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Health, climate change and ethics – an overview

Nuffield Council on Bioethics

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Executive summary

- This paper is the outcome of a scoping exercise carried out by the Nuffield Council on Bioethics to identify ethical issues arising in climate change and health, including human actions designed to mitigate and adapt to climate change. It examines these ethical issues under three linked headings: the ethics of the climate crisis; ethical issues arising in responses to the climate crisis; and ethical issues relating to research into those responses.

Ethics of the climate crisis

There are several ethical principles relevant to the climate crisis and to reflection on research and response:

- **Justice** - this addresses the just division, fair sharing, and equitable distribution of the benefits and burdens of climate change, and the identification and allocation of responsibilities to address that distribution.
- **Consideration of extending moral concern** - including concepts of rights - to the **non-human world**. Although human and non-human interests can coincide, important ethical questions arise where these rights and interests compete and adjudication is required.
- **Solidarity** - in the sense of shared practices reflecting a collective commitment to carry "costs" (financial, social, emotional or otherwise) to assist others. This may also extend to solidarity with (aspects of) the non-human world.
- **Intergenerational responsibility** - which seeks to identify what is owed to emerging, future and hypothetical generations and on what basis, and how to act when the interests of different generations conflict.

Although there is a compelling body of scientific evidence regarding climate change, it is important to note that there remains uncertainty about the degree of impact, its pathways and likely consequences. Ethically this uncertainty must be factored into any response.

Ethical issues arising in response to climate change

These issues emerge from more practical applications of the above principles to specific policy responses to climate change. These policy responses fall into three main categories: mitigation (reducing and limiting the drivers of climate change, particularly greenhouse gas emissions); adaptation (adjusting to current or expected effects of climate change); and costs and benefits (whether, how, in what form and to whom reparations for the harms of climate change, including in relation to human health, should be paid):

- The principle of justice requires consideration of how **responsibility** for action is identified and distributed, including responsibility for historical contributions to greenhouse gases, and possible reparation for past actions contributing to climate change.
- **Procedural justice** addresses complex and politically fraught questions about the governance of the global commons - what international or transnational frameworks are required for fair and effective responses to climate change? It also includes questions of how responsibilities in this regard can be enforced and how questions of compensation should be addressed.
- Any intervention requires consideration of simultaneously occurring **harms and benefits**, and a decision as to what an appropriate balancing of the two is, with the goal of maximising benefit and minimising harm. This includes consideration of benefit and harm

within strategies; trade-offs between mitigation and adaptation strategies; and of justice and fairness to ensure equitable distribution of benefit and harm. Such an approach also needs to consider fundamental human - and possibly non-human - rights and interests which may set aside constraints on utilitarian calculations. There are also incommensurability challenges - it is not clear, for example, that benefits and harms in climate change response can be reduced to a single unit of evaluation.

- New and emerging **uses of technology**, such as geoengineering, present various ethical challenges. Critical issues will include identifying and managing the risks of planet-scale interventions; their likely balance of benefit and harm; fairness in the distribution of those benefits and harms; potential rights and interests of the non-human world, including the normative content of concepts such as naturalness. Issues of potential moral hazard in technological solutionism - that we don't need behaviour change because technology will fix the climate - will also be ethically important.
- **Collective action and individual choice.** Climate change gives rise to demanding collective action problems. Although collectively we would all be better off in the long term if we acted to preserve the planet's resources, there are powerful short-term incentives to maximise individual shares of the collective good. The sheer scale of climate change presents ethical challenges in addressing individual behaviour change. If my individual actions make next to no difference, what moral obligations do I have to act?

General ethical issues arising in research

- Research into such a large-scale threat to the global commons requires urgent ethical reflection on issues that transcend the traditional focus on the **wellbeing of research subjects** - although this will remain vital.
- Questions of **global power and influence** in the choice of research subjects and design, the flow of intellectual and other goods arising from the research, and co-operation between resource-rich and resource-poor research institutions will be critical.
- Research must be **inclusive and transparent** in design and practice.
- **Respect for others as moral equals** requires research to be culturally sensitive and culturally informed.
- Attention must be given by funders and researchers to **prioritising** the research questions that matter most in relation to tackling climate change.
- Conducting research at such a level requires cooperation between a range of national and international bodies and individuals - particularly between researchers and local partners - and **fairness of collaboration** must be a priority.
- The collection, use and sharing of data and samples raise issues about **privacy and consent**, the **ownership** of data and samples, and **intellectual property** arising from the research.

