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Review Article

Ethical issues Climate Change

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1. Introduction

Climate change is the biggest global health threat of the 21st century. The World Health Organization reports that between 2030 and 2050, climate change will be responsible for 250 000 additional deaths per year from malnutrition, malaria, diarrhea, and heat stress. Furthermore, the direct damage costs to health are estimated to be between 2 to 4 billion USD per year by 2030. According to many studies we are heading towards 3 °C above preindustrial levels by 2100, which is serious enough. Furthermore the planet is currently amid a mass extinction episode due to climate disruption, habitat loss, overexploitation, pollution, and other factors; the decimation of vertebrates and the biological annihilation of nature will have grave consequences for humanity. [1-4].

The severity and urgency of this statement was evident in a recent statement signed by an overwhelming number of scientists. Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like it is." [W]e declare, with more than 11,000 scientist signatories from around the world, clearly and unequivocally that planet Earth is facing a climate emergency [5].

The scientific community is in consensus on global warming. Oreskes N. in an article analyzing the 928 abstracts published in refereed scientific journals between 1993 and 2003 with the keywords "climate change" found that all agreed that human activities were modifying the climate. None argued that climate change was simply a natural phenomenon. The Intergovernmental Panel on Climate Change (IPCC), which consists of leading meteorologists and climate scientists from 195 countries, is the principal international body for the assessment of climate change. This international body is 95% certain that human activity is the main cause of climate change mediated by increased levels of greenhouse gases (e.g., CO2, methane, nitrous oxide). Fossil fuel combustion and industrial processes, specifically, are the major contributors to rising greenhouse gas emissions and are driven by population and economic growth. In recent decades, rising greenhouse gas emissions have led to measurable changes in the global climate, impacting natural and human systems across every continent. The continued emission of greenhouse gases will cause further increases in global temperature, increasing the likelihood of severe, pervasive, and irreversible impacts on people and ecosystems. [6-7].

As climate action gets more urgent, the moral case of redistribution within nations is growing. The ethics of climate change is therefore increasingly one of inequality and class: the rich need to take less of the world's resources to allow for more people to gain access to the resources they require for their livelihoods. Indeed, just ninety legal entities (most of them multinational corporations have generated almost two-thirds of all climate pollution since the dawning of the industrial age, 2/3rd of them are oil, gas, and coal. Building coal plants in the industrialized world, therefore, is unacceptable both because it contributes to global warming generally and because it contributes concretely by undermining the livelihoods of communities living on small island states. As Micronesia has argued in a legal submission regarding a new Czech coal proposal, "any major new coal-fired projects. threaten the future of the nation." Many observers have noted that while the global North (the industrialized nations. has historically been the main source of emissions and is also the primary benefactor of industrialization, the negative effects of climate change are first, most strongly, and most frequently felt in the global South. The World Bank notes that the "adverse effects of global warming are tilted against many of the world's poorest regions [8].

Health Impact of Climate Change

The health impacts of climate change have been well documented and can be grouped into direct impacts, environmental system mediated impacts, and socially mediated impacts. (World Health Organization. Direct impacts are those caused due to increased frequency and severity of weather events. Climate change increases both the frequency and intensity of extreme events, leading to warmer summers and milder winters, and tens of thousands of premature deaths per year across the US and internationally. Exposure to extreme heat results in increased hospital and emergency room admis¬sions and is especially detrimental to those suffering from mental health conditions. Environmental system mediated impacts include high temperatures and humidity levels leading to accelerated microbial growth thereby increasing the exposure of food to pathogens and toxins leading to disruptions in food distribution and infrastructure. Climate change also leads to longer seasonal distribu¬tion and activity of vectors like ticks, fleas and mosqui¬tos and the risk of vector-borne diseases such as Lyme disease West Nile virus, etc.

Additionally, increases in water temperatures and extreme precipitation lead to increases in pathogens such as viruses, bacteria, and toxins produced by harmful algae that result in water borne illnesses ranging from diarrhea to septicemia. Finally, the socially mediated effects of climate change are substantial. These include lower food production in and access to food sources especially in poor coun¬tries, leading to undernutrition and stunting of chil¬dren. The extreme temperatures and humidity levels also make livelihood increasingly difficult for those who rely on outdoor jobs further affecting global econ¬omies. The WHO (2014a, 2014b estimated that climate change is expected to cause approximately 250,000 additional deaths per year between 2030 and 2050: 38,000 due to heat exposure in elderly people. 48,000 due to diarrheal disease. 60,000 due to malaria; and 95,000 due to childhood undernutrition [9-11].

