18

FROM SOCIAL REFORM TO SOCIAL TRANSFORMATION

Human Ecological Systems and Adaptation to a More Hostile Climate

HILARY BAMBRICK AND STEFANO MONCADA

Abstract

Improving public health frequently involves bringing about societal change. Increasingly large-scale and complex problems such as climate change pose significant threats to human health and impel re-conceptualisation of environment–human interrelationships, affording them the complexity they deserve and the opportunity to think 'ecologically'. Large-scale problems often trigger a large-scale response, but these attempted solutions may be slow to materialise, a poor fit to the local context, unsustainable and are often poorly evaluated. There is also a place for locally relevant community-managed activities, aimed not only at reducing adverse health impacts caused by the very large problem of climate change but also by improving other determinants of environmental health and poverty. One such potential case, in Ethiopia, is described.

Introduction

Since its very early days, successful public health has been a vehicle for social reform, driving fundamental changes to the human environment in order to understand and improve health, and to address inequalities. Much of what we think of as 'public health' could equally be called 'environmental health'. It recognises the importance of *context* to the capacity for a population to be healthy. It strives to make our surroundings conducive to better health, optimising benefits for the population at large by making changes to the settings in which

we go about our daily lives. The domain of public – or environmental – health, then, is very broad. It does not take an individualistic, curative, short-term, market-driven approach but is more concerned with disease prevention on a mass-scale and with long-term benefits to health and well-being. By definition, it is a progressive movement, arising from a core concern for social justice.

Over time, the type of exposure of interest to public health researchers and advocates has evolved, from solely 'miasmic' concerns to biological and then chemical and physical agents, and also, more recently, to embrace systemic environmental change. Biological agents – bacteria, viruses (though not identified as such at the time) – were the primary domain of the early public health movement, bringing about profound changes to water distribution and sanitation infrastructure. Chemical and physical agents, largely by-products of industry, then became of increasing concern with economic development. Vehicle emissions, pesticide residues and chemical waste are now all subject to legislation and control, though, like sanitation, this achievement has been greatest in more developed countries.

For much of the past 150 years, this focus on biological and chemical agents was appropriate, given the expanding knowledge of their associations with health. In hindsight, these problems appear relatively simple and well-defined, confined in time and space to readily describable and mechanistically straightforward causal chains. They frequently have linear dose–response relationships, or a definable risk threshold, and clear, observable benefits arising from action taken to minimise exposure. A traditionally scientific reductionist approach may be appropriate in these circumstances in order to identify specific agents responsible for ill health and to intervene to reduce exposure.

The Next Public Health Challenge: Eroding Civilisation's Life-Support Mechanisms

In contrast, and more recently, we have come to realise the significance of a third type of exposure, in that contemporary and substantial threats to human health are now resulting from large-scale disruptions to our life-supporting ecosystems. These involve changes that occur on a very large scale over space and time, affecting environmental stability, productivity, regenerative and waste-absorptive capacities and biodiversity. These systemic changes are shaped by complex social, political and economic drivers. Their associated health outcomes are more difficult to identify, measure and act upon than exposure to the simple causative agents described previously. A key example of such a large-scale and potentially intractable threat is anthropogenic climate change (Martens and McMichael, 2002).

Studying the health impacts of systemic environmental change requires new methodological approaches. Measurement of exposure at the community or broader population level is more appropriate (and feasible) than at the individual level, which is difficult to quantify. The challenge is to think 'ecologically', paying special attention to interconnectivity while recognising that associations may be indirect, non-linear and multidirectional. At the same time, it is essential not to lose sight of what is happening at the scale at which people actually live.

Tackling the consequences of climate change thus requires a kind of revolutionary thinking and revolutionary action, including in public health and epidemiology. After two decades of research effort into the potential health impacts of climate change, we are still developing a comprehensive understanding of what some of these impacts might be, let alone what we can do about them. We know, for example, that people die when temperatures are unusually hot, especially if they are older, unwell and socially isolated (Harlan et al., 2012). Mathematical and empirical modelling tell us that, up to a certain point and as long as humidity is sufficient, an increase in ambient temperature promotes the transmission of vector-borne diseases through its effects on vector survival and behaviour, as well as on pathogen replication (Jetten and Focks, 1997; Patz et al., 1998; Hales et al., 2002; Rogers et al., 2006). While such parameters determine whether or not a disease *can* occur, we know that the economic status of a country affects the intensity of transmission or even whether a certain disease *does* occur, given suitable parameters. We can therefore surmise that social and economic conditions will determine to a large extent how climate change will affect health, so that certain countries or particular groups of people are more vulnerable than others. Countries that have limited capacity to cope with existing climate-associated health risks are unlikely to have the resources to plan for and manage future risks. Populations with an already heavy burden of disease are particularly vulnerable; chronic obesity-related disease increases risk of death or ill health during periods of high temperatures, for example. These chronic non-communicable diseases are prevalent in many of the more developed countries such as the USA and Australia, and are an emergent problem in many least-developed countries (LDCs), such as Fiji and Samoa in the Pacific.