Introduction

Ethical analysis of issues in both the health impacts of climate change, and interventions designed to mitigate or adapt to those changes, has been relatively limited. In response to this, the Nuffield Council on Bioethics has carried out a scoping exercise - using desk-based research, literature review, and interviews with stakeholders - to identify and elucidate the ethical issues in this area, with a particular focus on both mitigation and adaptation strategies

This paper is the outcome of that scoping exercise. It begins with a broad overview of the nature of climate change, and the varieties of mitigation and adaptation response. It then outlines three linked themes of ethics in this area:

- the broad ethics of the climate crisis;
- the ethical issues arising in mitigation and adaptation strategies; and
- the issues relating to research into climate action.

This paper does not draw any firm conclusions or make recommendations for action, but finishes with a summary of the key ethical principles that should inform future discussions and decisions. Further work will be required to elucidate how these ethical issues operate in the context of policy responses to the health impacts of climate change.

Anthropogenic climate change

The mean global surface temperature of the Earth has risen by a little over 1°C since the 1880s, with conservative estimates expecting global temperature rises - without action - to reach 1.5°C by 2050 and 2.4°C by 2100.¹ Human emission of greenhouse gases has been the main driver of this climate change over the last century. The effects of climate change go further than increased temperatures, and include rising sea levels, ocean acidification, an increasing frequency of drought and fires, and declining biodiversity.

Climate change has severe and complex impacts on human health, leading many international organisations (including the World Health Organization) to designate it as “the biggest health threat facing humanity”.² “Climate change threatens human health and wellbeing through effects on weather, ecosystems, and human systems”, the 2021 report of the *Lancet* Countdown on health and climate change states: “These effects increase exposure to extreme events, change the environmental suitability for infectious disease transmission, alter population movements and undermine people’s livelihoods and mental health. The resulting strain on health and social systems disproportionately affects the most disadvantaged in society.”³

This paper assumes that the impacts of climate change on health - summarised as direct and indirect effects in **Box 1** - are becoming well-established. It also assumes that action to address climate change is morally required. It therefore explores the ethical values and principles arising from choices about what actions should be taken. It does recognise, however, that scientific uncertainty remains about the timing, scale and precise impact of climate change, including its pathways and effects. It acknowledges the importance of incorporating this uncertainty into any response.

Box 1 – Health effects of climate change

Direct

- **Morbidity and mortality resulting from extreme temperatures:** extreme heat increases the risk of death from cardiovascular, cerebrovascular, and respiratory conditions along with all-cause mortality.⁴
- **Mortality and injury as a direct result of adverse climate events:** including flooding and wildfire, and the spread of infectious disease resulting from health and other infrastructure loss due to adverse events.⁵
- **Risks to mental health and wellbeing:** heat extremes are associated with altered affective states, increased mental health-related hospital admissions and suicidality; and conditions such as post-traumatic stress disorder (PTSD).⁶

Indirect

- **Malnutrition and food shortages:** heat and drought have an impact on crop yield; increased sea temperatures reduce marine food productivity; and agricultural labour capacity is lost due to extreme heat.⁷
- **Water scarcity:** leading directly to reduced food production, lack of access to potable water and poor sanitation.⁸
- **Increased climate-sensitive infectious diseases:** including increased transmission of water-borne, air-borne, food-borne and vector-borne pathogens, such as malaria, dengue and Zika.⁹
- **Displacement and migration in response to climate change:** these undermine livelihoods, impede access to essential health services, and reduce psychosocial wellbeing.¹⁰ There are also the physical and mental health effects of violent conflict and forced migration.¹¹
- **Biodiversity loss and ecosystem disturbance due to extreme weather:** these lead to an increased risk of zoonotic diseases; loss of natural resources for drug discovery and other medical advances; and undermine food security.
- **Increased poverty and exacerbation of existing health inequalities:** these follow climate change impacts on employment and livelihood; food and energy prices; reduced mobility; and increased anxiety, poverty and unemployment among those already socially disadvantaged and marginalised.¹²
- **Increased tropospheric ozone:** increased temperatures drive ozone production in the troposphere. Tropospheric ozone is a greenhouse gas, is toxic to many plants and exacerbates respiratory diseases. It is linked to a million deaths a year.¹³
- **Decline in physical activity:** high temperatures reduce the number of hours for safe physical activity, reducing frequency, duration and intensity of physical exercise, with resulting impacts on physical and mental health.¹⁴
- **Broader mental health impacts:** often termed “climate anxiety” or “eco-anxiety”. This is thought to be contributing to increased mental distress, particularly in young people.¹⁵

