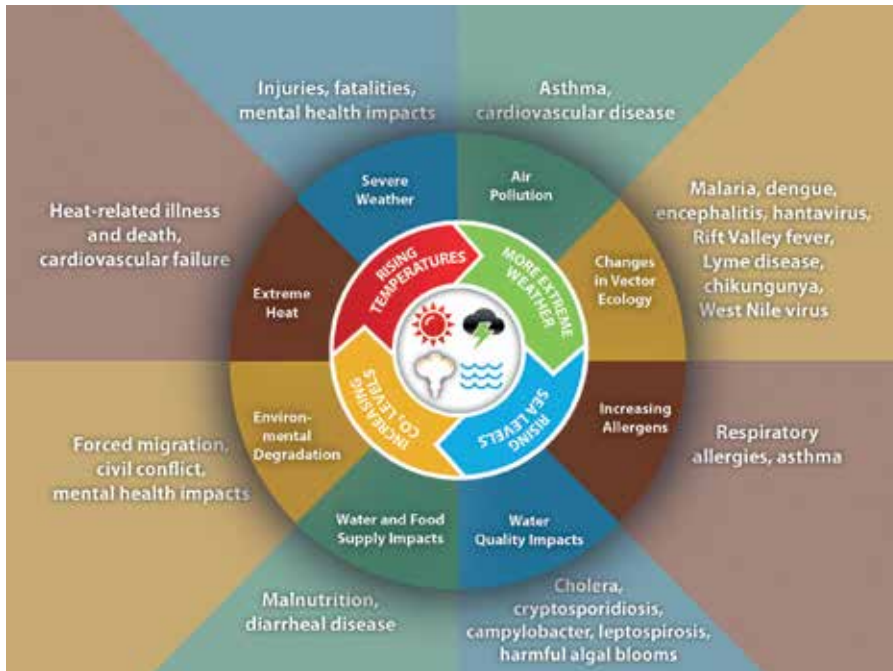


Figure 2. Implications of climate change for human health. Source: <https://www.ncbi.nlm.nih.gov/books/NBK525226/figure/ch8.sec2.fig1/> Courtesy George Luber, former head of climate change dept in the US CDC – recently fired when Trump started his climate change denial campaign.

we are facing a 1.5 °C global temperature increase (above pre-industrial levels) over the next few decades. The warming will have dramatic consequences for human health and the livelihood of populations, as depicted in Figure 1, such as flooding, extreme weather events and threatened ecosystems with potentially dramatic direct and indirect impacts on human health (Figure 2).

HUMAN PROGRESS AT A COST

The Planetary Dashboard (Figure 3) presents a set of 24 global indicators which reflect the patterns of human activity from the start of the industrial revolution in 1750 up to 2010, as well as the changes in Earth’s systems, including greenhouse gas levels, ocean acidification, deforestation and biodiversity loss.^[8]

The 12 indicators on the left depict human activity, like economic growth, population, transportation and water use, and those on the right major environmental components of the earth system, like carbon and nitrogen cycles and biodiversity. Human and earth systems trends show similar patterns with a dramatic shift starting in the 1950s, tagged as the Great Acceleration. There is strong evidence that key components of the earth system have moved beyond the natural variability exhibited in the last 11,500 years (since the beginning

of the Holocene epoch, which began at the end of the last glacial period), which has led us into a new geological epoch, the Anthropocene epoch, characterised by the dominant effects of humans on the earth systems.^[9]

Could you describe your personal journey into the domain of planetary health, climate change and health?

‘**F**or many years I was a practicing clinician and academic in the field of primary care, with training in primary care and public health. In the early 1990s, I was getting more interested in the issue of climate change and its implications for human health, though it did not appear high on the agenda in those days. I was contacted by the late Prof Tony McMichael – a well-known epidemiologist who sadly died in 2014 – who shared my interest and concern.^[10] We wrote technical papers on the possible impact of climate change on health, collaborated in the 1996 WHO/WMO/ UNEP report on climate change and health, and became involved in the Intergovernmental Panel on Climate Change (IPCC). As I became more aware of the details of these environmental changes and of the complexity of the relationship with human health, my interest began to grow. During the ten years I was Director of the London School of

Hygiene and Tropical Medicine (2000 - 2010), I was able to keep up some of my work – for example with a series in the Lancet in 2009 in which we looked at the health co-benefits of mitigating climate change (cutting greenhouse gas emissions), and how that would benefit human health in the near term.^[11] I was particularly interested in the near-term benefits of behavioural changes – like cutting greenhouse gas emissions – because it does have a direct effect on people’s daily lives and at the same time has a positive effect on the (long-term) process of climate change. After my period as Director of the LSHTM, I was asked by the editor of the Lancet to chair the Rockefeller Commission on Planetary Health, a commission that looked at the complexity of the relationship between a whole range of different global environmental changes – not just climate change – and human health. We also tried to outline potential solutions to adapt to environmental change, and particularly to reduce, or reverse where possible, these dramatic environmental changes that are occurring around the world. Briefly that is the kind of journey I travelled, keeping a focus on climate change and health, and expanding into work on sustainable cities, and on sustainable food systems which are essential to address the challenges of the Anthropocene epoch.’

In a column in BMJ and the Lancet series on Planetary health you make a plea for framing climate change as a health issue; could you explain the rationale behind this?^[12]

‘**I** honestly feel that climate change is a major threat to human health, and by framing it as a health issue, the public, politicians and policy makers will be more likely to get interested in the theme because it *directly* affects them and the society they live in. After all, most of us are anthropocentric,



Figure 3. Charting the 'Great Acceleration' in human activity from the start of the industrial revolution in 1750 up to 2010, and the subsequent changes in the earth system.

Illustration: Steffen et al. 2015, and F. Pharand-Deschênes/Globaia.

Source: <https://www.stockholmresilience.org/research/research-news/2015-01-15-new-planetary-dashboard-shows-increasing-human-impact.html>

for heat waves or infectious diseases. Thirdly, professionals can also have a role in mitigation of emissions, for example by looking at the environmental impact of the health system itself and their own role in this. For example, if you are a respiratory physician, you can encourage your patients to use powdered inhalers instead of the pressured type. You can also address the environmental footprint of the hospitals, as there are often very wasteful practices inside the hospital itself, including the procurement of pharmaceuticals and equipment with high GHG footprints. We can also ensure that, in the future, new hospitals and health centres are energy efficient. So there is a lot that can be done by health professionals in their day-to-day and professional lives. See Figure 4 for some of the possible solutions.'

How can we create a 'new narrative' and ensure that solutions cross borders, that working in an intersectoral and transdisciplinary manner becomes the norm, instead of working in silos?

'Great question, not easy to answer. Funding processes and policies are often very monodisciplinary. Also governments tend not to think and act in an interdisciplinary and intersectoral way. The responses we are looking for need to cut across the different sectors, because as much as we can accomplish in the health sector itself, if we really want to make a change we need to address the driving forces that are dramatically changing the environment around us. And there are a number of ways in which that can be done. At the UN level for example, the 17 Sustainable Development Goals are highly intersectoral and transdisciplinary. While SDG3 focuses particularly on the delivery of health care, others focus on topics which are central to the achievement of planetary health such as the provision of clean energy, sustainable cities and

wanting the best for our own species, our families and friends and the larger society in which we live. The implications for human health are obvious to me, and slowly we can see a recognition of its importance by the wider public, academics and policy makers. Also, increasingly we are seeing health professionals concerned about climate and other environmental changes, and funding institutions being prepared to invest money into this issue – albeit still very small amounts of money and very late. So it is happening and it has taken some time to mobilise opinion, but there is a change and we can certainly find a lot more interest amongst mainstream health professionals about what they can do in their work and also in their personal lives to address the challenges of climate change.

People may feel overwhelmed by the complexity of the issue, which may have an effect on their willingness to act; is this something you recognise?

'Yes, complexity turns people off, as they would want straightforward policies and to be able to see the effect more immediately. On the other hand, there are already many straightforward actions people can take, and sometimes policies are in place to encourage change, like eating more fruit and vegetables and, overall, a more sustainable

diet which in many countries also requires a lower consumption of animal products, more active travel (walking and cycling) and less dependence on the private car, and moves to zero carbon renewable energy that is not powered by fossil fuels. These are fairly clear messages that are both environmentally friendly and beneficial to health.'

What are the main issues related to climate change that (global) health professionals are dealing with, and what can they do in their practice to adapt to the effects of climate change?

'Increasingly we see studies that are attempting to quantify the effects of climate change on human health around the world, though we still have a long way to go as many of the effects are occurring at the back of many other changes. Health professionals should be aware of the effects of environmental changes on health patterns – like an increase in the risks of certain vector- or water-borne diseases. In Europe these can include the spread of *Aedes Albopictus* and increasing risks of Lyme disease and *Vibrio* infections. Secondly, health professionals – certainly the ones involved in public health – need to become involved in (national) adaptation plans in the case of extreme weather events, like early warning systems

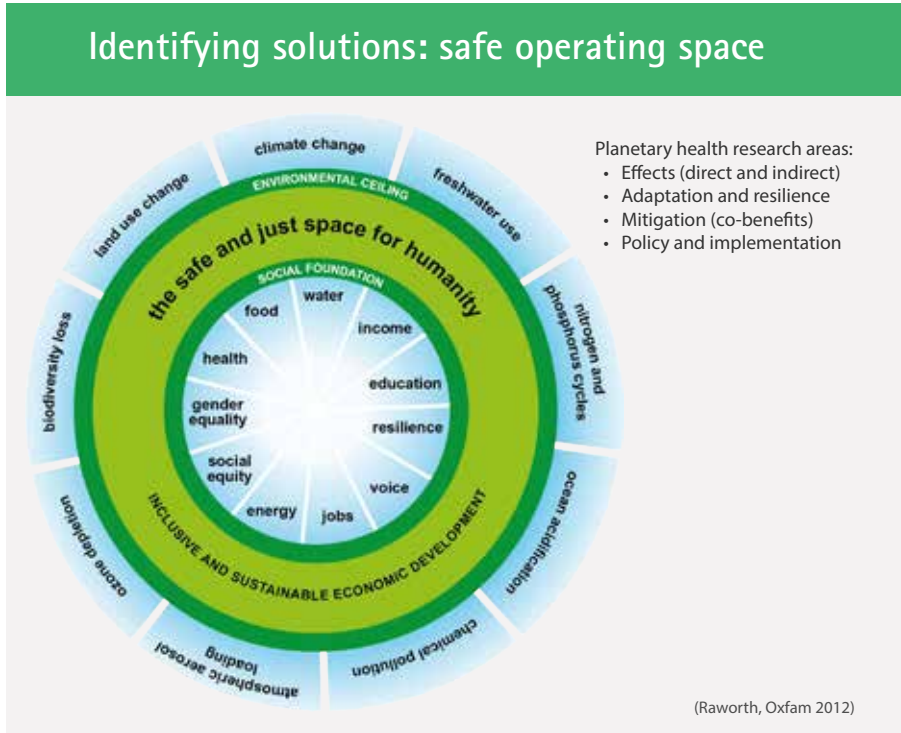


Figure 4. Solutions
 Source: www.oxfam.org/en/video/2012/introducing-doughnut-safe-and-just-space-humanity

food systems. They may appear to be complex, and there is some criticism, but nevertheless, health and sustainability are very much at the centre of the SDGs, and many countries are taking them quite seriously and integrating them into their planning processes. We also see some funding organisations thinking about research in a different way, like the Wellcome Trust, which is the largest funder of research on planetary health. The main challenge perhaps will be to change our own consciousness as we generally are brought up in a relatively narrow disciplinary sphere. This is a mode of thinking and working we would need to change, for example by changing our normal routine and starting to work across the boundaries of our profession. There are opportunities opening up, but it does take time. Also, we need to train a cadre of young researchers who are less rigid and more prepared to work in transdisciplinary teams. This is an important growth process for all of us.'

Could you reflect on the title of your keynote – imperatives for climate action to protect health?

The idea is clear. The reason we need to act is clear, considering

the fact that we are heading to a 3 to 4 degrees C increase in global temperature by the end of the century, that we are losing species at probably more than a hundred-fold greater rate than pre-human times, and that many countries are depleting their fresh water reserves, to name just a few reasons. While generally human health continues to improve, environmental changes are likely to have a reverse effect on our health. This makes it imperative to act now before these changes become catastrophic, in order to reduce the potential risks we are facing. It also includes dealing with scepticism and a great level of denial which is surrounding the debate. Overall scepticism is not bad in itself, as this is fuelling scientific engagement. Denial and refusal to face facts is more dangerous and is a profound ethical challenge which we need to confront, as this is an organized process to undermine science.'



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Dhaka sitting on a plastic bomb

Issues and concerns regarding water quality, public health and waste governance

Plastic, an offer of modernity, has become one of the largest and significantly important parts of our everyday life, but it is also posing a huge threat to our environment and to public health. Plastic does not only pollute the surface environment and freshwater and marine ecosystems, but toxic elements released from plastic also percolate through the surface and contaminate ground water, which we often use as 'safe' drinking water. This becomes problematic when we look into the entire governance infrastructure of plastic and the ground water interface, and how a state sponsored 'safe drinking water' campaign could instead lead to a 'risk society' in the global South. A recent study found that 83% of tap water samples taken around the world contained plastic pollutants, concluding that people may be ingesting between 3,000 and 4,000 microparticles of plastic per year from tap water.^[1] This paper sheds light on the complex interface of plastic, water and public health, with examples from Bangladesh, and advocates for a new strategy of plastic governance in modern states.