Yet, health-impacts modelling with regard to climate change has, to date, accounted only for changes to average climatic conditions over average populations, with little consideration of specific vulnerabilities, including impacts on elderly, migrant or indigenous groups in more developed countries or among those living in extreme poverty in LDCs. Neither has modelling attempted to quantify extreme events that may be outside previous experience and that, with expected increases in climate variability, are precisely the

type about which we are being warned. Nevertheless, the evidence that climate change has adverse consequences for population health is very strong (McMichael et al., 2005).

The Need for Transformational Thinking

Climate change is an unprecedented, systemic problem, and successful adaptation to minimise its human health impacts requires transformative thinking. This means moving beyond the social reform of early public health interventions that dealt with discrete, localised and measurable problems, towards changing the way we think about and relate to the environment. Fundamentally, it means seeing ourselves as part of the human ecological system rather than as something outside of or disconnected from it. This is the type of thinking pioneered by Tony McMichael and argued so persuasively in *Planetary Overload* (McMichael, 1993). Transformation for adaptation means changing our expectations about how we live, our relationships with the environment and, importantly, even our social, economic and political structures. But adaptation activities, when they do occur, tend to focus only on the short-term and can therefore be maladaptive. We are not fixing the system or thinking 'big' enough, and may even be creating problems for the future through accidently introducing practices that are maladaptive.

Often, there is a problem with institutions failing to recognise the nature and scale of the changes, as well as calibrating the responses. This is particularly true when funding opportunities look at adaptation mostly as a technological-based response to future climate change conditions, *de facto*, excluding the option of reducing countries' vulnerabilities to foster adaptation and improve health (Klein, 2008). This is a significant hurdle for small island developing states (SIDS) in particular. When developing one of its infrastructure projects following the implementation of its National Adaptation Programs of Action, Tuvalu was given funding only for the part of the project that would tackle the 'additional' costs due to adaptation, leaving the burden of financing the 'baseline' infrastructure of that project to Tuvalu's poor finances (Ayers and Huq, 2009). As a result, the project could not start until the proper cofinance could be found, effectively delaying Tuvalu's adaptation needs.

While climate change is a global problem, the global machinery that should be mitigating it through emission reductions is clunky, unconvinced, unwilling and, even with the best of intentions, slow. All may not be lost just yet; success in dealing with global environmental crises has occurred before; for example,

in mobilising action for environmental (and human health) benefit with the worldwide ban on chlorofluorocarbons under the 1989 Montreal Protocol and the nearly completed phasing out of leaded petrol.

Often, however, transformation begins at a smaller scale. The 'Transition Town' movement (www.transitionnetwork.org) commenced in the UK in 2003. The movement is about taking practical steps to advance local sustainability, largely by shifting from large-scale commercial production and supply to more local production. The movement aims to achieve low-carbon local economies and to adapt to changing climate independently from government and corporate decision making. It works to increase resilience by creating deliberate redundancy in the system through reliance on multiple, small-scale local producers. Diversification in production and supply, community self-reliance and independence are also key characteristics.

These changes are occurring in well-resourced and well-informed communities that probably will not suffer greatly under climate change, at least in the next few decades. Relatively speaking, they are well-buffered by economic and social resources and have populations in reasonably good health; also, the climate impacts in such temperate regions may be less severe, though recent events such as flooding and storm surges in the UK suggest even wealthy temperate nations may be affected. But the poorest populations in the poorest countries have far fewer resources to deal with climate change.

The appropriate scale is important when considering the impacts in any population. Problems that occur and are important at a community level may be overlooked in large-scale models. Absence of data can be partially compensated for by interpolation over large geographic areas, but this can miss local issues altogether. This problem is particularly marked in developing countries, where the capacity to collect or analyse health and environmental data is often low, and sometimes virtually absent.