Responding to the problem

Responses to climate change fall into three main categories:

- Taking action to prevent climate change, by reducing and limiting greenhouse gas emission, thereby slowing global warming and its related effects – known as **mitigation strategies**. Examples include moving from fossil fuels to renewable sources of energy, developing more energy-efficient housing and transport systems, and promoting healthy individual behaviours to reduce emissions, such as dietary change and more active travel. It also covers technological solutions, such as geoengineering, discussed in more detail below.

Discussion of mitigation strategies often refers to health “**co-benefits**”: the idea that action taken to mitigate climate change will have concurrent benefits for health – for example, reducing greenhouse gas emissions will improve both air quality and respiratory health. Many of these benefits will arrive in the relatively near-term (for example, because of reduction in air pollution from the use of renewable energy). Approaches which have mutual benefits for action on climate change and human health can avoid many of the ethical challenges which might otherwise arise in trade-offs between the two. At the same time, it is important to identify unintended consequences of climate action on human health, such as exporting negative health impacts to other countries or communities and exacerbating inequalities.

- Adjusting to current or expected effects of climate change – known as **adaptation**. Adaptation can be grouped into three main categories:
 - structural and physical adaptation, such as modifying built environments to make them more sustainable;
 - social adaptation, involving the use of education and information to change behaviour; and
 - institutional adaptation, such as making changes to laws, regulations, policies and programmes.

There will inevitably be interactions between mitigation and adaptation: many policy approaches will involve elements of both, or require trade-offs between them.

- A third area of policy interest is “climate change loss and damage”. This refers to policy approaches designed to “avert, minimise and address loss and damage associated with climate change impacts, especially in developing countries that are particularly vulnerable to the adverse effects of climate change.”¹⁶ Policy in this area ordinarily seeks to enhance the adaptive capacity of these countries and clearly links to the adaptation issues outlined above.

Ethics and climate change

There are a range of ethical considerations relevant to the climate crisis. These provide important background to climate action and research, and should inform policy in these areas.

Procedural and distributive justice

The health impacts of climate change are inequitable, with disproportionate harms falling on already disadvantaged populations. Questions of justice are therefore central, and invite reflection on the just division, fair sharing, and equitable distribution of the benefits and burdens of climate change, along with the identification and allocation of responsibilities to address it and the processes for enforcement of those responsibilities.

Justice can be roughly grouped into two categories – procedural and distributive.

Procedural justice has to do with the fairness of the decision-making process itself. It includes factors such as the processes required to ensure fair, transparent and inclusive decision-making. Procedural justice also invites reflection on particularly fraught questions of global governance. Climate change is, par excellence, a crisis of our global commons. No country or individual is immune from its effects - although if its effects go unmoderated there would likely be some countries who benefit, if only in the short term. It is also a global example of a “tragedy of the commons”, a situation when individuals, acting rationally in their own self-interest irreparably deplete a common resource, to the detriment of all.

In the face of the climate crisis, many national actors seek to maximise their own economic advantage in a race to exploit the Earth’s resources before they are exhausted. Methods of global governance to protect our common climate and planetary ecosystem against this catastrophic short-termism are required, but such structures are notoriously difficult to develop and are subject to political capture and gaming.