Climate change also affects the quality of the air that we breathe, both out¬doors and indoors due to increased particulate mat¬ter, higher pollen counts and increasing ozone levels resulting in negative health outcomes such as asthma, rates of which have increased significantly in recent years. [12]

Infectious Disease

Vector-borne diseases such as malaria, dengue, and Zika are sensitive to climate change and are expected to increase in tropical areas. When mature old-growth forests are cleared to create farms (as in West Africa), plantations (as in Malaysia), or pastures (as in Brazil), wild species move into new habitats and come into contact with species they do not normally encounter, which may then spread infectious diseases. COVID-19 was no surprise because new EIDs were clearly expected. A database on 335 EIDs starting in 1941 showed that they have been increasing significantly and have often been linked to environmental factors. Zoonoses, diseases originating in animals that can be passed to humans, were found to be 60.3% of EIDs; 71.8% of these originated in wildlife and 29.2% were from domestic species. Notable examples include the remarkably fatal Ebola hemorrhagic fever that emerged in West Africa in 1976 and had numerous outbreaks with mortality rates of up to 43%. A study of 40 Ebola outbreaks after 2004 found that they were significantly linked to the recent clearing of mature forest that led to more frequent contact between humans and infected animals [11-13].

NCD

The effects of air pollution are a major health threat in numerous countries and are directly linked to deleterious effects on cardiac and respiratory health. As global patterns of weather change, the number and type of extreme weather events, some precipitating natural disasters, will increase. Unexpected or unseasonal heavy rain can lead to flooding, which can release potentially carcinogenic chemicals into the environment from contaminated groundwater by washing over industrial sites or through overflow of sewage. Additionally, a warmer planet alters biogeochemical cycles, potentially exposing human populations to otherwise inert chemicals that are more volatile, or more soluble, at higher temperatures. For example, persistent organic pollutants are toxic and some, such as dichlorodiphenyltrichloroethane [DDT] and lindane, are possibly carcinogenic. Greenhouse emissions from industry are often released in combination with other carcinogenic pollutants eg, particulate matter between 25 μm and 10 μm in size, which is significantly associated with an increased risk of developing lung cancer [11-14].

Food Security and Malnutrition

Climate changes are thought to threaten the safety of the food supply chain through different pathways. One such pathway is the ability to exacerbate foodborne diseases by influencing the occurrence, persistence, virulence and, in some cases, toxicity of certain groups of disease-causing microorganisms. Food safety can also be compromised by various chemical hazards, such as pesticides, mycotoxins, and heavy metals. With changes in weather patterns, such as lower rainfall, higher air temperature, and higher frequency of extreme weather events among others, this translates to emerging food safety concerns. These include the shortage of safe water for irrigation of agricultural produce, greater use of pesticides due to pest resistance, increased difficulty in achieving a well-controlled cold chain resulting in temperature abuse, or the occurrence of flash floods, which cause runoff of chemical contaminants in natural water course [15].

Climate change and related environmental conditions, such as droughts and floods, are likely to adversely affect the ability to grow enough food for rapidly increasing populations. As a result, food and nutrition security will likely worsen, especially for poor people living in low-income countries. The prevalence of acute and chronic childhood undernutrition, with accompanying adverse effects on physical and mental development, is likely to increase, especially in those low-income countries already seriously affected by malnutrition. Increases in food prices resulting from climate change will also adversely affect the nutritional status of children and other vulnerable populations [12].

The COVID-19 pandemic is threatening global food security made worse by climate change, bringing new attention to sustainable agriculture. With over 820 million people now facing chronic hunger (people who go to bed hungry every night), the Executive Director of the World Food Program has warned of a looming global humanitarian catastrophe because of the pandemic. Famines can result from breakdowns of supply, and COVID-19 has encouraged governments to keep more of their food at home, posing problems for the food-importing countries in Africa and the Middle East In 2015 and 2018, Europe experienced more severe drought years than during the previous 2100 years that affected the agricultural sector. If several drought years will occur in succession in the future, the consequences for food availability in those densely populated regions could be dramatic [13-16].