Improving the Evaluation of Adaptation

The evaluation of adaptation interventions, both prospective and in place, is both commonly missing and urgently needed. Such evaluation could quantify benefits (or their absence), improving the evidentiary basis for policy and action. Qualitative methods can also tease out relevant problems and can be used to develop feasible solutions. Mistakes in adaptation no doubt occur. Comprehensive evaluation means that not only could successful programmes be replicated but also that unintended harmful consequences of health adaptation actions could be spotted and minimised. If research on climate change-related

health impacts and vulnerability remains underdeveloped, then research on the health impacts of *adaptation*, whether in rich or poor countries, is positively embryonic.

The Principles of Successful Adaptation in Low-Income Settings

Despite the considerable barriers to understanding impacts, implementing adaptation activities and evaluating these interventions, locally driven, small-scale adaptation activities are emerging in less wealthy parts of the world. Interventions that are likely to be most successful are those that bring multiple benefits to community health and economy, those that are developed through consultation and those where the community has ownership of the activity and responsibility for its ongoing management. One such adaptation intervention that fits these criteria is the building of biogas digester systems in poor urban communities to provide sanitation and fuel for cooking. The benefits of such biogas systems include the enhancement of long-term adaptive capacity and an overall improvement of key public health indicators and socio-economic attributes (Moncada et al., 2014).

A Health-promoting Technology in Ethiopia of Benefit for Climate Mitigation and Adaptation

Poor sanitation is a major cause of chronic diarrhoea, contributing to undernutrition and ill health, especially among children (Fenn et al., 2012). It can also be associated with trachoma, including in Ethiopia (Golovaty et al., 2009). The use of wood and charcoal as cooking fuel leads to high levels of indoor pollution and local deforestation, and is associated with respiratory disease (Po et al., 2011) and otitis media (Amusa et al., 2005). Wood and charcoal take time and money to procure.

A community-managed biogas digester system, costing approximately US$32,000 (costs that include a 25 cubic metre digester, four bio-latrines, a communal kitchen, a water point, sewerage system, environmental sanitation material and training, personnel cost and monitoring and evaluation), was installed as part of an official development assistance intervention financed by the Maltese government within the internationally funded initiative FAST-START.[1]

1 This initiative was agreed during the Conference of the Parties (COP 15) held in December 2009 in Copenhagen, where developed countries pledged to provide new and additional resources for the period 2010–12, with the intention to implement projects on climate change mitigation and adaptation.

This research project aimed to contribute to climate change mitigation by reducing reliance on both fossil fuels and firewood, and also to improve long-term climate change adaptive capacity in an informal (poor) community of 200 households (approximately 700 people) in the southern Ethiopian city of Shashemene, about 240 km from the capital, Addis Ababa. Such communities are especially vulnerable to climate change because of extreme poverty, a marginally productive and highly variable climate (Figure 18.1), little infrastructure and a heavy burden of existing health problems.

Figure 18.1 The biogas compound. The foreground building contains the latrines and the adjacent building is the community kitchen.
Source: Hilary Bambrick.

The biogas digester system, constructed by using locally resourced material and employing local companies, installed in the community takes the form of a simple four-cubicle latrine, from which methane gas produced by the waste is collected and piped into an adjacent community kitchen (Figure 18.2). The kitchen has four gas hotplates (Figure 18.3) and two clay plates for cooking the staple food, *injera*, a fermented flat bread made from the highly nutritious grain called *tef*. The slurry from the biogas system is also collected for use on the community garden. Goat and cattle manure is also collected from within the community and

added to the system, contributing to the facility's output while managing waste better. The provision of piped (treated) town water is also part of the facility intended to replace the use of water from the polluted local river.

Figure 18.2 The community towards the end of the wet season, September 2012, looking east from the main road over the river.
Source: Stefano Moncada.

Figure 18.3 The community during the dry season, February 2013.
Source: Stefano Moncada.

The facility was built in close consultation with the community, is managed by the community and provides a source of communal income. Use of the latrine and kitchen is free for all members of the community but a small fee is charged for use of the water (20 Ethiopian cents per 20-litre container, approximately 1 US cent). Custodianship of the system and responsibility for its upkeep is held by an elected community-user committee, which is led by the head male elder.