Distributive justice is concerned with substantive as opposed to procedural questions about how goods, services, and entitlements should be fairly apportioned: what might fairness in climate response look like? *Foster et al.* identify three aspects of distributive justice relevant to climate change and health:

- Inequalities in who has *contributed* to climate change;

- Inequalities in who is most *harmed* by climate change; and
- Opportunities to rectify injustice while addressing climate change.¹⁷

There is a considerable disparity between countries that have historically contributed most to climate change - largely the wealthier countries of the Global North - and those that are disproportionately at risk from it - mostly the poorer countries of the Global South. Many of these disparities are linked to and compounded by historical injustices - colonialism and its complex and exploitative aftermaths.¹⁸ Disparities in vulnerability to climate change also exist *within* countries, with vulnerable groups, including the poor and marginalised particularly exposed to its effects.

All of this points to questions of responsibility, to which we will return in our discussion of mitigation and adaptation responses below.

The non-human world – interdependencies and obligations

Discussions about climate change and health typically focus on *human* health. But such a narrow focus is misleading. For one thing, human health fundamentally depends on the non-human biosphere. The COVID-19 pandemic made this clear. Human health and animal health are inescapably intertwined. Animals are reservoirs and vectors for many human illnesses and diseases, but are also essential to many treatments, cures and, it is argued, our general wellbeing. Action taken to address climate change's health impacts must be considered in the context of this interconnectedness. For example, the production of plant-based food or biofuels requires extensive use of land - although less than for rearing animals for meat. This can lead directly to the loss of "natural" environments, such as rainforest, as well as competition with land use for animal feed or other agricultural uses.¹⁹ Alternatively, land restoration initiatives may increase animal-human conflict by increasing human proximity to wildlife and vector-borne diseases.²⁰

One field which seeks to take account of the interdependence of human health and the natural environment is the "One Health" (OH) approach. At its simplest, OH is an integrated approach to the management of emerging infectious diseases and zoonoses, recognising the significance of non-human animals as reservoirs and vectors of human diseases.²¹ In its richer forms, it is a collaborative, multisectoral and trans-disciplinary approach seeking to achieve optimal health and well-being outcomes throughout the biosphere, recognising the interconnections between people, animals and their shared environment. Further work may be warranted on whether existing ethical frameworks accommodate the OH approach or if it merits the development of its own ethical framework.²² In part this is because an acknowledgement of the irreducible dependency of human life on the biosphere invites important normative questions about the value of the non-human world. In one sense this appears straightforward. Given that our health and wellbeing directly depend upon healthy ecosystems, they have clear instrumental value: healthy ecosystems are necessary for the fulfilment of human ends, needs, interests or preferences.²³ A purely instrumental view of ecosystems locates their value in the services they provide for human life: clean air and water, healthy food, plus their amenity value for human recreation. Policy goals then focus on how to ensure the maintenance of these ecosystem services while maximising extractive - as well as "green" - economic activity. Such an approach sees ecosystem services as fungible: it doesn't matter how such services are provided, all that matters is that they are provided. If, for example, we can find technical methods for pollination or water filtration, there is no need to rely on bees or bivalves. According to this view, if we lose them, we have lost nothing beyond their utility to us.

Although such an approach tends to dominate economic thinking about the environment, and has driven innovative approaches such as the development of carbon markets, many important environmental thinkers seek to locate some form of *intrinsic* value in non-human biotic and even abiotic entities, independent of their value for human interests. Even if human beings no longer existed, the argument runs, the Earth's ecosystems, its landscapes and seascapes would still have moral value. Although this approach is philosophically challenging, it is making itself felt at a policy

level in the emerging “rights in nature” movement. Set out perhaps most systematically by US academic lawyer Christopher Stone in his landmark 1972 book *Should Trees Have Standing?*,²⁴ this approach recognises sufficient intrinsic value in non-human biotic and abiotic entities to make at least some of them eligible for protection by rights. A commonly cited example is from Aotearoa (New Zealand), where the Te Urewera Act (2014) and Te Awa Tupua Act (2017) established the rights of the Te Urewera National Park and the Whanganui River, turning them into legal persons represented by a system of joint Māori and government guardianship.

A third broad approach sees value emerging from relationships between humans and nature. Rather than conferring independent intrinsic value on nature, value emerges from meaningful relationships between humans and nature, or between humans in nature. Examples include the relationship between farmers and the land they cultivate or the complex, mutually respectful relationships indigenous people have traditionally had with their land. In addition to giving rights to the Whanganui river, the New Zealand jurisprudence cited above clearly recognises this relatedness - it is now legally acknowledged that the wellbeing of the Māori people depends upon the wellbeing of their natural environment.