EXPANSION OF PLASTIC IN MODERN SOCIETY

Since its rise in the 1950s, because of its durability, malleability, light weight and low cost, and due to a lack of environmental awareness and appropriate policy measures, global plastic production reached 322 million tonnes in 2015. Approximately 50% of plastics are used for single-use disposable applications, such as packaging, agricultural films and disposable consumer items, between 20 and 25% for long-term infrastructure such as pipes, cable coatings and structural materials, and the remaining 25 to 30% for durable consumer applications with an intermediate lifespan, such as in electronic goods,

furniture, and vehicles.^[2] An estimated 6.3 billion tonnes of plastic waste have been produced since the 1940s, and 79% of this is hidden in landfill sites or in the natural environment.

PLASTIC AND BECK'S 'RISK SOCIETY'

As Beck (1992) argues, we are suffering from the unwanted and unseen consequences of modernity, where industrial institutions both produce and legitimise risks that they cannot control.^[3] Modern society is structured around and impacted by new types of risks which have never existed before. Society lives in the future as it were and ends up exposed to the risks produced by modernity itself. This is more like a manufactured risk where a high level of human agency is involved in producing and mitigating such risks. In Beck's 'risk society', risks are universal and irreversible. As everyone in the society is equally exposed to these manufactured risks and since the consequences will be suffered in the future, there is no way that we can reverse the mistakes already made. Though the idea of a 'risk society' is more appropriate and relevant to the technologically advanced world, if we take the plastics industry as an artefact of modernity, its future threats to public health and our environment as a whole fit very well into the discussion of 'risk society' across the globe.

The impact of plastic on the global environment is one of the major concerns in the present world. Plastics contains many toxic chemicals and hazardous substances, which could potentially cause eye irritation with impaired vision, respiratory problems, liver dysfunction, cancers, skin diseases, lung problems, headache, dizziness, early child puberty, disruption in reproductive gland development and sperm production and other reproductive health problems, and cardiovascular, genotoxic, and gastrointestinal issues. This is the result of the irresponsible commercialisation of plastic, which has led to single-use

plastics applications, inadequate post-use treatment, low recyclability and reusability rates, and a high potential of disintegration into microplastics.

These emerging risks are very much associated with the management of plastic wastes and, as mentioned earlier, a huge amount of plastic is ending up in landfills, which pose a further threat to drinking water and the environment in general. Panno et al (2019) studied shallow groundwater aquifers – source of 25% of global drinking water – which are open systems and susceptible to contamination by surface-borne pollutants. They studied filter pads of the water samples and counted samples with specific morphologies (fibre, fragment, foam, bead, and film) and recorded colour. Chemical identity of the microplastics was obtained by pyrolysis gas chromatography mass spectrometry (Py-GCMS). This is a cutting edge analytical method to identify compounds with unique details. This research was conducted in a developed country where used plastics are managed and recycled. Therefore, all the microplastics found were fibres associated with chemical proxies of septic tanks (triclosan, phosphate, and chloride). For countries where the use of plastic is rising rapidly and plastic waste management is not strictly practiced, this study hints at a direct plastic-water nexus and rings the alarm bell for future contamination of subsurface water.

BANGLADESH: PLASTIC-WATER NEXUS

The plastic-water nexus is essential to understand the linkages between plastic contamination, water, and future uncertainties. A huge portion of plastic ends up in landfills, gradually decays, and releases toxic chemicals, which then seep into ground water and pose a significant threat to human health. The world is now more cautious about plastic wastes. In December 2017, about 200 nations at the UN Environment Assembly in Nairobi signed a resolution



A typical waste disposal in a slum dwelling in Dhaka City (Bashpotti Slum, Mirpur, Dhaka).

to eliminate plastic pollution in world oceans immediately. Just a month later, the European Commission released a plastic strategy calling for all plastic packaging in the EU market to be recyclable or reusable by 2030 and for the reduced consumption of single-use plastic. In March 2019, 170 countries echoed the EU's pledge to 'significantly reduce' the use of throw-away plastics by 2030. Many countries in the world, particularly the rich countries, have invested resources in plastic waste management, i.e. recycling, but this is not the case in a country like Bangladesh. Despite being the first country in the world to ban the use of the poly shopping bag in 2001, Bangladesh is currently the largest user of plastic in the world. Bangladesh plastics industries produce basic products for readymade garments, construction material, packaging and household goods. From these activities, Bangladesh is generating 336,000 tons per year of plastic waste, and around 17,000 tons per year is going to the landfill. Non-degradable plastic accounts for 73% of litter in any aquatic habitat, with roughly 50% disposed of after single use. With increasing urbanisation this will become even worse. The picture given below is one of the examples of how plastics are everywhere in a city slum area. Plastics are either carelessly thrown away, anywhere, or they are taken to the city corporation dumping

stations via domestic and commercial bins, eventually ending up in landfill sites. Without legislation and policy guidelines on sustainable plastic use the country seems not to have the right political drive to implement the 2019 Nairobi plastic pollution declaration.

As the landfill sites in Bangladesh accumulate plastic waste, the risk of groundwater contamination becomes imminent. Ironically, Bangladesh's dependence on groundwater is actually increasing. Before shallow tube wells were introduced in the early 1970s, people used water from ponds, rivers, wells and homestead water tanks for drinking and other domestic purposes. This exposed them to waterborne diseases. There were several solutions to this problem, such as boiling and filtering surface water, harvesting rainwater, using water purification tablets and drinking tube well water. Shallow tube wells were patronised by international donors like UNICEF and popularised through local politicians, who capitalised on this opportunity as a means of winning votes by distributing them to their constituencies. Having a tube well in the home yard was also symbolic of family identity and prestige. This shows how human choices, values, interests and relationships are embedded in knowledge production. Thus, despite being relatively the most

expensive solution, shallow tube wells became a dominant feature in rural parts of Bangladesh. In the cities, deep tube wells became the major source of piped water for domestic use. The Dhaka Water Supply and Sewerage Authority (D-WASA), established in 1963 as an independent organisation, is currently serving 12.5 million people with 2110 million litres of water per day, mainly relying on underground water.

CONCLUSION

There are many studies on the monstrous consequences of the use of plastics, particularly for the surface environment and the aquatic ecosystem. However, the plastic - drinking water nexus has not drawn much attention yet. In addition, there is a huge grey area in relation to understanding responsibility and accountability, and more generally the governance of plastic waste management. There are several scattered initiatives without any concrete guidance at the national level; a more precise understanding and awareness at all levels is extremely important.

By portraying a picture of the plastic-water nexus, this paper aims to encourage a discussion of waste management in a broad context. It applies Beck's 'risk society' concept, which has so far been used only in the North, to make it relevant to the global South. Hopefully, this paper will contribute to the formulation of a new vision of collective activities towards a responsible use of plastics.



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The Dutch Knowledge Agenda on Climate and Health

Climate change is an increasing health concern in the Netherlands. Just looking at the past few months, the observed additional mortality due to record high temperatures and the significant health problems due to lesions caused by oak processionary caterpillars are examples that can be observed in a changing climate (see Table 1).^[1,2] At the same time, Dutch society is already planning and implementing multiple climate mitigation measures (e.g. the National Climate Agreement) and adaptation measures (e.g. the National Adaptation Programme). These measures can create interesting opportunities to simultaneously improve our health (so-called health co-benefits). On the other hand, there are also concerns that they will be accompanied by unintended health risks (see Box 1). For example, urban greening is often mentioned as a climate adaptation measure to tackle the urban heat island effect. However, it requires careful design and implementation in order to avoid an increase in pollen concentrations or increasing urban populations of disease vectors such as mosquitoes and ticks.

In a recent publication, the European Academies' Science Advisory Council (EASAC) stresses that the existing knowledge gaps relating to the health impacts of climate change and climate-related policies need to be addressed.^[6] The Netherlands has always been one of the frontrunners in climate change research, facilitated by successful national research programmes such as Knowledge for Climate (*Kennis voor Klimaat*) and the Climate Change Spatial Planning Programme (*Klimaat voor Ruimte*). Unfortunately, health-related research has so far not been among the main objectives of these programmes. Consequently, many

BOX 1: SIDE EFFECTS OF CLIMATE POLICIES – HEALTH CO-BENEFITS AND UNINTENDED HEALTH RISKS

The past years have witnessed an increasing call to consider the health implications of climate mitigation and climate adaptation measures, as they can create important health co-benefits as well as unintended negative health impacts.^[4,5,6]

Health impacts of climate mitigation measures are, for example:^[3]

- Decreasing the use of fossil fuels does not only reduce the emission of greenhouse gasses but also of other air pollutants.
- More active transport (e.g. taking the bike instead of the car) is both climate-friendly and healthier.
- Reducing food-related greenhouse gas emissions by eating less meat will also result in a healthier diet.
- Improved insulation of buildings will reduce energy consumption but can negatively impact indoor climate.

Health impacts of climate adaptation measures are, for example:^[3]

- Urban greening can reduce heat stress but can also have positive impacts on mental health as well as negative health impacts via changes in pollen concentrations and tick/mosquito populations.
- More space for urban water features to reduce heat stress and for water storage to prevent flooding can have positive health impacts via stress reduction and additional recreation facilities, as well as negative health impacts via changes in mosquito populations and risks relating to water quality.

TABLE 1. HEALTH IMPACTS OF CLIMATE CHANGE IN THE NETHERLANDS.^[3]

HEALTH IMPACT	EXAMPLES
HEAT STRESS	Additional mortality and morbidity due to more frequent and longer heat events, in particular in vulnerable groups (e.g. elderly, chronically ill).
ALLERGIES	Changes in the timing and duration of the pollen season can impact allergy-related health problems such as asthma and hay fever. Our climate can become more suitable for the spread of exotic allergenic species such as ragweed. In addition, changes in allergy symptoms caused by dust mite and the oak processionary caterpillar can be expected.
VECTOR-BORNE DISEASES AND ZOOSES	Changes in the presence, population size/dynamics, and seasonality of vectors and disease pathogens. It is, for example, expected that the Dutch climate will become more suitable for the tiger mosquito, which can transmit diseases such as chikungunya, dengue and zika.
WATER-RELATED HEALTH IMPACTS	Changes in the geographical spread and seasonality of water-borne pathogens and infections such as Legionella. In addition, possible changes in pathogen concentrations in drinking water and the growth of blue-green algae (cyanobacteria) in surface waters need to be considered.
FOOD-RELATED HEALTH IMPACTS	Changes in the geographical spread and seasonality of water-borne pathogens and infections such as Salmonella, Campylobacter and Listeria. Impacts on crop yields and food quality (nutrients), resulting from, for example, extreme weather events, changing atmospheric CO ₂ concentrations and pests.
AIR POLLUTION	Changes in atmospheric concentrations of, for example, particulate matter and ozone can impact our health. Interactions with heat stress and pollen concentrations need to be considered.
ULTRA-VIOLET (UV) RADIATION	Climate can influence the amount of UV radiation via changes in cloud formation and the recovery of the ozone layer. This can affect, for example, skin cancer rates.

research questions relating to the health impacts of climate change (policies) in the Netherlands are still unanswered. It is, for example, still difficult to quantify

the health impacts resulting from climate change or from specific climate mitigation and adaptation policies.



DEVELOPING THE DUTCH KNOWLEDGE AGENDA

To get a better insight into the climate change related health risks in the Netherlands, the Organisation for Health Research and Development (ZonMw) asked the Dutch National Institute for Public Health and the Environment (RIVM), Maastricht University and Wageningen University & Research (WUR) to develop the Dutch Knowledge Agenda on Climate and Health. This agenda has identified studies that are required to explore and address the health implications of climate change and climate-related policies. Relevant knowledge gaps and research questions were identified through literature review and a broad consultation of stakeholders. The participatory consultation was based on two surveys complemented with in-depth interviews.

- The aim of the first survey was to identify the existing research questions within the theme Climate and Health. The questionnaire was sent to Dutch scientific experts (n=58) and consisted of mainly open questions.
- The aim of the second survey was to prioritize the different research topics. The questionnaire was sent to a broader group of stakeholders (n=114; e.g. scientific experts, policymakers at different policy levels, and professionals) and consisted of mainly closed questions.
- Interviews were conducted with 12 selected key stakeholders from a variety of backgrounds for an in-depth exploration of their knowledge needs and research questions.

RESEARCH PRIORITIES

The outcomes of the literature review, surveys and interviews were synthesized into five priority research topics for the Netherlands:^[3]

1. Integrated analysis of current and future health risks of climate change. This will require additional research into, for example, patterns of exposure and their spatial distribution, exposure-response relationships and vulnerable groups.

2. The development, implementation and evaluation of measures to tackle current and future health effects of climate change (adaptation/prevention). This requires:
 - The development and cost-benefit analysis of possible sets of policy measures, including consideration of health costs;
 - The organisation of policy (advice) on climate change and health, with consideration for perception, behaviour and vulnerable groups;
 - The development of knowledge sharing between research and practice, and providing information for various target groups.
3. The development and implementation of an integrated monitoring and assessment system for both analytical studies and information supply (see points 1 and 2).
4. Health impact assessment of climate adaptation measures. Consistent inclusion of health in the evaluation of climate adaptation measures (for example in the context of the Dutch National Adaptation Strategy) in order to prevent unintended negative health impacts and strengthen positive ones. The Dutch Environment and Planning Act offers an opportunity to link and optimize environmental, health, and climate policies with the aim of protecting and promoting health.
5. Health impact assessment of climate mitigation. Consistent inclusion of health in the evaluation of climate mitigation measures (for example in the context of the National Climate Agreement) in order to prevent unintended negative health impacts and strengthen positive ones.