This small, relatively simple facility is expected to bring multiple benefits to the community, including a reduction in typhoid and other diarrhoeal episodes (which will, in the longer term, lead to improved growth and health outcomes for children) and reduced respiratory and other illnesses associated with indoor air pollution, such as otitis media and eye disease. Other benefits to household economy and community functioning are also anticipated, generating synergistic improvements to health and well-being. These include less time and money spent on collecting cooking fuel and water, and enhanced economic productivity due to fewer illnesses. The local environment will also benefit, with the loss of fewer trees and improved outdoor air quality. Climate change mitigation through reduced greenhouse gas production by the community has the potential to be scaled-up in Ethiopia, with planned support from its government. Importantly, this project addresses a locally identified need. The facilities are community managed. This local relevance and sense of ownership will increase the likelihood that it will be sustained.

Evaluation of this project involves a pre-intervention survey (undertaken) and three or more follow-up surveys, involving all households in the community, to be undertaken four and 12 months after the biogas system becomes operational. These surveys will ask detailed questions on individual's health and sanitation practices, household socio-economic indicators, time use and economic resources. The post-intervention surveys will identify which households are using the new facilities and how they are being used, enabling comparison of health and other outcomes according to 'exposure' to the intervention. Preliminary results show a significant uptake in use of the new facilities, as well as improved public health-related behaviour, such as the reduced use of the polluted rivers, both for defecation and as a source of water for drinking and cooking, with an increased used of piped treated water (Moncada et al., 2014).

Some key community characteristics garnered through the baseline survey include a mean household size of 3.6 people, mean age of 23 and mean household income of US$1.56 per day. Participants were identified as being from 13 different ethnic groups. Most were identified as being Orthodox Christian or Protestant, with a minority being Muslim or Catholic. Most participants had a primary school education, with 21 per cent having a secondary and 4 per cent a tertiary education. A non-trivial fraction of those with a primary school education are likely to be illiterate (Bambrick et al., 2015).

Before the intervention, approximately two-thirds of households used a shared or private pit for a toilet, and approximately one-quarter practised open defecation in or near the river. Notable health problems included malaria, typhoid, anaemia, trachoma and tuberculosis, while eye conditions, gastrointestinal disease, otitis media and acute and chronic respiratory conditions represented the greatest cause of sick days.

In addition to the quantitative data collection through the household survey, the study also uses participatory rural appraisal methods (Chambers, 1994). These involve in-depth focus group discussions with women and men from the community to identify the ways in which climate – especially climate variability – affects their daily life and their strategies for coping with climate-associated risks. This information, along with the data gathered through the surveys, will help to develop adaptation further; to guide future development interventions that are locally relevant, feasible and sustainable.

Planned systematic evaluation studies such as the one just described are all very well for deliberate formal adaptation interventions, but it is likely that many climate adaptation actions will be *ad hoc*, informal and context specific, and will arise in response to a perceived immediate threat. Documentation and monitoring of such activities, when they occur and when possible, will be useful to avert or minimise any adverse unintended consequences.

Conclusion: Local Adaptation for a Global Problem

While climate change poses challenges to human health that are unprecedented in scale and complexity, attempts to adapt to minimise adverse health outcomes will occur at varying scales: large-scale, government-reliant and small-scale, community-driven. Other informal adaptive responses to climate change may arise independently, and even set trends, perhaps spreading via social media and mobile telephony. At any scale, and whether formal or informal, successful adaptation will require greater understanding of the human ecological system so as not to attempt to impose change without due consideration of interconnectivity, feedback and non-linearity. Opportunities to maximise community co-benefits (i.e. other positive outcomes such as reduced obesity-related chronic diseases or improved income security) should be given priority, if they appear more cost-effective.

We still await multilateral government action to deal with the global problem of climate change. While the support of governments and large corporations remains necessary (especially in taking action to limit the amount of warming caused by greenhouse gas emissions), multiple implementation of successful small-scale, locally appropriate adaptation activities driven by communities is

also vital. Enough of these could restrict the health consequences arising from anthropogenic climate change to a manageable scale. And, as we believe this project in Ethiopia will demonstrate, many such projects will also deliver short- as well as long-term economic and health benefits.