Migration and Climate Change

Environmental consequences include increased tempera-

ture, excess precipitation in some areas and droughts in others, extreme weather events, and increased sea level. These consequences adversely affect agricultural production, access to safe water, and worker productivity, and, by inundating land or making land uninhabitable and uncultivatable, will force many people to become environmental refugees [12].

With climate change, more frequent extreme climatic events, such as windstorms, heat waves, heavy rainfall, droughts, and floods are predicted. This is likely to cause resettling of people to other regions that are less prone to these risks. Moreover, over time and with changes in agricultural and industrial land use in some areas of the world, massive migrations and redistributions of people could occur displaced individuals are at risk of stigma, stress and depression, restricted access to health care, economic hardships, and in some cases, threats of deportation. Globally, children are projected to bear 88% of the burden of disease due to climate change, and climate-driven, human-induced disasters expose children to risks of long-term physical and mental health harms. Child health threats stemming from displacement and migration exemplify questions of social and intergenerational injustice inherent in the climate crisis [15-17].

Humans and Their Relationship with Nature

These events highlight a few of the many ethical challenges climate change poses that are increasingly the focus of policymaking and public engagement [18].

Before understanding the ethical aspect of climate change it is important to get an understanding of the relationship between Nature and humans. The interaction between humans and nature has been a complex one defined by their relationship and status with respect to each other. Theories like Descartes put nature at the disposal of humans with the assumption that resources are unlimited. This assumption led to the abuse of nature in various forms. This theory's claims were also refuted by the introdction of the ecological science approach (Arthur George Tansley, 1937 which considers man as part of nature and the ecosystem being finite with limited resources. However, ecological theory also suffers from anthropocentrism just like Descartes. Probably the best approach would be interaction based on respect for each other, where humans appreciate the existence of other living species and nature and consider themselves accountable for their actions. [19].

Ethics in Climate Change

Social scientists, humanists, and philosophers have identified a variety of ethical dimensions of climate change, as well as several unique features of the problem that may hinder our ability to respond ethically and cooperatively. Gardiner, for instance, characterizes the ethical dilemma of climate change as one shaped by the dispersion of causes and effects, fragmentation and diffusion of responsibility, and the inadequacy of existing institutions and lack of an effective system of global governance. These elements together create a 'perfect moral storm' that fuels uncertainty and impedes collective action Eth¬ics reflects on the human goods that climate change can undermine and examines questions such as what actions are right or wrong in relation to climate change, who has what duties, and how these relate to others' rights, for example, to be protected against effects of climate change. Over the past twenty years, several moral philosophers (among others have explored whether anthropogenic climate change involves questions of good and bad, right and wrong, responsibility and blame (e.g., Davidson 2008; Gardiner 2006; Jamieson 2007, 2009; Shue 1993; Singer 2006). Taking a normative approach, these researchers have attempted to lay out how and why climate change poses an ethical problem for policymakers, economists, and laypersons alike and thus why confronting climate change should be treated as a moral imperative [20-22].

Indeed, as of 2020, half of Americans now perceive climate change as a moral issue (vs. 38% in 2019), and more than two-thirds of Americans indicate that climate change will harm the world's poor (67%), future generations (73%), and other species (73%). Similar trends have been documented in other countries, with majorities in France, the United Kingdom, Norway, and Germany viewing climate change as a moral issue, which is generally a stronger predictor of climate mitigation and adaptation policy support in these nations than perceptions that climate change will have negative effects on their home country [23].

Interest in the ethical dimensions of climate change stems, at least in part, from the fact that morality is a key driver of human (social behavior. Both as individual actors and as collectives (families, communities, nations). We care deeply about right and wrong, about the intentions we see in others' actions, and about the implications of our and others' behavior with respect to questions of justice and harm. Thus, if climate change is recognized as an ethically significant issue, there may be reason to believe that people will be motivated to effectively confront the causes of the problem; on the other hand, if many individuals fail to identify climate change as a moral imperative, this may pose a significant barrier to effectively responding to the issue (individually and collectively [22].