OUTLOOK

Building on the literature review and consultation, the Dutch Knowledge Agenda on Climate and Health has identified key research areas that need to be addressed to explore and anticipate the health impacts of climate change and climate policies in the Netherlands.^[3]

The Knowledge Agenda forms the foundation for a coherent future national research programme. It explicitly calls for an integrated and interdisciplinary research approach. This does not only require cooperation between different scientific disciplines but also the active involvement of different policy sectors and practitioners (e.g. communities of practice). Together, we can create the knowledge needed to safeguard a healthy living environment and a healthy society in a changing climate.



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Bluetongue, tiger mosquitoes, giant ticks and processionary caterpillars

As a researcher you can only hope that politicians and authorities take the effects of the complex interplay between climate, diseases and other factors more seriously. Prof. Pim Martens is professor of sustainable development at Maastricht University. His research focusses on sustainable human-animal-nature relationships, including climate change and health. Pim Martens is founder of AnimalWise, a 'think and do tank' integrating scientific knowledge and animal advocacy to bring about sustainable change in our relationship with animals.



THIS SUMMER A TIGER MOSQUITO WAS FOUND IN THE NETHERLANDS

It is time for drastic measures to reduce the emissions of greenhouse gasses. Only in this way can we avoid an increase in the global temperature of 2 °C. An increase of only 1 °C in global temperature will lead to serious societal impacts, such as sea-level-rise, dying of coral reefs, and more frequent weather extremes (e.g. heatwaves). With a temperature increase of more than 1 °C, more extreme impacts are to be expected, also on health.

In his keynote lecture at the NVTG congress on the impact of climate emergency on health, Pim Martens discusses the transmission of vector-borne diseases (VBDs) and how climate changes the equation, for example leading to a more rapid spread of vectors and (tropical) diseases impacting (human) health. This happens in particular when vectors move to new habitats or, conversely, when people move into areas where

vectors already exist. Much of the debate so far has centred on the attribution of past changes in disease rates to climate change, and the use of scenario-based models to project future changes in risk for specific diseases. Obviously there is an unavoidable uncertainty in such analyses; also the attribution of risks to climate change needs to be estimated compared to other effects of socio-economic and public health determinants.

Researchers recently found traces of anthrax bacteria under permafrost in Siberia – a warming climate could potentially release them. A bit closer to home, but a little longer ago: at a workshop organized by the University of Wageningen and Maastricht University in 2003, a group of researchers from Liverpool presented a study into the possible spread of bluetongue virus, spread by a small insect (midge), in sheep, as a result of climate change. At that time, the disease was predominantly found in Southern Europe. Based on the outcomes of modelling, researchers predicted the spread of the disease to Northern countries, including the Netherlands. Unfortunately, at that time policymakers didn't take it too seriously. However, it took only three years before the disease was diagnosed among sheep at an agricultural enterprise in Kerkrade, the Netherlands.

In 1997, I completed my PhD on the effects of climate change on the spread of infectious diseases such as malaria and dengue fever. The models I used predicted a potential risk of an increased range of the tiger mosquito – responsible for the spread of, among others, dengue fever and the zika virus – as a result of climate change. The mosquito is now on its way from Southeast Asia to Europe and – as already indicated 22 years ago – there is a good chance that the mosquito will survive and settle permanently in the Netherlands. This summer, a tiger mosquito was found in the Netherlands.

Researchers were right in their 'predictions' of the spread of these two insect-transmitted diseases in animals and humans (predictions in quotation marks because of course we can't precisely map all the factors that spread a disease). In addition, climate change influences the occurrence of diseases in Northern Europe, diseases of which we hadn't thought about until recently, such as the discovery of six *Hyalomma* ticks in Germany, close to the Dutch border. These ticks are triple the size of a normal tick and can transmit dangerous diseases. It didn't take long until the tick was spotted in the Netherlands also. Another nuisance is caused by the increased populations of oak processionary caterpillars, suffered by many in the Netherlands.

As a researcher you can only hope that politicians and authorities take the effects of the complex interplay between climate, diseases and other factors more seriously. Perhaps the recently published *Knowledge agenda research programme on climate and health* (see elsewhere in this edition of MTb) – developed by researchers from Maastricht University, University of Wageningen and the National Institute for Public Health and the Environment (RIVM) – will motivate the relevant players to take action. Not only to answer the many questions that remain, but also to tackle effects in an integrated way in consultation with public health authorities, citizens and other parties. Let's collaborate and organize ourselves, instead of having to deal with many more unpleasant surprises that impact our health whilst we are unprepared.



Pim Martens

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This column is an adaptation of an earlier column at www.pimmartens.info in which he particularly focuses on the increased risk of vector-borne disease associated with climate changes.



It is the food, stupid!

The link between human and planet health is our food system

1 IN 3 PEOPLE WORLDWIDE ARE MALNOURISHED

Since the very first beginning of agriculture, around 10,000 years ago, we have been able to increase food production in terms of calories to keep up with population growth, but we have not yet solved the challenge of feeding the (growing) global population with adequate diets. Today, two billion people lack key micronutrients like iron and vitamin A, two billion adults are overweight or obese, 150 million children are stunted, 50 million children are wasted, and nearly 40 million children are overweight. 88% of countries face a serious burden of either two or three forms of malnutrition.^[1] Malnutrition in all its forms, including obesity, undernutrition, and other dietary risks, is the leading cause of poor health globally. Low-quality

diets cause micronutrient deficiencies and contribute to a substantial rise in the incidence of diet-related obesity and diet-related non-communicable diseases, including coronary heart disease, stroke, and diabetes. Unhealthy diets pose a greater risk to morbidity and mortality than does unsafe sex, and alcohol, drug, and tobacco use combined, and 6 of the top 10 risk factors are diet related (see Figure 1).^[2]

The world's population is expected to grow to almost 10 billion by 2050, boosting agricultural demand – in a scenario of modest economic growth – by some 50% compared to 2013.^[3] Income growth in low- and middle-income countries would hasten a dietary transition towards higher consumption of meat relative to that of

cereals, requiring even higher agricultural (feed) production and adding pressure on natural resources.^[3]

FOOD SYSTEM TRANSFORMATION FOR HEALTH AND SUSTAINABILITY

The international development community has recognised these challenges. In particular, the 2030 Agenda for Sustainable Development, adopted by the international community in September 2015, provides a compelling but challenging vision on how multiple objectives can be combined to define new sustainable development pathways. The second Sustainable Development Goal (SDG 2) explicitly aims at ending hunger, achieving food security and improved nutrition, and promoting sustainable agriculture, simultaneously by 2030. Dr Lawrence Haddad,

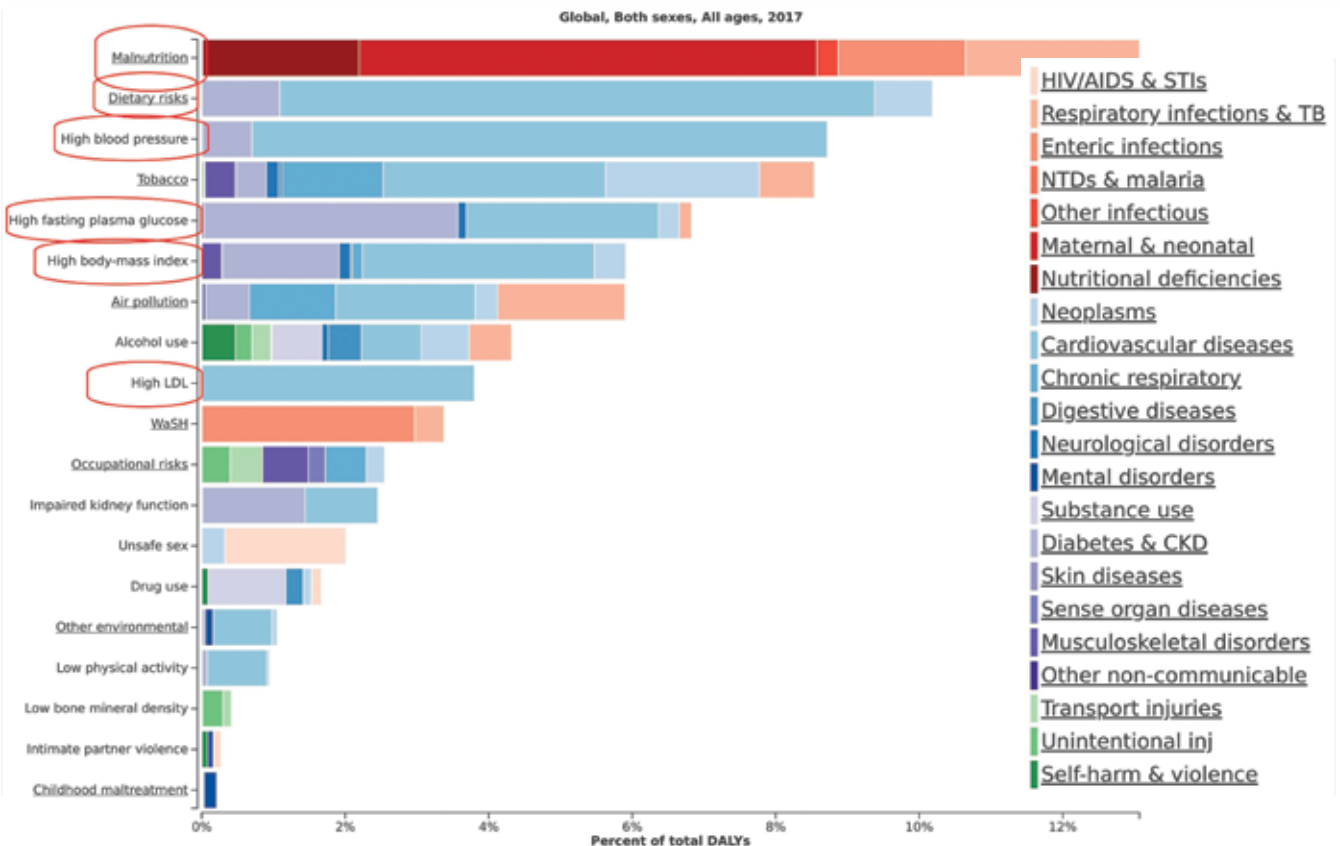


Figure 1. A comparative risk assessment of burden of disease (measured in % of total disability-adjusted life years, DALYs) attributable to 19 risk factor clusters (data from 2017).

IRONICALLY, ONE OF THE LEAST USED SETTINGS TO PROMOTE BETTER NUTRITION IS THE HEALTHCARE SYSTEM

Global Alliance for Improved Nutrition (GAIN) Executive Director and World Food Prize winner 2018, formulated the challenges as follows: ‘There are two vital and interlinked questions faced by humanity. First, how do we have to eat differently to significantly reduce malnutrition? Second, what food production systems do we have to put in place to use natural resources sustainably and live within climate change targets?’^[4]

The recently published EAT-Lancet Report provides a ‘Healthy Reference Diet’ that sets ranges of intakes for food groups to ensure human health which can be sustainably produced within the boundaries of one planet.^[5] To achieve the consumption of this ‘Healthy Reference Diet’ requires substantial dietary shifts, ultimately leading to an

increase in consumption of fruit, vegetables, legumes and nuts, and a decrease in unhealthy foods such as added sugar, ultra-processed foods (i.e. foods high in energy and low in nutrients, and often cheaper than nutritious foods) and animal source products, especially red meat (see Figure 2).^[5] However, the required changes differ greatly by region and are context-specific, e.g. many vulnerable groups in low income countries should still increase their consumption of animal-source foods in order to meet their micronutrient requirements.