Intergenerational responsibility

Broadly speaking, intergenerational justice is the idea that those alive at any given point in time have a duty to leave the world habitable for those who come after them.²⁵ This has become well-established in many concepts and approaches to climate change, where the present generation is seen as a “custodian” or “steward” of the environment, with responsibility for future generations. There are ethical challenges associated with assigning rights or status to those who are unborn, or even hypothetical. In the environmental context, some have argued that as future generations do not exist, they cannot “have” any rights or interests or be owed anything by current and existing generations.

Another familiar challenge to questions of intergenerational justice is what philosophers call the non-identity problem.²⁶ Simply put, this asks how future persons can be harmed, or disadvantaged, by acts or social policies which are necessary conditions of their coming into existence. Unless their lives are unspeakably burdensome such that they are better off not having existed, any policy that results in their existence straightforwardly benefits them. Although the non-identity problem is fatal for accounts of intergenerational justice that focus on the interests of specific people, it appears less fatal when the wellbeing of future groups is in play. Intuitively, at least, it is not incoherent to talk of obligations to the wellbeing of future generations considered in the round.

Another issue relating to intergenerational responsibility arises where mitigation seeks to limit population growth (a key stressor in environmental damage and climate change). There are a number of ethical issues inherent in any policy seeking to limit the number of children people can have: such policies are restrictive of individual autonomy; they raise questions of justice concerning access to reproductive health services; and may come up against deeply held religious beliefs relating to contraception and family size.

Solidarity

Solidarity - shared practices reflecting a collective commitment to carry “costs” (financial, social, emotional or otherwise) to assist others.²⁷ This is particularly important given the global impacts of climate change. Emergencies such as the COVID-19 pandemic have illustrated how inter-connected and interdependent nations are, and lessons from the pandemic response may be brought to bear on climate change and health. Co-ordinated action on a global level will be essential to address climate change, and its subsequent health impacts. Financial, technical and logistical support for less well-resourced countries will be needed to ensure a more equitable distribution of benefits and burdens. The research required to identify and develop effective interventions also depends on

international collaboration, and on adequate funding from both governments and philanthropic organisations.

Ethical issues in mitigation and adaptation strategies

Responsibility

Questions of responsibility for climate change are ethically complex. Partly, this is to do with the challenges associated with identifying causality. The links between the actions of individuals, organisations and corporations, and any subsequent changes in climate, are far from straightforward. Causality is widely dispersed both temporally and geographically. The enormous complexity of climate, and its liability to “natural” fluctuations provide further challenges in assigning responsibility. There is a large consensus, for example, that the devastating floods in Pakistan in 2022 were linked to anthropogenic climate change. Leaders in Pakistan understandably called for climate-based reparations.²⁸ But precisely who should pay these reparations is not obvious. Do the countries, communities and corporations that have contributed most to anthropogenic climate change in the past have particular responsibilities to address it? And if so, which countries and to what extent? What about countries beyond the Global North, such as India and China, which are contributing significantly to current emissions? Do they also have obligations to support poorer countries to bring about system change, even at detriment to themselves, and to support adaptation measures that protect the most affected?

We know that adaptation strategies are going to be critically important to low Human Development Index (HDI) countries where the effects of climate change are more acutely felt. Like responsibility, adaptive capacity is unevenly distributed, and many countries lack the economic and social capabilities to design and implement large-scale adaptive strategies.

Questions of responsibility also arise at an individual level. Do we as individuals have an ethical obligation to moderate our behaviour to prevent harm to others? And if we do, how demanding should those obligations be? To what extent are we all obliged to choose low-carbon technologies, change our diets or seek more active travel options? Where collective action is required, and sufficient people act, this can provide incentives for free-riding - some will be motivated to continue with their preferred lifestyle because sufficient numbers of others have adapted theirs. This then invites questions about incentives to change, and even the potential for more coercive state interventions

By corporate and governmental standards very few individuals make a serious contribution to climate change. Systems and processes must therefore be developed to ensure that corporate responsibilities are not inappropriately offloaded onto individuals.