Many of the arguments put forth by moral philosophers in support of the claim that climate change poses an ethical problem rest on two seemingly reasonable premises. The first is that the Earth's atmosphere, which provides significant life-sustaining services to humans and all other life on the planet, can be considered a public good. A piece of the global 'commons'. The second is that Earth's life-sustaining atmosphere is in fact a limited resource, subject to depletion and/or degradation under certain conditions. This second claim is especially important because, as Peter Singer (2006 clarifies, 'Climate change is an ethical issue, because it involves the distribution of a scarce resource the capacity of the atmosphere to absorb our waste gases without producing consequences that no one wants'. In a closely related vein Jamieson (2009 argues that climate change is a moral issue because it involves 'rich people appropriating more than their share of a global public good and, in addition, harming poor people by causally contributing to extreme climatic events such as droughts, hurricanes and heat waves'.

Thus, Jamieson slightly extends Singer's argument by suggesting that past and present distributions of 'atmospheric use' are in fact unjust for two intertwined reasons. First, some people (i.e., rich individuals who primarily, but not exclusively, live in developed nations have used and continue to self-appropriate more of the atmospheric commons than have others (i.e., poor individuals living primarily in developing nations). Second, such 'atmosphere grabbing' has the very real potential to cause physical harm to many people, including those who are not yet born. Additionally, the problem is compounded by the fact that the perpetrators of harm (i.e., those who emit greenhouse gases at levels far above what could reasonably be considered equitable have not compensated those who are harmed by their actions. The economics and ethics of climate change must start with the science describing the nature of the problem, because as soon as that is set out, we see the issues in terms of the management of immense risks, with unmanaged climate change likely to produce movement of people, destruction, conflict, and loss of life across the planet over the next century or so on a great scale. Those are not minor perturbations around some basic underlying growth story and have profound implications for both the relevant ethics and the formulation of the economics [22-24].

Population Dynamics and Climate Change

One key application of the above discussion of ethical perspectives is population: climate change can, and does, kill people, either directly or through the conflict it can cause. It can also prevent people from coming into existence, (Though, as philosophical discussion about the so-called 'non-identity problem' (see Parfit 1984 has revealed, whatever path we take on climate change will ultimately lead to a different set of persons being born than would be born because of having taken a different path. such as the 'lost children' of those who might be killed or otherwise die prematurely. And these premature deaths are likely to be very unpleasant, e.g., from conflict, starvation, dehydration, inundation, etc. The scale of the potential consequences means that those, including economists, who think about policy cannot avoid the issues. The first question we must face here is trying to value premature (and very unpleasant deaths and the prevention of future lives. A second question concerns population as a determinant of climate change in that more people imply more emissions.

Killing or damaging human lives and causing premature death are central potential consequences of badly managed climate change. Age specific death rates are a central determinant of population size, as are demographic structures, age-specific birth rates and fertility rates. The different elements feed into each other. Thus, arguments about causing death led us to a discussion of population size and of the relevant ethics, particularly in the sense of how we value populations of different sizes. The size of the human population, in the near-term and distant future, is a key determinant of climate policy: All else equal, a larger population entails more emissions and therefore more mitigation to achieve a given climate target (1–3), and it also means more future people will be vulnerable to climate related impacts [23-25].

Responsibilities

Most approaches to moral philosophy assess or evaluate actions or policies in one of two ways. The approach which dominates the attention of economists is to evaluate actions or policies by assessing the desirability or otherwise of their consequences. This is the 'consequentialist' approach, of which the Bergson-Samuelson, or Paretian, welfare analyses are special cases familiar to economists. There are, however, many other well-developed moral theories that do not judge actions or policies by reference to their consequences. at least, do not do so exclusively.

Non-consequentialist theories: we consider four very briefly, which we crudely label Kantian, Contractarian (such as Rousseau or Rawls), Aristotelian and 'commonsense pluralism'. At the heart of Kant's framework is a 'categorical imperative' which gives a criterion for judgement of moral behavior in oneself or others. Essentially, it invokes the notion of 'duty' and examines its bases. One of Kant's formulations of the categorical imperative is: 'Act only according to that maxim whereby you can, at the same time, will that it should become a universal law'. It is an approach to guide the individual. It focuses on the source of action – the will – as the object of moral evaluation, rather than on the possible consequences. Kant's second formulation of the categorical imperative is never to treat 'humanity' only as a means or instrument. Knowingly harming the prospects and livelihoods of the others by polluting their environment would seem to be using those others merely to our ends.