In the so-called Global Syndemic of Obesity, Undernutrition and Climate Change report, the Lancet commission on Obesity argues that ‘The pandemics of obesity, undernutrition, and climate change represent three of the

gravest threats to human health and survival. These pandemics constitute The Global Syndemic, consistent with their clustering in time and place, interactions at biological, psychological, or social levels, and common, large-scale societal drivers and determinants. Their interactions and the forces that sustain them emphasise the potential for major beneficial effects on planetary health that double-duty or triple-duty actions, which simultaneously act on two or all three of these pandemics, will have.’^[6] A system perspective is required to address the underlying drivers of The Global Syndemic within the context of achieving the Sustainable Development Goal, in particular human health and wellbeing, planetary health, social equity and economic prosperity. The major systems drivers

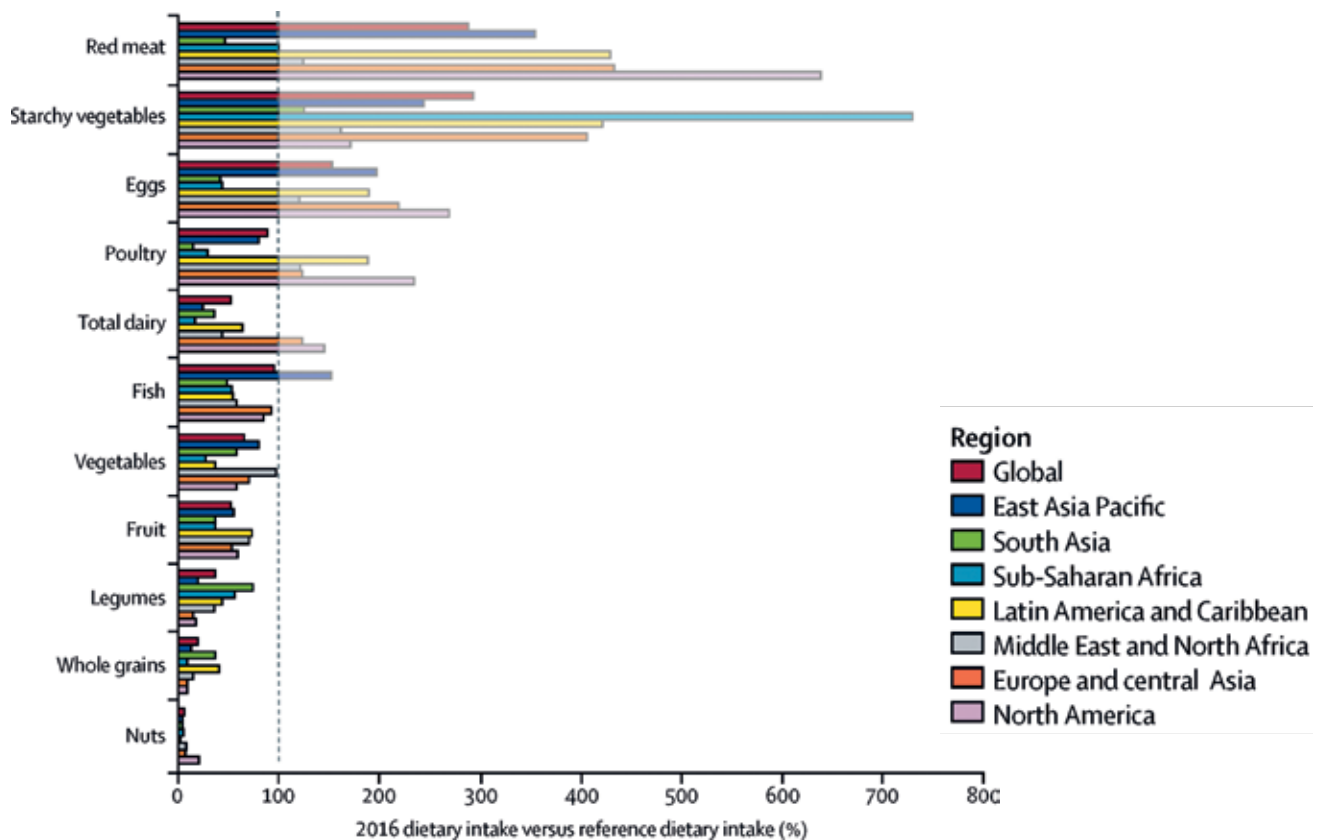


Figure 2. Intake of various types of food by region. The intake of the recommended reference diet is indicated with the vertical, dotted line at 100%.^[5]



are food and agriculture, transportation, urban design and land use.^[6]

To achieve these changes in food and agriculture, a comprehensive and multi-sectoral context specific approach is required to move the dominant food system to a desired sustainable food system that provides healthy diets. This will require the buy-in of all partners, actors and especially consumers. The walls between agriculture, climate, water and sanitation, health care and nutrition will need to be breached, and nutrition-specific and nutrition-sensitive interventions (see text box) will need to be integrated.

The Lancet introduced the terminology 'nutrition sensitive' and 'nutrition specific' in its Maternal and Child nutrition series in 2013.^[7] Nutrition sensitive interventions and approaches comprise those that indirectly impact nutrition: agriculture and food security; social safety nets; early child development; maternal mental health; women's empowerment; child protection; classroom education; water and sanitation; health and family planning services. Nutrition specific interventions and programmes include: adolescent health and preconception nutrition; maternal dietary supplementation; micronutrient supplementation or fortification; breastfeeding and complementary feeding; dietary supplementation for children; dietary diversification; feeding behaviours and stimulation; treatment of severe acute malnutrition; disease prevention and management; nutrition interventions in emergencies.

POLICY INERTIA

Governments, supported by civil society and knowledge institutes, will need to lead the governance of the development and implementation of evidence-based policies beneficial for society, health and planet, without vested commercial bias. 'Policy inertia, a collective term for the combined effects of inadequate political leadership and governance to enact policies to respond to The Global Syndemic, strong opposition to those policies by powerful commercial interests, and a lack of demand for policy action by the public governments and civil society [...] prevent change to the existing systems', argue the authors of the Global Syndemic report.^[6] Last, but not least, the private sector needs to be encouraged to be part of the solution by developing sustainable and health-promoting business models and shifting business outcomes from a short-term profit focus only, to sustainable, profitable models that explicitly include benefits to consumers, society and the environment.

THE ROLE OF HEALTH PROFESSIONALS

So why is this relevant for global health professionals? First of all, as unhealthy diets pose by far the largest risk factor to morbidity and mortality, every medical professional should at least have a good understanding of current diets and desired dietary shifts, taking into account that the changes needed differ greatly by region and are context-specific. Secondly, as a comprehensive and multi-sectoral context specific approach is required to move the dominant food system to a desired sustainable food system that provides healthy diets, global health professionals need to be part of the design and implementation of double- and triple-duty actions. Ironically, one of the least used settings to promote better nutrition is the healthcare system.^[8] And lastly, being aware of the enormous risk and burden that a failure to change our food system would put on the shoulders of our children and grandchildren, we need everyone to advocate for breaking down 'policy inertia' and make their small but important contributions.

Or, as Professor Wangari Maathai, founder of the Green Belt Movement and Nobel Peace Prize laureate tells us: 'I will be a hummingbird; I will do the best I can'.^[9]



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THE PANDEMICS OF OBESITY, UNDERNUTRITION, AND CLIMATE CHANGE REPRESENT THREE OF THE GRAVEST THREATS TO HUMAN HEALTH AND SURVIVAL

What is the price of a false alarm? From early warning to long-term planning

DOOMSDAY

Friday the 13th is often perceived as a day of disasters, doomsday, a day to be careful and expect the worst. Friday the 13th 1970 definitely can be seen as such. Hundreds of thousands of Bangladeshi fled their homes because of Cyclone Bhola – a storm which is still listed as one of the major natural disasters with half a million casualties. Friday the 13th last September was a much more pleasant day. Prof Maarten van Aalst delivered his inaugural speech – Earlier

warning, earlier action: resilience in the face of rising risks – in acceptance of the Chair ‘Spatial resilience for Disasters Risk Reduction’ within the Faculty of Geo-information Science and Earth Observation (ITC) at the University of Twente.^[1] The flip side of this horrific cyclone in Bangladesh was, according to van Aalst, that we learned a lot and recognised the need for early warning systems. But people are still dying because of hurricanes and storms, though most often the magnitude is

much lower. The main idea of this Chair is to operate on the interface of science, policy and practice, and make scientific information useful for actual humanitarian work on the ground, which entails building bridges between academia and practice. As van Aalst explained in our conversation,^[2] there is a lot of information at the local level that hardly ever finds its way into the academic world or global decision-making levels such as the Intergovernmental Panels on Climate Change (IPCC).

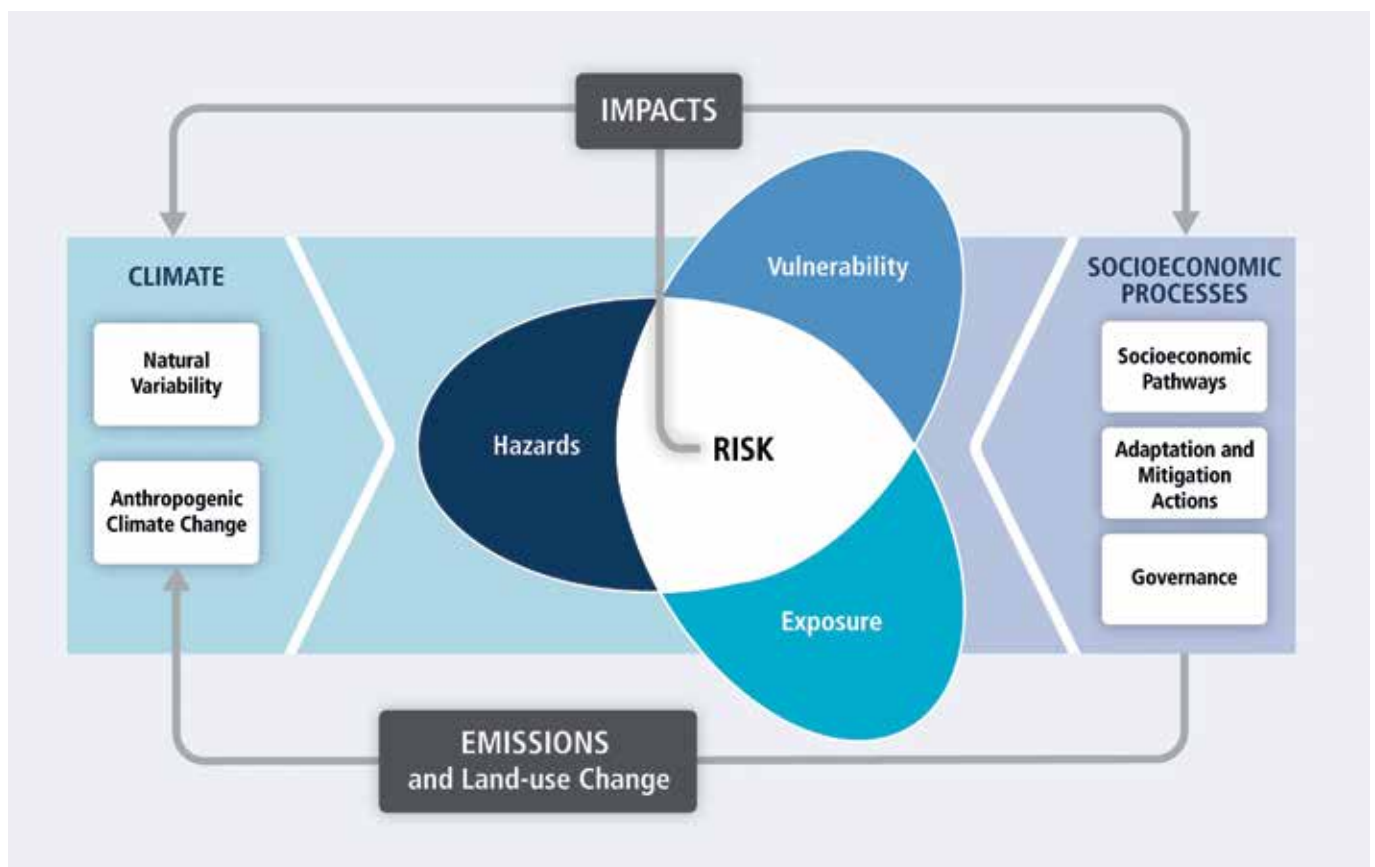


Figure 1 – Risk of climate-related impacts results from the interaction of climate-related hazards (including hazardous events and trends) with the vulnerability and exposure of human and natural systems. Changes in both the climate system (left) and socioeconomic processes including adaptation and mitigation (right) are drivers of hazards, exposure, and vulnerability. [IPCC, 2014]

Ref: IPCC, 2014: Summary for policymakers. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1-32.



Likewise, good scientific knowledge also doesn't flow back to local level decision-making and to the ordinary people whom it concerns. Language or cultural barriers and mistrust are interfering factors, and it is in such instances that organizations like the Red Cross often play an intermediary role.

SPATIAL RESILIENCE

Resilience can't be built in isolation from its direct context. As Figure 1 shows, risk is situated at the centre, although this is not a straightforward top-down relationship. Risk is a convolution of hazards, exposure, and vulnerability that all impact on a person or system. Therefore, risk is influenced by many things. It is also fluid and subject to change – for example as a result of climate change and other factors such as demographic changes, growth in wealth, migration, and urbanisation patterns. Part of our work - hence the title 'spatial resilience' – is to better understand this interplay between risk, hazard and resilience, with spatial resilience referring to location and context, including time.^[3]

For example, the Red Cross Red Crescent (RCRC) works on building resilience in populations and helps respond to disasters. Urban slums are generally most vulnerable when a disaster strikes, for example in case of extreme weather events. When this happens, we act immediately, and we also try to better understand why it happened and trace the antecedents. Slums generally develop in areas that are not ideal for settlement, thereby increasingly putting people at risk. In such cases, besides managing acute situations we document the history and, by doing so, we may be able to anticipate those risks by better understanding the context – in this case the complexity of rainfall forecast, land use, deforestation and so on. Climate change then is one part of the problem, but there are other factors that may aggravate flood risks, such as deforestation upstream. These are the interrelationships that we need to understand better. We also need to make our insights available for



humanitarian use, but also for earlier action, longer-term risk reduction, and regular development planning.

SPENDING WISELY

Working on prevention is thought to be a lot more effective and sustainable than just spending more and more on disaster response. We asked van Aalst what kind of preventive measures are likely to have the biggest impact on reducing the disasters caused by climate change. Van Aalst: 'This is highly context specific, depending on the state of existing risk management and health systems in a country. Take the example of what happened this summer in the Netherlands, and in France. We now see much lower mortality than in the 2003 heat wave in Europe which killed tens of thousands of people. We now have national plans dealing with heat waves, and this has strongly reduced mortality.