Acknowledgements

The Shashemene biogas project is a collaboration between KOPIN (Kooperazzjoni Internazzjonali), WCDO (Women and Children Development Organization Ethiopia), the Institute for European Studies at the University of Malta and the Centre for Health Research at the University of Western Sydney. Involved in project implementation and evaluation are Kassahun Ararso, Melaku Hailu Marie Briguglio, Sarah Mallia, Adriana Grech, Eyob Lalensa, Tesfahun Bekele, Berket Mola, Zegeye H. Michael, Zelalem Tarekegn, Muluwork Gemechu, William Grech and Dominik Kalweit.

References

Amusa, Y.B., Ijadunola, I.K. & Onayade, O.O. 2005. Epidemiology of otitis media in a local tropical African population. *West African Journal of Medicine* 24, 227–30.

Ayers, J.M. & Huq, S. 2009. Supporting adaptation to climate change: what role for Official Development Assistance? *Development Policy Review* 27, 675–92.

Bambrick, H., Moncada, S. & Briguglio, M. 2015. Climate change and health vulnerability in informal urban settlements in the Ethiopian Rift Valley. Environmental Research Letters 10(5) doi: 10.1088/1748-9326/10/5/054014.

Chambers, R., 1994. The origins and practice of participatory rural appraisals. World Development 22(7): 953–69.

Fenn, B., Bulti, A.T., Nduna, T., Duffield, A. & Watson, F. 2012. An evaluation of an operations research project to reduce childhood stunting in a food-insecure area in Ethiopia. Public Health Nutrition 15(9): 1746–54.

Golovaty, I., Jones, L., Gelaye, B., Tilahun, M., Belete, H., Kumie, A., et al. 2009. Access to water source, latrine facilities and other risk factors of active trachoma in Ankober, Ethiopia. *PloS One* 4, e6702.

Hales, S., de Wet, N., Maindonald, J. & Woodward, A. 2002. Potential effect of population and climate changes on global distribution of dengue fever: an empirical model. *The Lancet* 360, 830–34.

Harlan, S.L., Declet-Barreto, J.H., Stefanov, W.L. & Petitti, D.B. 2012. Neighborhood effects on heat deaths: social and environmental predictors of vulnerability in Maricopa County, Arizona. *Environmental Health Perspectives*. 121(2): 197–204.

Jetten, T.H. & Focks, D.A. 1997. Potential changes in the distribution of dengue transmission under climate warming. *American Journal of Tropical Medicine and Hygiene* 57, 285–97.

Klein, R.J.T. 2008. Mainstreaming climate adaptation into development policies and programmes: a European perspective. In: *European Parliament, Financing Climate Change Policies in Developing Countries*. European Parliament, PE 408.546 IP/A/ CLIP/A/CLIM/ST/2008-13, Brussels, Belgium.

McMichael, A.J. 1993. *Planetary Overload: Global Environmental Change and the Health of the Human Species*. Cambridge University Press, Cambridge, UK.

McMichael, A.J., Woodruff, R.E. & Hales, S. 2005. Climate change and human health: present and future risks. *The Lancet* 367, 859–69.

Martens, W.J.M. & McMichael, A.J. (eds) 2002. *Environmental Change, Climate and Health: Issues and Research Methods*. Cambridge University Press, Cambridge, UK.

Moncada, S., Bambrick, H. & Briguglio, M. 2014. Enhancing Local Adaptive Capacity in Informal Urban Settlements in Ethiopia. *Adaptation Futures. Third International Climate Change Adaptation Conference*. Fortaleza, Brazil May 2014.

Patz, J.A., Martens, W.J., Focks, D.A. & Jetten, T.H. 1998. Dengue fever epidemic potential as projected by general circulation models of global climate change. *Environmental Health Perspectives* 106, 147–53.

Po, J.Y., FitzGerald, J.M. & Carlsten, C. 2011. Respiratory disease associated with solid biomass fuel exposure in rural women and children: systematic review and meta-analysis. *Thorax* 66, 232–39.

Rogers, D.J., Wilson, A.J., Hay, S.I. & Graham, A.J. 2006. The global distribution of yellow fever and dengue. *Advances in Parasitology* 62, 181–220.

This text is taken from *Health of People, Places And Planet: Reflections based on Tony McMichael's four decades of contribution to epidemiological understanding*, edited by Colin D. Butler, Jane Dixon and Anthony G. Capon, published 2015 by ANU Press, The Australian National University, Canberra, Australia.