Approaches based on contractarianism, such as those of Rousseau or Rawls, have a similar problem to that of Kant. With whom is the social contract? What should be the role of those not yet born who could not be present to participate in it other than if we act on their behalf? And we may be, indeed are likely to be, uncertain as to who and how many will exist in the future and how their presence or absence depends on our decisions. Interestingly, Rawls largely avoided the issue of future generations in his analysis of social contracts based on an 'original position The Aristotelian approach or, more broadly, virtue ethics, differs from other approaches in that it asks not 'what ought we to do?'. But rather 'what sort of person should we be?' It emphasizes the role of moral character, or 'virtues', in living an ethical life. It suggests that we can recognize, discuss, and comment on 'good behavior' as we might recognize good playing of the violin. Aristotle in his Nicomachean Ethics pointed, for example, to courage, temperance, and magnanimity as key aspects of a virtuous life. 'Common-sense pluralism' embodies the view: 'the role for moral philosophy is primarily to explain and justify our everyday moral beliefs and attitudes rather than seriously to challenge them'. Unfortunately, such an approach does not help us very much if every day or standard behaviour has arisen because of ignorance of its broader consequences, in this case of the long-term impact of greenhouse gas emissions. The ethical question on which we are seeking guidance concerns how we should act collectively, collaboratively, or individually in response to the potentially immense risks of unmanaged climate change [24].

In terms of the broad approaches in the mainstream of western moral philosophy, consequentialism, and its special cases such as utilitarianism, or the Bergson–Samuelson approach. The consequentialist approach, to express its statement of ethics in a simple way, embodies the idea that we should act to produce the best outcomes or consequences relative to some criterion or criteria which measure overall goodness and badness of consequences. Over the past two centuries, the nations that are now classified as developed countries emitted large quantities of carbon dioxide into the atmosphere as they became industrialized. Most of it is still there, and that is why the atmosphere has exhausted its capacity to absorb more greenhouse gases without a change in the planet's climate. Developed nations account for three-quarters of the world's greenhouse gas emissions while constituting only one-quarter of the world's population. The United States uses at least five times its notional quota under a system of equal per capita shares. Using the principle that the polluter should pay, it therefore seems reasonable that the developed countries, rather than the developing countries, should currently bear the burden of dealing with the problem of global warming [24-26].

The burden of responsibility was discussed in detail in Kyoto Convention in 1997. The Kyoto Protocol adopted the 'grandfathering principle': the developed countries were required to reduce emissions by an average of 5% compared with 1990 levels. Hence those already heavily polluting in 1990 could continue emitting more GHGs than lower-emitting countries. In post-Kyoto negotiations, which envisage developing countries also being included in the emissions reduction programmer, the richer countries continue to press for the application of the principle. "Grandfathering Principle" was deemed more practical than moral. It was also argued that inclusion of developing countries might push them more into poverty, and increase inequality, "thereby lacking them into a state of underdevelopment". The Buenos Aires Declaration launched The Program on the Ethical Dimensions of Climate Change at the 10th Conference of Parties to the United Nations Framework Convention on Climate Change held in early December of 2004 identified a few specific ethical issues and associated questions concerning climate change about which express ethical reflection is an international imperative: Where the question of What, Who and How much remained the most important topic of discussion [27-29].

Regarding the range of potential bearers of responsibility, which could be individuals, corporations, or states, for instance, the allocation of responsibilities has so far focused on practice at the level of nation-states, and there has been international agreement on the principle of common but differentiated responsibilities among them. He divided responsibility into 'What' and 'Who'? What needs to be done and who is responsible? Where the topic of 'What' is discussed under two headings: Mitigation and adaptation. Many philosophers advocated for a distinct approach, while others argued for either mitigation or adaptation, but integrated approach theories need to be discussed. The topic of 'who' is more intense than 'what' as the responsibility lies upon individuals, corporations, or the state. "The allocation of responsibilities has so far focused on practice at the level of nation-states, and there has been an international agreement on the principle of common but differentiated responsibilities among them". The table below summarizes the allocation of responsibilities and their respective pros and cons:

Table 1 | Differentiating common responsibilities: who should bear the costs of dealing with climate change?