Changes in lifestyle can only be made where these options are available and affordable. In many parts of the world, urban design, poor public transport and limited food and fuel options make them all but impossible.

Balance of benefit and harm

One essential aspect of ethical policy making involves identifying probable harms and benefits arising from a proposed intervention, and ensuring that any choice will likely maximise benefits and minimise harms across target populations.

Identifying what constitutes “benefit” and “harm” in this context can be challenging. Interventions bring their own unintended harms, and benefits and harms can also interact in a variety of ways:

- **Balancing benefit and harm *within* strategies:** Many interventions bring potential harms as well as potential benefits. A mitigation approach seeking to reduce greenhouse gas emissions, by using fissile nuclear fuel to generate energy, gives rise to significant potential costs in terms of the management of radioactive waste and possible human and non-human exposure to ionising radiation.²⁹ Land restoration initiatives may increase animal-human conflict by increasing proximity to wildlife, pests and vector-borne diseases.³⁰

Recognising simultaneous harms and benefits is particularly important in the context of co-benefits in mitigation strategies, where it can be tempting to focus on the concurrent benefits of action on climate change to health. One approach to mitigating greenhouse gas emissions in many countries is to move industries and sectors to net-zero. Without careful consideration, this approach could have harmful economic and social effects that disproportionately fall on those in low-income brackets. These can include job losses in fossil fuel industries, and increases in the costs of energy, transportation, food and housing. A clear recent example was the poorly thought-out Sri Lankan policies designed to reduce chemical fertiliser usage and promote environmentally sustainable farming practices. They were disastrous: crop yields plummeted, and prices of staple foods went through the roof.³¹

- **Balancing benefit and harm *between* strategies:** Trade-offs can be required between adaptation and mitigation strategies. The increased use of air conditioning (an adaptive strategy) can reduce extreme heat exposure - but where fossil fuel is used to generate the electricity, it can generate greenhouse gas emissions, undermining mitigation approaches.
- **Equity and fairness:** Benefits and harms are unevenly distributed in and between populations. Air conditioning can reduce extreme heat exposure for some, but creates urban heat islands, is expensive to run and is unaffordable for those on low incomes, benefitting those who can afford it and passing the burdens of heat exposure to those who cannot.

Assessing benefits and harms is made more challenging because of their potential global reach and dispersal. Actions taken in one part of the world may have consequences - including unforeseen and unintended consequences - in another part of the world. Air conditioning is widely used in rich countries. In doing so, high HDI countries may simply “export” the negative health impacts of climate change to other countries, or to vulnerable groups in their own countries. Equity and fairness considerations must therefore be prominent in global discussions about balancing benefits and harms in climate action.

- **Future and longer-term harms:** The picture is further complicated by consideration of future or hypothetical benefits and harms, and what we owe to future generations, including those who have not been born. The impacts of climate change will be long-lasting, and the most serious effects may not be felt for many years. Action taken, or not taken, now will have consequences for current and for future generations - for example, a particular action or policy taken now may be financially costly in the short-term, but have very substantial longer-term benefits.

This balancing exercise can also be felt acutely in the context of healthcare. Healthcare facilities and services generate greenhouse gas emissions, currently accounting for around 4-5% of global emissions through the provision of services, prescription medicines and assets which are specific to the healthcare setting - for example, ambulances, inhalers and nitrous oxide.³² Long-term action on climate change will undoubtedly improve the health of many, but action on climate change which seeks to reduce greenhouse gas emissions from healthcare may affect what services and treatment can be provided. The potential future

benefits must be weighed against the immediate need to provide high-quality healthcare services to those who need it.

- **Uncertainties:** Finally, in some circumstances discussion of benefits and harms may need to consider uncertain or probabilistic benefit and harm. Some of the emerging technologies outlined below are as yet highly uncertain in their effects.

Fundamental rights and interests

Although the identification and balancing of benefits and harms is an important part of ethical policy making, it does not exhaust all relevant moral considerations. Just as consideration of the requirements of justice may require an adaptation of the calculus of benefits and harms, so does the need to show respect for fundamental human rights and interests. A policy may be unethical despite maximising apparent overall benefits where, for example, anticipated harms may fall on an already disadvantaged population. Similarly, a mitigation policy that forcibly restricts the ability of large numbers of people to have more than one child, whilst potentially effective in limiting greenhouse gas emissions, comes up against fundamental liberty and reproductive rights and interests. The emerging “rights in nature” movement seeks to locate comparable rights and interests in the non-human world in a way that would set further constraints on a simple utilitarian calculus. Were the climate crisis to intensify, it is likely that, as we saw during the earlier waves of the COVID-19 pandemic, pressure will build to set side-constraints on some of these fundamental rights and interests.