Yet despite these plans, including for example formal early warning systems and protocols in hospitals and care facilities, the event this summer still resulted in 400 deaths in the Netherlands (1500 in France). This shows that we can still do more in terms of prevention, in which community mobilization in response to early warnings plays a role. We can ensure that information trickles down to the community and that the community knows how to act – in this case for instance by ensuring that vulnerable elderly people in the community drink enough in periods of heat. In other contexts, such as low-lying coastal areas exposed to storm surges, early warning systems that enable people to get out of harm's way ahead of a disaster can have equal life-and-death results. These are so-called low hanging fruits – where prevention has also proven to have a very good rate of return on economic investment.

The recent report of the Global Commission of Adaptation calculated that investment to alter climate change

and adaptation – 1.8 trillion over the coming decade – is estimated to yield benefits of the order of 7 trillion.^[4]

Investing in warning systems is among the top measures that pay off the most. Other investments include developing smarter cities, better infrastructure, mangrove protection, and making water resources more resilient. However, we need to be sure that warning systems reach the most vulnerable persons in time, that they are as accurate as possible, and that people know what early actions to take. It's also critical to plan these forecasts and early actions well



in advance and to realise that forecasting is a difficult trade. If you wait until a forecast is 100% certain, you are basically too late. However, a false alarm may decrease people's willingness to respond to future warnings, so we should be clear that there is always a certain risk of a false alarm.

It is our task to make people understand these trade-offs. This type of communication with the community is something that requires a lot of attention. It is not always a scientific judgement, but rather a matter where being in tune with the local language and culture becomes crucial.'

GEO-ENGINEERING

Is it time to adapt to climate change by accepting that we are not able or willing to cut greenhouse gasses? Van Aalst: 'The initial discussions on climate change focused on the magnitude and on whether we actually could reduce greenhouse gasses enough to prevent climate change becoming a real problem. Since about 20 years, we have also been talking about adaptation, accepting that we are not doing enough about greenhouse gasses. We also know that there is no perfect adaptation. For instance, when heat-waves get worse, you can start to adapt in society, investing in urban green spaces and promoting behavioural change etc. But we have to acknowledge that we are not keeping pace with the rising risks, and we already do see impacts – including mortality – of



increasing heatwave risks today. In the UN climate convention, this negotiation track is called “loss and damage”.

Looking further ahead, some are already calling for even more drastic options. In the context of the Paris Agreement, countries have agreed we need to keep global temperature rise below 2 degrees, or ideally even 1.5 degrees. It’s a rather abstract number, but the science is very clear that beyond those limits some risks become really difficult to manage. However, we also know that our efforts to reduce emissions are way too slow – we’re currently not on track to keep temperature rise below these limits. And it is possible that at some point there are feedbacks in the climate system that actually lead to a more rapid temperature rise, or that we reach tipping points where the impacts suddenly get much direr very quickly.

This is the sort of situation for which some people are saying we need to be able to quickly cool the climate, for instance through what’s called ‘solar radiation management’ which is basically artificially mimicking volcanic eruptions. In the past, these have indeed led to periods of global cooling, due to large amounts of sulphur dioxide in the upper atmosphere blocking sunlight, directly affecting the radiation balance of the earth, and ultimately cooling down the earth. For instance, in the years after the Mount Pinatubo eruption in 1991, there was a dip in global temperature and even a little dip in global sea level rise. Some suggest that by depositing similar particles into the upper atmosphere with rockets or high-altitude airplanes, we could simply create a similar cooling effect. But there are big questions. First of all, this is not a proven technology. But more importantly, there would also be side effects – for instance on rainfall patterns – side effects that we cannot fully predict. And such cooling also does not stop many of the impacts on our oceans, which will continue to get more acidic with rising CO₂ concentrations. Perhaps most critically, there will then be really tricky ethical issues. There will be trade-offs – with winners and losers from the deployment of such systems – but who

would decide about such deployment, and who will compensate the losers? It is likely that a country that is very concerned about some of the impacts of continuous warming will deploy it unilaterally and hurt others. Finally, there is also the risk that these technologies may be seen as an ‘easy way out’ of global warming, and thus take the pressure off the transition to renewable energy. So in all, this is not a magic bullet that will solve all our problems. Instead we need to keep strengthening our ambition to reduce emissions and to deal with the rising risks we will continue to face in the coming decades.’

A RACE WE CAN WIN?

Last September, the UN Climate Action Summit took place, convened by UN Secretary General Guterres, with tens of heads of state attending. The summit had the subtitle ‘a race we can win’. We asked van Aalst whether he shared this optimism, and how we can (fast) forward the Paris Agreement on climate change. Van Aalst: ‘We need optimism, but we also need the right level of concern and moreover the right level of scrutiny towards the political declarations being made there. One of the reasons I am relatively positive is the stronger voice of youth movements calling their leaders to account. The fact that we have that public outcry alongside the political grandstanding is critical. First of all, the level of ambition that is committed is important. But secondly, monitor how this translates into practice afterwards, and in practical planning and not just by national climate change ministries and governances but across society as a whole. So we indeed need the scrutiny of many Greta Thunbergs – not only in the Climate Action Summit but at all levels, from local communities and cities to national governments and indeed the United Nations.’



Esther Jurgens

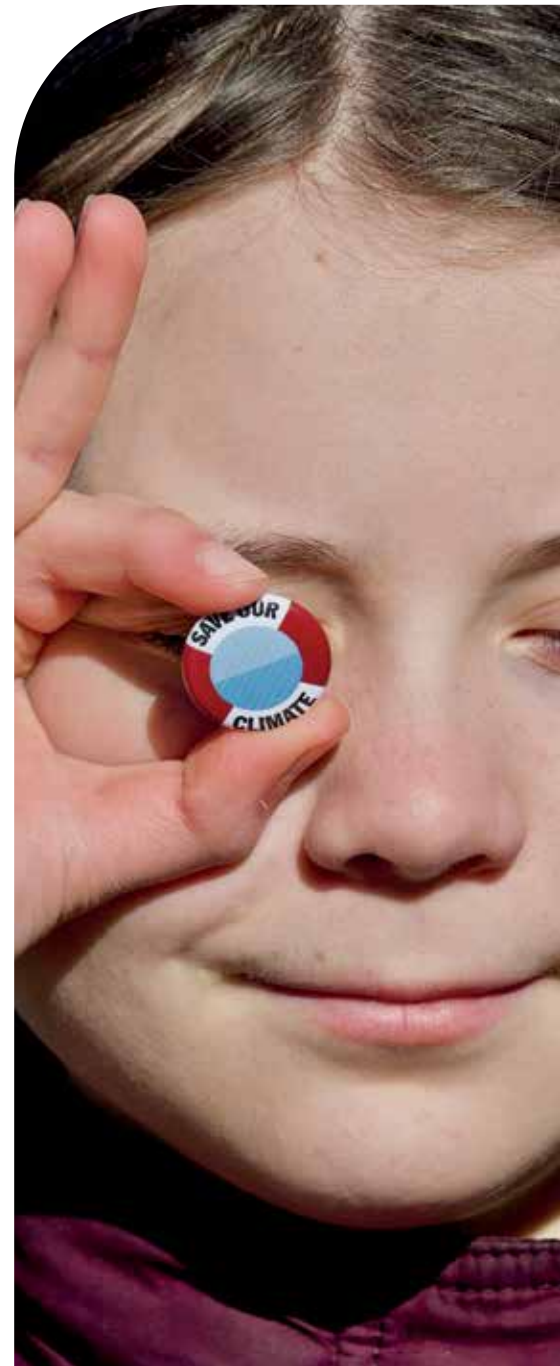
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With the assistance of Olga Knaven, MD.

NOTES

1. The Chair was named after Princess Margriet, honorary president of the Netherlands Red Cross, on the occasion of her 75th birthday. Van Aalst is Director of the Red Cross Red Crescent Climate Centre (<https://www.climatecentre.org>) and Coordinating Lead Author at the Intergovernmental Panel on Climate Change (IPCC) – the UN organization on evaluating the risks of climate change. He is also a scientist at the International Research Institute for Climate and Society, Columbia University, New York, US. Van Aalst studied Astrophysics and Atmospheric Science at Utrecht University and the German Max Planck Institute for chemistry. The focus of his research includes climate change, sustainable development, disaster management and prevention.
2. This article is based on van Aalst’ inaugural lecture (see: <https://vimeo.com/360553013>) and an interview with van Aalst a couple of days after the lecture.
3. Spatial resilience focuses on the importance of location, connectivity, and context for resilience, based on the idea that spatial variation in patterns and processes at different scales both impacts and is impacted by local system resilience, in: Cumming Graeme S (2011). Spatial Resilience in Social-Ecological Systems.
4. See: <https://gca.org/global-commission-on-adaptation/adapt-our-world>

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The effect of climate change on communicable and non-communicable diseases

The World Health Organization has stated that 'Climate change is the greatest challenge of the 21st century, threatening all aspects of the society in which we live'. The impacts of climate change include thawing of permafrost, coastal erosion, increases in droughts, floods and heatwaves, risks to infrastructure and food security, and the arrival of new diseases.^[1]

Climate change affects human health in two ways: there is a direct effect (heat waves, air pollution, storms and floods) and an indirect effect through expansion of mosquito populations (vector-borne diseases such as malaria, dengue), contamination of water (food-borne disease), and deterioration of environmental conditions.^[2]

Models indicate that climate change is not the only factor but that other anthropogenic (man-made) factors also contribute, including socio-economic transformation, human population growth, habitat reduction including deforestation, land use modification and fragmentation ('wild' vs human land use), and change in biodiversity.^[3]

The combined effect of these factors may be summarized as follows:^[4]

- Increased risk of introduction and endemic transmission of exotic diseases from around the world, either direct or vector-borne, such as Severe Acute Respiratory Syndrome (SARS)
- Re-emergence of endemic diseases, such as West Nile Virus disease, Lyme disease and other vector-borne infections in the Americas
- South-to-North spread of disease by increasing vector ranges

The impact of this may be aggravated by the aging populations in which chronic diseases are common.

CLIMATE CHANGE AND VECTOR-BORNE DISEASES

In the past decade, new diseases have (re)-emerged such as Middle East Respiratory syndrome caused by coronavirus (MERS-CoV) in the Middle East, and ebola in Africa. Other vector-borne diseases spread from their endemic areas; for example, spread to the Americas occurred in the case of dengue (from Asia and the Caribbean) and chikungunya, Zika and yellow fever (from Africa). While the incidence of food-borne, water-borne and air-borne diseases may be increase due to climate change, the principal focus globally is on the increase of mosquito-borne diseases that are responsible for 212 million cases per year (malaria, dengue, chikungunya, Zika virus disease).^[3]

The main epidemiological and clinical aspects of mosquito and other vector-borne disease are summarized in Table 1.

Aedes aegypti is the most important vector in this context; it transmits viruses that cause dengue fever, chikungunya, Zika, and yellow fever.

Dengue is globally the most important arboviral infection. In recent years, the disease has spread beyond the main endemic areas (Asia, Caribbean) to virtually all continents with half of the global population at risk. Classically the vector is *Aedes aegypti*, but in recent years *Aedes albopictus* has become a competent vector and has become established in Europe. This is thought to be caused by an increase in their geographic ranges, but genetic changes of these viruses also occur that make them adaptable to animals and possibly facilitate human-to-human transmission.^[4] Mapping suggest that further expansion of *Aedes aegypti* will occur

in Southern Europe with possible spread to Western Europe including Germany and the South of the UK, based on increased temperatures and rainfall. Besides increased temperatures, flooding, urban migration and subsequent overcrowding are also risk factors for dengue outbreaks.

There is no effective vaccine. Intensive vector control is applied with new options for innovative approaches. The intracellular bacteria *Wolbachia*, which interferes with viral replication, has been successfully introduced in wild *Aedes* mosquito populations. The first results look promising, and the result of formal studies in Indonesia and Vietnam that measure the efficacy are eagerly awaited.^[5]

Dengue was followed by chikungunya, a disease that was practically unheard of except in East Africa and has spread widely to the Old and New World. It has now been transmitted, for example, to Japan and Europe, supposedly because of the spread of the vector as the result of climate change.

Zika also originated from Africa and spread to Micronesia and French Polynesia between 2007 and 2014, causing thousands of cases. In 2015, it was introduced in Brazil and spread further to most regions in South and Middle America, with 1.5 million cases in Brazil alone. Up to 8000 cases of congenital neurological malformations have been reported such as microcephaly, as well as retinal abnormalities such as macular and optic nerve atrophy.^[6]

Higher temperatures are not always responsible for vector spread and increased frequency of disease. Tick-borne encephalitis is caused by the *Ixodes ricinus* tick that in Sweden feeds on roe deer. After the massive death of deer during a harsh winter, the ticks fed on small rodents that are likely to be more viraemic and thus

TABLE 1: SUMMARY OF CLINICAL FINDINGS, CLASSICAL AND NEW ENDEMIC AREAS, AND RISK OF FURTHER SPREAD OF THE MOST IMPORTANT VECTOR-BORNE DISEASES.