Principles	Differentiation criteria	Pros	Cons
Causal responsibility ('polluter pays')	Those who have caused the build-up of CO_2 in the atmosphere should bear the costs	It seems fair that those who cause a problem should deal with it	Those who emitted in the past may not have realized they were doing anything wrong, and now are dead anyway; so while requiring future polluters to pay may be fair, we cannot impose costs on past polluters
'Beneficiary pays'	Those who have benefited from excess emissions should pay	This principle maintains connection with causal responsibility by allowing that past polluters can be deemed to have bequeathed liabilities to those who have been advantaged today by past emissions	Because it assumes that strict liability can apply retrospectively and can be inherited, present beneficiaries can complain that it is unfair on them
Ability to pay	Those who are able to should pay	This recognizes that past emissions may not have yielded present benefits for a given country and places costs on those least harmed by having to bear them	Disconnecting responsibility from causation can have perverse incentives if the ecologically efficient are effectively required to subsidize polluters

Table 1: Differentiating common responsibilities: who should bear cost of dealing with climate change?

Hayward, Tim (2012). Climate Change and Ethics. _Nature Climate Change_ 2:843–848.

Debate on Individual Responsibility

In discussions of global climate change, it is often assumed that the consequences of the choices of a single individual are negligibly small. Jamieson, by contrast, advocates inculcating green virtues at the individual level. He argues that although the nation-state is a level of social organization relevant to addressing climate change because it is causally efficacious, it is not the primary bearer of ethical responsibilities. The responsibility of individual has also been challenged by an argument that claims that, on average and over the course of a lifetime, the emissions of a single typical American are significant enough to contribute to the severe suffering and/or deaths of two future people [21-30].

However, Seager et al. argues that individual action would even be counterproductive: In the absence of collective action and enforcement in a non-cooperative game, those individuals (or countries that voluntarily curb climate emissions

will have the practical effect of incentivising others to increase emissions. For example, Americans who reduce consumption of fossil fuel resources will undoubtedly reduce fossil fuel prices—thereby enabling increased consumption of fossil fuels by others. The result may not in fact be beneficial to the future people for whom they are concerned, but instead transfer the greatest benefits to those individuals or countries that do not voluntarily curb emissions. But a claim of ineffectiveness of individual actions against climate change should not be considered as an argument against individual moral responsibility, rather as an argument for collective action. To confirm or refute that the consequences of individual behaviour for climate change are ethically negligible we should consider too the criterion of negligibility. For Nolt, for example, the threshold of non-negligibility is the level at which individual behaviour produces harm. We take a more pragmatic intuitive approach. If one finds that even the minimal estimate of impacts is non-negligible, then one does not need to argue over the precise cut-off criterion of negligibility. So, identification of the broad order of magnitude of impacts may suffice for identifying whether impact is ethically negligible or not [31].

To address a problem like climate change requires collective action; how is this to be achieved when individuals and groups are motivated by conflicting interests? Furthermore, even if an individual wants to do the right thing, how may their ethical obligations be affected by failure of others to comply with theirs? If some people fail to do their bit, can others be reasonably expected to pick up a share of the load that has been left by the defaulters? The theoretical debate about individual responsibility is in its infancy but is likely to heat up as more philosophers devote attention to this issue [20-21].

Responsibility of Rich/Developed Countries

Savacool B.K., pointed some of the hindrances that have plagued progressive energy policy and climate action. Specifically, lack of attention to warnings about a potential crisis, delayed responses to building evidence of crisis onset, nationalism at the expense of the global good, politics overshadowing social welfare, marginalized populations (e.g., people of low socio-economic status, or people in low- and middle-income countries experiencing adverse consequences at higher rates, conspiracy theories and fatigue of mitigation measures. For the US to try to reduce its greenhouse gas emissions to a fifth of what they are now – as the equal per capita share principle suggests it should do – would cause a major economic crash, especially if this were to be done in, say, a single decade. We do need to take consequences into account, and especially costs for the poor and disenfranchised. That, however, includes the 2.4 billion poor people living on less than the purchasing power equivalent of US$2 per day, all of whom are disenfranchised, so far as US energy policy is concerned, and very few of whom will have the resources to adapt to adverse climate change [26-32].