The use of technology

Climate technologies are designed to address climate change through the reduction of greenhouse gas emissions or the limiting of solar radiation. Many of these technologies are well-established, such as the use of renewable energies in place of fossil fuels. Others, like geoengineering, which involve the intentional manipulation of the earth’s climates system, are more speculative or futuristic.

All uses of technology give rise to questions about justice. Not everyone has equal access to current or developing technology with all their associated benefits and harms. Where digital solutions or innovations are proposed to tackle climate change - for example, the use of online communication to reduce climate emissions from travel - digital exclusion, a lack of digital skills and access, gives rise to questions about fairness. Digital technologies can also have significant - often unseen - environmental impacts as a result of the carbon generated by very large-scale computer processing.

In the context of more novel interventions, such as geoengineering, other ethical issues present themselves. There is significant scientific uncertainty about the effects of these technologies - raising questions about whether the science justifies the risk. Climate is complex and to a degree unpredictable. Interventions that unintentionally change global precipitation patterns, or disturb prevailing winds or oceanic currents could have disastrous and unpredictable consequences, and their use requires caution.

The Asilomar International Conference on Climate Intervention Technologies in 2010 developed a set of principles (“the Asilomar Principles”) to help guide research in this area:³³

1. **Promoting collective benefit:** Promoting the collective benefit of humankind and the environment must be the primary purpose of research.
2. **Establishing responsibility and liability:** Responsibilities for the governance and oversight of large-scale climate engineering research activities must be clarified or created.

3. **Open and cooperative research:** Research must be conducted openly and cooperatively, within a framework that has broad international support.
4. **Iterative evaluation and assessment:** Progress on climate engineering must be assessed through iterative, independent mechanisms.
5. **Public involvement and consent:** Public participation and consultation must be engaged in research planning and oversight, assessments, and development of decision-making mechanisms.

Some have expressed concern about technological solutionism - the belief that every problem can be solved through technology - arguing that the promise of a scientific fix, however distant, will weaken political and public will to develop policy solutions aimed at changing behaviour.³⁴

Many of these technologies would alter or intervene in “natural” processes, which bring into play concepts of naturalness and may affect the public acceptability of such interventions. This was the subject of work by the Nuffield Council on Bioethics in 2015.³⁵ Concepts of naturalness are more significant to some than to others, depending in part on relationships with the land and natural environments.

Ethical considerations in research

The Nuffield Council on Bioethics’ report on *Research in global health emergencies*³⁶ examined the ethical challenges in carrying out research during times of global health crisis - and many of the ethical concepts set out in that work are directly relevant to climate change and health.

Inclusivity and transparency

Research into climate change and health requires consideration of who is most affected by the changes, how they can be meaningfully involved in decisions about what research takes place, where it should take place, how it is undertaken and where the benefits of the research should flow. There is little doubt that current structures of research into global health issues overwhelmingly favour the Global North, and it is essential that questions of power and justice are addressed in research into climate change. Sustained and meaningful engagement with affected communities is therefore central to ethical research.

We know that the health impacts of climate change fall unfairly, with disproportionate effects on disadvantaged populations - those in low HDI countries, members of minority groups, people with low incomes, women, children and older adults, and those with chronic health conditions or disabilities.³⁷ Deliberations and discussions regarding research into climate change, including priorities, methodologies and outcomes, must be transparent and inclusive. Fairness and respect for others as moral equals should help guide decision-making about what should be researched, to what extent it involves or impacts on individuals and communities, and how any benefits and burdens of research should be allocated.

Cultural sensitivity

Linked to the above, and to the requirement to show respect for others as moral equals, is the need to understand and appreciate the context within which research is being undertaken. This includes understanding the concerns of local populations; showing sensitivity and understanding of local values and customs; and ensuring culturally appropriate and respectful consent processes, where appropriate.