MICRO-ORGANISM	VECTOR (MAIN)	CLINICAL DISEASE	ENDEMIC AREA (ORIGINAL)	SPREAD TO	CLIMATE CHANGE AS FACTOR	OTHER RISK FACTORS
MOSQUITOS						
West Nile virus	<i>Culex</i> spp.	80% Asymptomatic fever, headache, vomiting, lymphadenopathy 1% encephalitis, and other neurological features. More severe in elderly	Africa	Established: USA, Greece, Romania, Russia Expected: Southern Europe Belgium Netherlands	yes	Migratory birds
Dengue virus	<i>Aedes aegypti</i>	Fever, joint pains, rash, thrombocytopenia, shock meningoencephalitis	Asia N. America	Widely spread globally Recently established: Georgia, Abkhazia, Sochi, Portugal (Madeira) Expected: Spread to W Europe (Germany and south UK)	yes	<i>Aedes</i> spp may be endemic or first became established and then were infected by travellers with Dengue
Chikungunya virus	<i>Aedes albopictus</i> (Asian tiger mosquito) <i>Aedes aegypti</i>	Fever, prominent arthralgia, rash	Africa	Europe, Japan	probable	<i>Aedes</i> spp first became established and then infected by travellers
Zika virus	<i>Aedes aegypti</i> <i>Aedes albopictus</i>	Adults: fever, conjunctivitis, rash; Guillain-Barre syndrome Congenital infection: microcephaly and retinopathy	From Africa (reported in 1950s) to Asia (2007) to South America (2015)	Georgia, Madeira	yes	Introduction expected in Europe particularly where <i>A aegypti</i> is present Sexual transmission also possible
SANDFLIES						
Leishmania spp	Phlebotomus spp	Cutaneous leishmaniasis: chronic skin ulcer visceral leishmaniasis: fever, hepatosplenomegaly		Central and Northern France, S. Germany	yes	Dogs are important reservoirs
TICKS						
Tick-borne encephalitis virus	<i>Ixodes ricinus</i>	Biphasic 1st 'viral illness' 2nd cranial nerve involvement, flaccid paralysis, tremor	Introduced in Europe in recent decades	Sweden, Czech Republic, Baltics (?)	doubtful	Socio-economic, human behaviour, increased awareness
<i>Borrelia burgdorferi</i>	<i>Ixodes scapularis</i> <i>Ixodes ricinus</i>	Lyme disease: malaise, skin rash, myocarditis, neurological abnormalities	Temperate climates	Sweden	yes	
Crimean Congo haemorrhagic fever virus	<i>Hyalomma</i> tick	Haemorrhagic fever	Eastern and Southern Europe	Western Europe	yes	Ticks may arrive with birds, virus with travellers



infectious to ticks with an increase in numbers of human cases.^[7]

The effect of climate change itself and its effect on vectors is even more complex. Infections that are known to appear as major outbreaks after heavy rainfall include Ross River fever and Murray tick encephalitis in Australia and Japanese encephalitis in South-East Asia.^[2] The risk of spread of the vector range is not linear. For Ross River Fever, the optimum temperature 26.4 °C; when temperatures reach the thermal limits, i.e. decrease below 17 °C or increase above 37.5 °C, transmission no longer occurs. This explains why in temperate climates the disease is seasonal. With increasing global temperatures, the disease may spread to non-endemic areas, whereas in other areas transmission may stop if temperatures were already near the thermal limit.^[8]

It is interesting to consider the effect of climate change on helminthic infections. For schistosomiasis, the hotter and dryer climate changes may reduce the snail vector population, which, together with mass drug administration and the possibility of a vaccine, may reduce the incidence of this disease. On the other hand, for lymphatic filariasis, climate change may expand vector ranges and breeding seasons, with increased incidence as a consequence.^[9] With regard to soil-transmitted helminths, *Ascaris lumbricoides* will remain important, while ancylostomiasis (particularly hookworm) is expected to become the dominant species in Africa.^[9]

Climate change may also promote proliferation of an existing vector such as *Anopheles spp.* in previously malaria endemic areas such as the UK or the Netherlands, with the theoretical risk of re-introduction of malaria. The outbreaks of *P. vivax* in Greece (2009-2012) were however thought to be the result of introduction by travellers.^[10]

NON-COMMUNICABLE DISEASES (NCDs) AND CLIMATE CHANGE: IS THERE ANY RELATION?

NCDs are responsible for 70% of global deaths and this number is

expected to rise.^[11] There are parallels between climate change and NCDs; both are preventable, largely caused by human behaviour and they require a multisectoral response. Both are global disasters for which solutions are available; these require leadership and diversion of funds.^[11]

Many impacts of climate change on body systems are still poorly understood. One potential impact is in kidney disease, where dehydration may cause blood hyperosmolarity and reduced kidney perfusion. Heat stroke may cause rhabdomyolysis (breakdown of muscle) with direct effect on kidney function. Poor hydration may predispose to kidney stones and urinary tract infection.^[12]

An impact on mental health has also been suggested directly via heat stress or indirectly, for example via economic loss, threats to health and well-being.^[13]

The effect of climate change has so far focussed on increasing temperatures and the effect of heat on mortality. One review that was mainly restricted to urban areas and did not include Africa or the Middle East showed that mortality caused by cold is greater than that caused by heat, as defined as temperatures below and above optimum temperature. This is thought to be due to (non-communicable) cardiovascular or respiratory disease. Temperature-attributable deaths caused by cold and heat were 7.2% and 0.42%, respectively. The effect of extreme heat (heatstroke) or cold (hypothermia) contributed < 1%. These observations suggest that various climate change scenarios should be taken into account in policy making and adaptation measures.^[14]

CONCLUSION

While the effects of climate change on health are unmistakable, increasing insight shows that other factors - socio-economic and ecological factors as well as urbanization - may be equally important. Vector-borne infectious diseases are likely to become more common in endemic areas as well as in non-endemic areas due to the increasing range of vectors. Other infectious conditions may become less common.

The effects on non-communicable diseases are not yet fully understood.



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WHILE THE INCIDENCE OF FOOD-BORNE, WATER-BORNE AND AIR-BORNE DISEASES MAY INCREASE DUE TO CLIMATE CHANGE, THE PRINCIPAL FOCUS GLOBALLY IS ON THE INCREASE OF MOSQUITO-BORNE DISEASES THAT ARE RESPONSIBLE FOR 212 MILLION CASES PER YEAR

Research in sub-Saharan Africa: telling the stories of burn survivors

Thom Hendriks (32), Global Health and Tropical Medicine doctor, recently came back from Tanzania. Over the past two years, he was working as a medical doctor and a burn care researcher at Haydom Lutheran Hospital. Currently, he is working as a PhD-candidate at the Plastic Surgery department of the Amsterdam University Medical Centre (AUMC). Thom tells about his experiences below. 'Haydom Lutheran Hospital is a fairly large hospital, with 10 Tanzanian specialists, 10 residents and 24 interns. It has four departments: surgery, paediatrics, obstetrics and internal medicine. I was mostly working at the surgery department.'

Thom's week consisted of daily ward rounds, radiology meetings, wound care of burn patients, and operations in theatre. Twice a week, he did a 24-hour call. As second on call, Thom was supervising and training the interns. The third on call, the surgeon, was available for consultation. 'There were many patients in need of surgery and only few doctors available, so the exposure to pathology and surgery was large, and the learning curve steep.'

BURN CARE RESEARCH

Burn wounds are common in sub-Saharan Africa. A frequent complication of burn wounds is burn scar contractures. Contractures are excessive scar formations that can impair joint flexibility and cause disability in patients. Together with his supervisors Matthijs Botman and Paul van Zuijlen Thom decided to set-up a research project about burn care. 'During our work, we noticed that the evidence in the field of burn wounds is scarce. Surprisingly, this lack seems not only relevant for sub-Saharan Africa,

but globally. For instance, worldwide very few longitudinal studies looked into the development of burn scar contractures in burn survivors. Also, few looked into the effectiveness of reconstructions of these contractures.'



Taking care of a paediatric burn patient

To address this Thom embarked on two studies. In the first study he followed patients with a burn wound for one year to study how often burn scar contractures develop in the setting of his hospital. For instance, after one year, 31% of patients developed contractures, compared to 20.9% in the Netherlands. In the second study he follows patients that underwent complex reconstructions of such contractures to study the impact of the surgery. These reconstructions are performed during short-term surgical missions by his supervisors and plastic surgeons of the Amsterdam UMC and Burn Center Beverwijk, supported by Doctors of the World.

RESEARCH CAN HELP YOU BROADEN YOUR HORIZON

'Doing research in a resource-limited setting is pioneers work', says Thom.

'The staff is occupied with clinical tasks, and research is not a priority. This means that you have to set up and do most of the data collection yourself. However, in Haydom the situation was very good. They have their own research department and they supported me. The presence of all the interns and registrar doctors made it possible for me to spend extra hours on my project. And some of the doctors were very interested to learn about research and joined me along the way.'

Thom is enthusiastic when he tells about the benefits of doing research. 'Besides the knowledge you generate with the research, there are more benefits. Research can broaden your horizon, it gives you a long-term perspective', Thom explains. 'Global Health doctors are usually busy with their daily clinical work. If it is possible to devote some of your time to research, it may help to change your perspective. You can focus on a single topic; you have long-term goals and follow patients for a longer time. This helps to build a sustainable relationship with the hospital and its patients. On the other hand, the research project can also be beneficial for the hospital. For instance, results can be used to implement quality improvements and to strengthen the local healthcare system over time.'

BUILDING SUSTAINABLE BRIDGES BETWEEN HIGH AND LOW-INCOME COUNTRIES

When asked what the added value of Global Health doctors is, Thom replies: 'Global health doctors are capable of building bridges and establishing sustainable partnerships. For instance, we can connect the academic knowledge and skills of the Amsterdam UMC with the needs and requirements of Haydom Lutheran Hospital. As a global health doctor we can stay for a long time, and we can learn from each other via bilateral knowledge exchange. While I

NEWS FROM THE NVTG WORKING PARTIES

taught my colleagues about burn care and skin grafting, I learned from them as well – about the extensive pathology we saw, how to treat severe cases, the way culture interacts with our work and how to approach patients in such a setting. Another example is a Tanzanian colleague and friend of mine who came to the Netherlands and followed a course on Global Surgery at Utrecht University. Such exchange programs are very valuable, and I hope they will become more common. I believe it is worthwhile to strengthen such sustainable collaborations in global health.'

TELLING THE STORIES OF THE PATIENTS

Thom is now preparing journal publications of the studies that he conducted and he is enjoying it. 'Research helps me to tell the important stories of the patients and doctors that I met. As global health doctors, we see, do and learn a lot. Since returning to the Netherlands, I have many stories to share, in particular about the lack of burn care for patients in Tanzania or the challenges that doctors face when treating patients with burns. With the results of my study, I can also support these stories with research data so that they become more powerful. It gives me the opportunity to share these patients' stories at conferences and publish them in medical journals, so their voices will be heard. In the end, it's not about the numbers, it's about the message.'



Interview by Nathan Beijneveld, doctor in Global Health and Tropical Medicine in training (16-08-2019)
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"Into the World" Campaign Medical Doctor Global Health and Tropical Medicine

Into the World is a campaign that was launched by members of the Dutch Society for Tropical Medicine (NVTG) to raise awareness of the role of Dutch medical doctors in Global health and Tropical Medicine (AIGT). A beautiful book was published with personal stories and perspectives on international health, available in both Dutch and English. This fall, the campaign is publishing brand new online material containing stories on the important work in the field of Global Health that these passionate doctors do. Interested? Take a look via our website www.mdglobalhealth.com, via Instagram (campagne.intotheworld) and our Facebook page (@artsIGT)!

Into the World calls for a change in the Dutch training climate for medical doctors – striving for attention towards and awareness of the importance of Global Health as well as sustainable training for Global Health doctors. Our climate is changing. In this time of globalization, we are all world citizens. It is time that our government takes responsibility for sustainable funding for the training of global health doctors. [1] The system is in place, doctors are keen, and the training program is recognized by the Royal Dutch Medical Association (KNMG) – what remains is only a small step out Into the World.



Thom and his team in the operating room.



Everything changes, including the climate

Public health authorities are preparing for future threats and are projecting the likely impact of climate change on public health risks. In doing so, it is easy to get overwhelmed by the volume of heterogeneous information in scientific articles and public opinions. During the last fourteen years, working as an entomologist in the Public Health domain, I frequently participated in discussions among various stakeholders. In each instance, participants were passionate, but not necessarily talking about the same thing. The reason is that both vector-borne diseases and climate change are broad concepts. Therefore, important questions to ask ourselves are i. What are we talking about? ii. What do the numbers tell us? and iii. What are probable causes of the changing numbers?

WHAT ARE WE TALKING ABOUT?

Vector-borne diseases are caused by pathogens that are transmitted by blood sucking arthropods. Globally, the burden in humans is dominated by diseases transmitted by mosquitoes, especially malaria and dengue, followed by those transmitted by ticks, sandflies and to a lesser degree by triatomine bugs, lice, fleas and mites. In livestock, productivity loss is mainly caused by pathogens transmitted by biting midges. In total, vector-borne diseases comprise well over a hundred diseases that are caused by viruses, bacteria, protozoa, and helminths; many are zoonoses. The intricate biological processes underlying the interactions between pathogens, vectors and their vertebrate hosts make the predictability of disease risk a risky business and very difficult.^[1]

Climate change can be defined as any significant long-term change in the expected patterns of average weather of a region or the entire world over a

significant period of time. In current debate, climate change is synonymous with global warming, whereas climate change also involves rising sea levels, increasing UV radiation, changes in rainfall and wind patterns and consequently relative humidity. Climate change also impacts land use and land cover, crop suitability and agricultural patterns and human behaviour.

Since an important part of the life cycle of pathogens takes place outdoor in cold-blooded vectors, global changes including climate change can lead to changes in the transmission dynamics of the pathogens with the ultimate consequence of a change in disease risk.

^[2] However, without explicitly specifying ‘which disease, where, when and how’, making generalized statements that go further than ‘climate change affects vector-borne diseases’ can be misleading. A contextual approach is needed to understand climate and human health and to develop public health strategies.^[2] To set a good example, in the following, I choose to discuss the case of dengue in Brazil.

WHAT DO THE NUMBERS TELL US?

In their “Dengue – Epidemiological Update of 13 September 2019”, the Pan American Health Organization reported that in Brazil, between epidemiological week 1 and 34 of 2019, a total of 1,439,471 probable cases of dengue were reported, of which 1,015,124 cases were laboratory-confirmed. Among the confirmed cases, there were 591 deaths, and 486 deaths remain under investigation. The incidence rate is about 6 times higher than in the same period of 2018.^[3]

Since the large year-to-year variation in dengue incidence is characteristic for endemic countries, long-term surveillance data are necessary to see whether 2019 was an exceptional epidemic year. Nunes et al. showed that over the last 30 years Brazil (1986-2015) experienced extensive epidemics, characterized by emergences and re-emergences of

different dengue serotypes and a strong increase in the number of severe and fatal cases.^[4] The latter is illustrated by the case numbers (fatalities) of the main epidemic year in each of the three decades: 104,399 (0) in 1991, 696,472 (159) in 2002 and 1,649,008 (986) in 2015. While the numbers for 2019 are comparable to those of 2015, the long-term data show a dramatic increase of cases of dengue in Brazil during the last three decades.

WHAT ARE THE PROBABLE CAUSES OF THE CHANGING NUMBERS?

Dengue epidemiology is determined by the interaction between the virus, mosquito vector and humans, and we need to look for its drivers and for changes therein. The dengue virus has four related but antigenically distinct serotypes (DENV 1-4), each having several different genotypes. Viral genotype and serotype, and the sequence of infection with different serotypes, are known to affect disease severity, also known as antibody-dependent enhancement of infection.^[5] The mosquito species responsible for vectoring the vast majority of dengue cases in the world, including Brazil, is the yellow fever mosquito *Aedes aegypti*. This mosquito species feeds almost exclusively on humans and thrives in urban settings.

^[1] Many factors have been identified as having contributed to the emergence of epidemic dengue. In 2011, Gubler recognized three principal drivers: 1) urbanization, 2) globalization, and 3) lack of effective mosquito control.^[6]

NEITHER CLIMATE
NOR THE CHANGE
THEREIN PLAYS A
SIGNIFICANT ROLE IN
THE INTRODUCTION OF
ASIAN TIGER MOSQUITO
IN THE NETHERLANDS



Between 1986 and 2015, the percentage of Brazil's population living in cities grew from 70.7% to 85.8%.^[7] In the same period, the total Brazilian population grew from 138 to 206 million inhabitants.^[7] As a result, the number of people living in cities nearly doubled (98 to 176 million) in 30 years. Scaling theories suggest that global urbanization is driven by a phenomenon known as superscaling, in which doubling the size of a city increases wealth and innovation by approximately 15% per capita.^[8] However, besides positive aspects, there are negative influences as well, such as increases in the amount of garbage, AIDS and possibly dengue.^[8]

Second, globalization has implications for the way in which countries interact with each other and for people's behaviour. The Dengue virus has also globalized as people travel more than ever before. In Brazil, this has resulted in the co-circulation of the four dengue virus serotypes and the increasing occurrence of severe and fatal cases.^[4,5]

Third, like elsewhere in the world, Brazil lacks effective mosquito control strategies.^[6] Shortly after World War II, the use of synthetic insecticides against larval and adult mosquitoes grew in importance.^[1] At the same time, it became apparent that mosquitoes quickly develop resistance to any newly developed insecticide, leaving the vector controllers nowadays largely empty handed.^[9] This has led to a (re) appreciation of population reduction or replacement by sterile insect techniques, which are neither easy nor cheap and have their own challenges.

More recently, the possible influence of climate change on the emergence of dengue worldwide has entered the discussion. This may be due to the fact that the temperate world has been confronted with the incursion of invasive mosquitoes.^[10] However, when focusing on Brazil, *Aedes aegypti* has been inhabiting Brazilian cities in vast numbers, ever since the investments in vector control programs were abandoned in the mid-1970s. In addition, the effect of the increase in temperature due to climate change has been most pronounced in

temperate areas where temperature is a limiting factor. For the biggest part of Brazil, this is not the case. The impact of climate and climate change, including precipitation patterns, on the geographic distribution of dengue is still uncertain and needs to be investigated.^[11]

WHAT ABOUT THE NETHERLANDS?

Higher summer temperatures in Netherlands will likely increase the risk of the emergence of mosquito-borne diseases. However, other factors, particularly anthropogenic ones, will undoubtedly play more important roles. For example, neither the climate nor the change therein plays a significant role in the introduction of *Aedes albopictus* or Asian tiger mosquito in the Netherlands. These mosquitoes are introduced via imported goods, and prevention is currently focused on this type of incidental introduction. Kraemer and colleagues state that the distribution of the main dengue vector, the *Aedes aegypti* and its relative *Aedes albopictus*, over the next 5–15 years is predicted to occur independently of extensive environmental changes, as both species continue to expand into their anthropogenic ecological niches through spatial dispersal.^[10] The increase of imported dengue in Europe is predominantly due to the fact that global dengue incidence was high (see above) and therefore also the related risk (of the ever increasing number) of international travellers importing the virus into Europe.^[12]

In conclusion, while climate change currently dominates the public debate, other global and local changes are more important when it comes to the spread of dengue.



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MAKING
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A young female with Casal's necklace

Consult Online is a digital consultation service, designed for medical doctors in global health and tropical medicine working in remote areas with limited resources. For more than 10 years, associated medical specialists have been assisting doctors abroad with advice on differential diagnosis and treatment for difficult cases, provided free of charge via email correspondence.

Find Consult Online here:
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Photo 1. Casal's necklace: erythematous pigmented skin rash, encircling the lower part of the neck (a sun-exposed area).

CASE

A 25-year old female rice farmer came to the outpatient clinic with a sudden onset of painful erosions and superficial ulcerations on both legs since two weeks, now spreading to her arms, chest, face and mouth. After a few days, some of the wounds began to deteriorate, producing a watery discharge and a bad odour.

On examination, she did not look ill, had normal vital signs, and was alert and adequate. Necrotic tissue was visible on both legs and multiple burn-like erosions were seen on feet, hands, neck and face. Rapid diagnostic tests for HIV and syphilis were negative. The family could not pay for any extra diagnostic tests. Due to the need for daily wound care, the patient was admitted to the female surgery ward.

SETTING

This case was from Tanzania. Despite the relatively high economic growth over the last decade, about 13 million people still live in extreme poverty in Tanzania.^[1] The life expectancy at birth

occupations in the region are agriculture, livestock keeping, and fishing. The hospital has more than 300 beds. An ICU, an operating theatre, and a laboratory with basic diagnostic facilities including cultures are present.

in Tanzania is 66 years. Main health-care characteristics show prevalence of thinness (BMI < 18.5 kg/m²) among women of reproductive age to be about 10% and prevalence of anaemia in the same group to be 40%.^[2]

The patient described presented at a district hospital near Lake Victoria. The main

SPECIALIST ADVICE

Dermatologists of Consult Online were asked for advice on the most likely differential diagnosis and treatment options. The dermatologists pointed out that the affected areas of the skin were all areas exposed to sunlight. They stated that the affected area in the neck is called 'Casal's necklace'.





Independently, they all came to the conclusion that pellagra was the most likely diagnosis, a disease caused by a vitamin B₃ deficiency. Probably, a secondary bacterial infection emerged over the last days. The dermatologists advised supplementation of vitamin B₃. The secondary infected wounds should be treated with antibiotics, and good wound care is essential. Furthermore, the specialists advised that causes of pellagra should be evaluated.

FOLLOW-UP

The patient started with supplementation treatment (nicotinamide). Dietary advice was given to improve her nutritional status. Soon after starting the nicotinamide, the skin lesions improved significantly and no new lesions emerged. Unfortunately, once daily wound care was no longer necessary, the patient stopped showing up for follow-up at the hospital.

BACKGROUND

The Spanish physician Don Gaspar Casal first described pellagra in 1735: a multi-system disease caused by a cellular deficiency of niacin.^[3] Niacin (vitamin B₃ or nicotinic acid) is widely distributed in plant and animal foods. Rich sources are meats, yeast, grains, legumes and seeds. In high-income countries, pellagra can occasionally be seen in patients with alcohol abuse, HIV infection, anorexia and patients with malabsorption (for example Crohn's disease). In low- and middle-income countries, pellagra is more widespread.^[4]

CLINICAL FEATURES

Pellagra is characterized by a photosensitive pigmented dermatitis, diarrhoea and dementia. The symptoms do not always appear in this order and most often this triad of symptoms is not complete.^[5] Pellagra is characterized by a chronic course with periods of exacerbation and remission. If not treated in time, it may result in death from multi-organ failure.^[3]

The skin lesions are typically located symmetrically in sun-exposed areas. Initial clinical manifestation is often erythema and itching on the back of the hands.^[6] Subsequently, the skin becomes



Photo 2. Secondary bacterial infection of the wounds on both feet.

oedematous and vesicles or blisters may develop. Thickening and hyperpigmentation occur progressively. Painful fissures may develop on palms and soles.^[6] Gastrointestinal disorders include diarrhoea and vomiting. Neuropsychiatric manifestations are diverse; headache, loss of concentration, apathy, confusion and memory loss may occur.^[3]

TREATMENT

The treatment for adults with acute pellagra is oral nicotinamide 100 mg 3-4 times daily until resolution of major acute symptoms (often after several days), followed by 50 mg twice daily until the skin lesions are healed.^[3] It is recommended to add vitamin B complex since patients very often also have a deficiency of other B vitamins. Perhaps even more important, appropriate dietary advice should be given for the future.



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Linkages between climate change and sexual and reproductive health & rights: a demographic perspective

Global warming is projected to reach 1.5°C between 2030 and 2050 and the expectation is that the impact of climate change on socio-ecological systems will be grim and widespread. Although countries are already grappling with climate-induced food scarcity and the associated sustained displacement and mobility of people, available empirical evidence suggest that climate change is taking a toll on human health and changing the morphology of disease transmission^[1]. The World Health Organisation (WHO) estimates that climate change will account for about 250,000 deaths per year due to malnutrition, malaria, diarrhoea and heat stress between 2030 and 2050^[2]. Alongside increasing mortality and morbidity due to drought, extreme heat and hurricanes, the associated changes in temperature, water and air quality have already contributed to the resurgence and increased virulence of several infectious diseases^[3].

**BY 2050
THE GLOBAL
POPULATION IS
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TO ABOUT 9.7
BILLION PEOPLE**

Besides increased recognition of the health implications of climate change, there are also concerns that continuous population growth, urbanisation and unsustainable consumption patterns will undeniably contribute to greenhouse gas emissions which in turn will have adverse implications for climate

change and associated impact on human health. Similarly, debates in the media and political circles have revolved around the suggestion that we – as a global society – should focus on reducing fertility rates because of population growth being responsible for (further) climate change. Whilst some scholars particularly highlighted the difficulty in determining the extent and magnitude of the future impact of population growth on climate change, others have bemoaned the glaring absence of population components in climate change policies and negotiations^[4,5]. Linkages between population growth, reproductive health and climate change have long been a neglected (research) area, although recently more efforts have been invested in better understanding the dynamics between these areas^[6].

This article seeks to stimulate a debate on population dynamics as a climate change mitigation response. It examines the role of Sexual and Reproductive Health and Rights (SRHR), and in this light proposes a rights-based approach to sexual and reproductive health in discussions on population and climate change, instead of an approach based on family planning alone^[7].

CLIMATE CHANGE AND POPULATION POLICIES

By 2050 the global population is expected to have increased to about 9.7 billion people, which evidently will be one of the significant drivers of greenhouse gas emissions and global climate change. Scholars advocate for population stabilisation or control as a viable way to address climate change and the associated impacts^[8]. The prediction is that population stabilisation will likely contribute to a 30% to 40% decrease in emissions and subsequent decrease in global warming^[9].

For many years, consideration of using

population policy to mitigate climate and environmental change has largely been ignored or silenced^[8]. In the view of Bongaarts and O’Neil [5 (p 650-652)] this seeming disregard is attributable to four misconceptions: (1) population growth is no longer a problem; (2) population policies are not effective; (3) population does not matter for climate change; and (4) population policy is too controversial to succeed. Stephenson et al.^[6] express the fear that linking population to climate change may shift attention away from the primary problem of high consumption in developed countries. They suggest that it could also further encourage putting the blame on “people in developing countries who are worst affected by climate change but have contributed very little to carbon emissions”^[6] (p 1670). Bongaarts and O’Neil^[5] argue that a neglect of sexual and reproductive health services as an integral component in climate change response policies undermines climate change mitigation and adaptation efforts in the long term.

LIMITATIONS AND PROSPECTS

The emphasis on population control or family planning as a strategy for climate change mitigation may exaggerate/emphasize population increases without addressing other factors influencing climate change, such as consumption patterns and levels of economic development^[10]. In addition, the ICPD 1994 Programme of Action stipulates that access to contraception and, more broadly, reproductive rights are universal rights. Every person should be free and have access to their choice of contraception, irrespective of its relation to the environment, leaving aside environmental arguments.