One stakeholder interviewed for this paper noted that cultural sensitivity shouldn’t be viewed unilaterally, and that there was a need for “intercultural discourse and discussion”, so that

knowledge and strategies from other countries can be shared and heard. For example, countries with hot climates, where extreme heat may be experienced more frequently, may be able to share natural or human mitigation strategies with countries experiencing these temperatures for the first time - particularly around issues such as housing design, urban planning, working patterns, lifestyle choices and diet.

Fairness in collaboration

Climate change is a global problem requiring global solutions. Conducting research at such a level requires cooperation between large numbers of organisations and individuals - particularly between researchers and local partners - and fairness of collaboration must be a priority. This involves seeking consensus on the aims and objectives of the research, and a fair distribution of its associated harms and benefit. This points to a widely identified problem in research: the paucity, and challenges, of defining and implementing global standards and governance frameworks.

Some respondents to the Nuffield Council on Bioethics call for evidence as part of the research in global health emergencies work argued that there is an ethical imperative to collaborate, and that organisations and individuals should be prepared to transcend their primary research interests - or the desire to gain credit for what is being achieved - in order to prioritise the welfare of those affected by current and future emergencies.³⁸ Given the scale and importance of climate change, such a duty may also exist here.

Systems level

Ethical research does not just concern the behaviour of individual researchers. The decisions taken at a policy level - for example, by funders, regulators, research institutions and others - are enormously influential in creating, shaping, but also limiting the possibilities for ethical research. In addition to frameworks for research projects and programmes, it is important to develop policies at an organisational level to decide research priorities and guide research practices.

Data and sample collection

The collection, use and sharing of data are an essential part of research, but raise ethical issues around privacy, information security, ownership of data and samples, intellectual property and consent.

Given the links between climate change and health, and the opportunity for co-benefits, there may be a push to use health data and metrics to inform climate change policies and programmes. Data sharing is an essential part of effective research collaboration, but breaches of confidentiality and misuse of data can lead to harm and exploitation and undermine trust in large-scale research projects.

Many data collection issues relate to the global nature of the climate change response, and different cultural or societal understandings of data and sample collection. There may be different social, cultural, or religious status to biological samples, whether human or non-human. A particular concern given the colonial legacy in science and medicine of the taking of body parts and raw materials from exploited communities.³⁹

There is lack of research into the mental health impacts of climate change. The concept and meanings of mental ill health are subject to wide cultural variation. Stigmatisation of mental ill health remains a global issue, and treatments vary considerably. It can therefore be difficult to obtain an accurate or consensual picture of the global mental health effects of climate change.⁴⁰ The enduring stigma associated with mental ill health means that ethical considerations around informed consent and confidentiality in research will be critical.

Key ethical considerations in funding research in climate change and health

When considering research in climate and health, with a view to avoiding catastrophic climate breakdown in a way that allows human health to flourish, the following ethical concepts and considerations can help guide decision making.⁴¹

Justice and fairness in responses to climate change

Research proposals must, where appropriate, consider how they will address issues of justice and fairness in the benefits and burdens of both mitigation and adaptation responses, and research into mitigation and adaptation responses to climate change. Questions of justice and fairness arise between countries or regions, internally to countries, and across generations.

Fairness also involves avoiding unjustifiable bias in the selection of research topics, research subjects, the location of the research and those recruited to undertake the research. It also includes fairness in the distribution of goods, including intellectual property, arising from research. Fairness includes duties not to exploit.

The obligation to reduce the health burden of climate change

All research should recognise, as a core part of its purpose, the obligation to reduce the health burden of climate change. This is the purpose of funding research into climate change and human health. The duty to reduce the health burden underpins ordinary ethical obligations to maximise the impact of research by adhering to best standards in research practice. It must also drive a rigorous approach to the prioritisation of research - identifying and promoting what matters most in climate change.

Equality of respect throughout the research process

Linked to concepts of justice and fairness, equality of respect means engaging openly, fairly, transparently, and meaningfully with relevant parties, particularly those who may be directly affected by the research. Consideration therefore needs to be given to forms of participatory decision making, including community engagement.

Research collaborations must be characterised by equality of respect for all parties to the collaboration.

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