Increasing access to contraception alone would not be the right argument for climate change mitigation. This argument suggests a straightforward



causal relationship between contraceptive access and use, and overlooks the fact that perceived side effects or power relations within couples may prevent contraceptive use even when it is available^[11]. We need to invest in education, health, women empowerment, (gender) equality and power relations^[12,13]. This line of reasoning is further supported by the principles of the demographic transition model which suggest that declines in mortality, due to improved housing, sanitation, nutrition and health care, will lead to declines in fertility.

LOW-INCOME, HIGH-FERTILITY COMMUNITIES OFTEN LIVE IN THE REGIONS THAT ARE EXPECTED TO BE HIT EARLIEST AND HARDEST BY THE CONSEQUENCES OF CLIMATE CHANGE

Karen Newman^[14] – an internationally well-known promotor of reproductive rights for sustainable development – emphasizes that low-income, high-fertility communities often live in the regions that are expected to be hit earliest and hardest by the consequences of climate change, as attested to by the floods in Bangladesh and droughts in the Sahel over the past years. In North-East Ghana, communities experience hunger due to meagre food resources, psychological stress from crop failure, laborious farm work and climate-related migration. The excess intake of alcohol as a coping mechanism for distress from climate-related crop failure and lack of food also promotes violence and abuse within the household^[15]. Sustaining large households may increase vulnerability to climate change because families are left with less capacities to adapt^[13,14]. To increase resilience, Newman^[14] suggests interventions that integrate SRHR in climate change mitigation and adaptation projects. Examples include providing fuel-efficient stoves - which eliminates the need to collect fire wood - to women and girls who are at increased risk of gender-based violence, and the

Blue Ventures project in Madagascar where rates of unintended pregnancies have declined after sexual and reproductive health services were integrated in projects that address food insecurity and environmental degradation^[12].

CONCLUSIONS

Low-income, high fertility communities often live in regions that are severely affected by climate change. Addressing the unmet need of contraception in these communities may reduce their vulnerability to climate change. However, we should avoid a narrow interpretation of SRHR that focuses only on access to contraception. For instance, sexual education can contribute to individuals making informed choices about if, and when, to have children. Thus, a comprehensive approach to SRHR and wider efforts to increase wellbeing are needed to empower communities to respond to the challenges posed by climate change.

JOIN THE DEBATE

The Knowledge Platform 'Share-Net Netherlands' will further explore the linkages between SRHR and climate change during the NVTG symposium on November 6 and in a special thematic meeting planned for early 2020.



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Thinking about waste: a case study on the perceptions and practices of food waste in The Hague

There is enough food to feed everyone on the planet, but an estimated 821 million people go hungry every year, with many more suffering from food related challenges, such as wasting, stunting, micronutrient deficiencies and obesity.^[2,3] Paradoxically, almost a third of all edible parts of food – about 1.3 billion tonnes per year – are lost or wasted.^[1] In low-income countries, food loss and waste (FLW) occurs early in the food system (costing about US\$ 300 billion); by contrast in higher income countries FLW occurs in the latter stages of the food system, specifically retail and consumption (costing almost US\$ 700 billion).^[1]

While food loss (FL) implies 'the decrease in the quantity or quality of food' before it reaches the consumer, food waste (FW) is 'the discarding or alternative use of food that is safe and nutritious' primarily in the consumer phase.^[2] In the European Union (EU) an estimated 88 million tonnes of edible and inedible parts of food are lost or wasted yearly, with an associated cost of €43 billion.^[13] Households account for 53% or 47 million tonnes of the total EU's edible and inedible waste.

The Netherlands is identified as the largest generator of FLW by volume, between 1.77 and 2.55 billion kilograms, with consumers accounting for the largest share, ranging between 33%–38% of the total.^[13] Assessed as a public health problem, FLW relates to questions of food insecurity and nutrition,^[11,2] both

increasingly pressing concerns in the Netherlands since data indicate increasing use of food banks and food price increases in 2019.^[14]

METHODOLOGY

This study's leading research question was: How is household FW perceived and managed by different communities living in the Central Innovation District (CID) of The Hague? The study concentrated on households, hence the focus on food waste. The research question was operationalized through a mixed-methods approach, including cross-sectional survey, PhotoVoice and focus groups. In this paper, we report on the findings from the PhotoVoice study.

Given that the terminology, understandings and practices of FW can vary, study participants chose to join one of three language communities – Dutch speaking (DS), English speaking (ES) and Arabic speaking (AS). They took photos of their FW during one entire week in September and October 2018. While the topic of FW was provided, participants were free to define, interpret and associate their own practices, registered in the photos. During the interview, each participant selected 3 photographs and discussed their stories in line with the SHOWeD framework: what is seen? what happens? how does this affect our lives? why? and what can be done about it?^[15]

RESULTS

REVEALING PRACTICES THROUGH THE PHOTO-TAKING PROCESS

For the participants, FW was a complex and nuanced practice that included buying too much food, dealing with leftovers and handling vegetable scraps. FW is 'multi-faceted ... and it's a very tricky one in our prosperous society' (DS6). Plastic waste was repeatedly cited as contributing to FW: 'I did bring all

kinds of snacks ... and then all of a sudden you have so much plastic' (DS5).

The photo-taking process allowed participants to critically reflect on their own FW practices: 'You know, we ignore in day-to-day life or we do not pay attention like wastage' (ES3). This triggered certain changes in household practices, including reducing portion sizes for children, improving household communication and rethinking the food preparation process. Participation also spurred conversations outside the household; participants discussed food waste with colleagues and friends and felt it was an important issue to raise awareness.

THE HOUSEHOLD: TRANSITION FROM FOOD TO WASTE

Food does not automatically become waste; there is a process that begins before food is being thrown away and its transition to waste. This process is affected by sensory cues, such as smell and/or visual defects (mould), indicating when food becomes waste (Photo 1).

Cultural beliefs about when food should be eaten and storage of leftovers impact the transitions to waste. For example, some participants asserted that food needs to be eaten fresh (within one hour of being cooked) to ensure proper nutritional quality; any leftovers were discarded rather than stored: 'Because the food is more healthy if it is eaten within an hour ... I see most of the time when we make more ... it goes for waste' (ES2).





Photo 1. 'It was at the back of the fridge and got forgotten about.' (ES6)

UNAVOIDABLE WASTE

Most household waste was associated with food preparation (Photo 2). Some food waste is deemed unavoidable such as eggshells, coffee grounds, tea bags and peels. Some participants were unsure how to classify certain forms of waste, such as carrot tops and cucumber ends (Photo 3).



Photo 2: Food preparation waste of DS1.



Photo 3. 'It was a different kind of waste.' (ES7)

CHILDREN MAKE A DIFFERENCE

Households with children struggled to control preferences in relation to FW. Provisioning of food especially for children was highlighted as a concern. Parents did not seem to serve correct portions to children, who also went through phases where more or less food was consumed. Several participants spoke about altering portion sizes: 'I started thinking about making smaller sandwiches for the children' (ES5); but there was a resignation that FW is something 'that you get automatically with small children' (DS4). (Photo 4)



Photo 4. 'That's a lunchbox [...] That also occurs a lot [...] I ask: 'What do you want for lunch?' and then I prepare that, and she leaves half of it.' (DS5)

WASTE IS CONNECTED TO THE PROCESS OF PLANNING, PURCHASING AND CONSUMPTION
Households spend a lot of time on food work such as planning, cooking, storing and consuming food. An aspect that can hinder this planning effort is the difficulty of finding items in adequate quantity for consumption: 'It's very difficult to buy the right amount ... I never make it through a bag of bread' (ES7).

BEYOND THE HOUSEHOLD: CHALLENGES TO REDUCE FW

Household specific waste is linked to wider municipal, state, country and global systems related to food cultivation, subsidies, system-level practices, waste disposal systems and available purchasing options. For example, there was a lack of options for non-plastic wrapped food (Photo 5). Attempts to reduce plastic related food waste may involve finding other places to get groceries. However, one participant noted

that even at the market in The Hague many vegetables can only be bought in bulk: 'We basically bought a whole lot of bell peppers' (ES1); while plastic waste was reduced, the quantity of food did not align with needs, resulting in waste.



Photo 5. Plastic recycling by ES5.

INFORMATION AND TRUST

The availability of trusted information is another aspect that affects FW. For some, food disposal is dictated by expiration dates: 'Because of my financial situation, I try also [not] to waste ... But sometimes ... If it is expired then I have to throw it away' (AS1). But for some, the final decision to waste food depends on the sensory appeal of food: 'What I also consider a good thing is that I pay a little less attention to ... the "best before" date ... now I am more like: taste it first, smell it for a bit, just check whether it is really already off' (DS3).

FOOD WASTE MANAGEMENT SYSTEMS

Participants spoke about lack of information in relation to recycling facilities, processes, requirements and access to such facilities. Particularly important here are the difficulties of dealing with organic waste (lack of information about composting, infrastructure for home composting, or the availability of a GFT bin/collection point). Some participants did use the week of taking photos to better identify the different types of waste associated with food and looked into the municipal waste management systems to determine what can be placed in which bin.

CONCLUSIONS

Food waste is an interplay between households, the municipality, and the food system (including producers and suppliers), negotiating what is and is not controllable. Participants in the study were generally unaware of the extent of their FW until the PhotoVoice; this research gave them opportunities to visualize and potentially act upon their FW. Control over FW management is dependent on the levels of consciousness and information people possess. Some scholars indicate FW is not just one behaviour but a chain of practices including planning, buying, use, cooking and leftovers management, which all culminate in waste.^[5,7,12] Attempts to understand household FW management to determine the best strategies for behaviour change have produced mixed results.^[4,6,8,9,10,12] Unlike in other research, participants in this study were willing to accept responsibility for their practices of unconscious and/or uninformed FW. A different issue relates to aspects out of their control e.g. quantities per unit item for sale and plastic packaged food. Significantly, it was not the plastic shopping bags but rather the plastic wrapping of many items and ready to eat meals that presented what was perceived as an unavoidable challenge. There is a desire to 'do the right thing', yet socialization and time management to improve food planning are barriers.

Through this study, we argue for a broader approach to examine, understand and act upon FW. While FW can be fought in the household planning and provisioning phase, efforts to reduce FW should also involve the wider food system and municipal governance. To produce change, FLW cannot be thought of separate from the wider social, economic, and political systems linked to consumption, food insecurity and food safety.

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WE IGNORE IN DAY-TO-DAY LIFE OR WE DO NOT
PAY ATTENTION LIKE WASTAGE

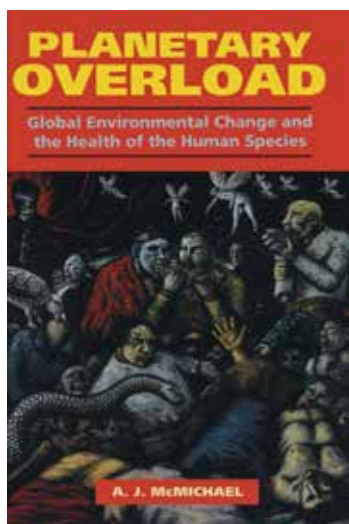
Humans are newcomers

Antony J. McMichael (1993)

Planetary Overload: Global Environmental Change and the Health of the Human Species

Cambridge University Press
Number of pages: 352
Price: € 51,99

Although published in 1993, *Planetary Overload* could have been written yesterday. The statistics may be somewhat obsolete but its message certainly is not. Could humans really become ‘an endangered species’? It may sound like science fiction, but this resourceful, intelligent book describes how this actually could become reality if we continue to damage ecosystems with overpopulation, the spread of technology, and our conspicuous consumption - trends which since the publication of this book have only intensified - and continue to disrupt the subtle balance between human populations and our life-support systems. Thereby steadily overloading our Earth’s capacity to absorb, replenish and repair.



Planetary Overload has three parts, with the first four chapters discussing the nature of the problems posed by ecological disruption, and presenting the possible impact of environmental changes on human health. The second part is what McMichael refers to as the ‘meat of the book’, in which he reviews the underlying problem of excessive population growth. This is followed by five chapters exploring the origins of ecological disruption: climate change, stratospheric ozone depletion, land degradation and the impairment of food production, loss of biodiversity, and the burgeoning growth of cities. The final three chapters place these phenomena in a broader social context, exploring our impediments to addressing the root causes of macro-ecological problems and the inequalities of wealth,

trade and influence. Readers are challenged to reflect on the limitations of neoclassical economics, the effect of structural adjustment programmes (cutting government expenditure in ‘non-productive areas’), how we can reconcile economy with ecology, and what we mean by growth and development in light of the impact of these processes on human health.

The final chapter presents ways to address the systemic causes of environmental problems in today’s world: massive population growth; third world poverty and a festering burden of debt of poor countries; non-sustainable consumption and biosphere-damaging waste generation in rich countries; widespread non-sustainable agricultural practices; and the environmentally damaging industrialisation and exploitation of natural resources in poor countries struggling to increase export earnings. McMichael’s list is long and although the magnitude of the problems is overwhelming, he does offer some hope. *Planetary Overload* is skilfully written, though not always an easy read, as the book is packed with data, figures and statistics. On the other hand, according to the author himself ‘what is most important here is not factual detail, but the overall import of the analysis and argument’.

Humans are relative newcomers: we have walked on our planet’s surface for less than one ten-thousandth of Earth’s lifespan. We really are newcomers, with no special immunity against the usual fate of biological species on Earth: extinction. Wisdom comes with experience and age, and the capacity to learn from past mistakes. *Planetary Overload* is a compelling invitation to prove our name right, *Homo sapiens* (wise), and to start learning the lessons that are staring us in the face.
Esther Jurgens

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