During the Copenhagen Climate Conference in 2009, high-income countries pledged to provide $100 billion to low- and middle-income countries to help them adapt to climate change. However, this pledge has not been met. Although high-income countries reaffirmed their pledge at the recent Glasgow Climate Conference, the prospects for meeting this financial commitment are not good, especially given the global economic recession caused by the COVID-19 pandemic. Political and economic rivalries that have influenced the formation and implementation of agreements designed to minimize global warming may interfere with efforts to ensure that climate change mitigation agreements are just at a global level. For example, the Kyoto Protocol required developed nations to meet greenhouse gas emission targets but exempted developing nations to allow these countries to burn fossil fuels. (United Nations. (1997). Kyoto protocol to the United Nations framework convention on climate change. The rationale for including this provision in the treaty was to protect developing nations from the adverse economic effects of reducing their greenhouse gas emissions. However, this provision proved to be controversial, and many countries argued that all nations, not just developed nations, should do their part to mitigate climate change. India, for example, was exempted from the Kyoto Protocol, but India is a highly industrialized developing nation that produces huge amounts of greenhouse gases. While China was not exempted from the Kyoto Protocol, political leaders in the United States and other countries were concerned that China would not live up to the requirements of the treaty and would use it to gain an economic advantage over countries that abide by the treaty [33].

The Kyoto Protocol already permits developed countries to sell entitlements to emit greenhouse gases that they do not need to use themselves. Because the developing nations have no binding quotas in the first round of Kyoto cuts, they have nothing to sell. But if the Kyoto Protocol were based on equal per capita shares, the developing nations would see that they have nothing to lose, and a great deal to gain, by agreeing to be bound by the same rules as the developed countries. They would then be able to sell their quota. India, for example, would have a quota proportionate to its population of around one billion, but on current emissions it would require only about a third of that amount. So, it would be able to sell on the world market entitlements to emit more than 600 million per capita shares. The United States and other developed nations would bid for those entitlements, and others that would be offered by other developing nations. If the total global quota is a significant reduction on present global emissions, this system would provide every country with an incentive to reduce its emissions – the developed nations, so that they would not need to buy so much from others, and the developing nations, so that they would have more of their quota free to sell. As a result, the developed nations would be able to avoid the kind of drastic reductions in emissions required by a system based on equal per capita shares without saleable quotas, but to do so they would have to transfer some of their wealth to the developing nations. There would be nothing unfair about such a transfer, for it represents the fact that the wealth of the developed nations is made possible by their use of a resource that they do not own. They would simply be paying the rent [26-33].

Role of Technology/ Geoengineering in Climate Change Mitigation

The Royal Society defines geoengineering as ". The deliberate large-scale intervention in the Earth's climate system, in order to moderate global warming..." (Royal Society 2009: 1). Geoengineering as a technological intervention to avert the dangerous climate change has been on the table at least since 2006. The global outreach of the technology exercised in a non-encapsulated system, the concerns with unprecedented levels and scales of impact and the overarching interdisciplinarity of the project make the geoengineering debate ethically quite relevant and complex. Thus far geoengineering proposals fall under the general scheme of Carbon Dioxide Removal (CDR or Solar Radiation Management (SRM). The first scheme aims at reducing greenhouse gases in the earth's atmosphere. The second scheme involves attempts to reduce the amount of energy from the sun reaching the earth [34].

CDR methods that remove CO_2 from the atmosphere without perturbing natural systems, and without large-scale land-use change requirements, such as CO_2 capture from air (and possibly also enhanced geochemical weathering are likely to have fewer side effects. Techniques that sequester carbon but have land-use implications (such as biomass-based methods, including biochar and soil-based enhanced weathering may be useful contributors on a small scale although the circumstances under which they are economically viable and socially and ecologically sustainable remain to be determined. The extent to which methods involving large-scale manipulation of ecological systems (such as ocean fertilization can sequester carbon affordably and reliably without unacceptable environmental side effects is not yet clear [35]. SRM techniques are expected to be relatively cheap and would take only a few years to influence the climate once deployed. However, there are considerable uncertainties about their consequences and additional risks. Of the SRM techniques considered, stratospheric aerosol methods appear to have the most potential because they should be capable of producing large and rapid global temperature reductions, as their effects would be more uniformly distributed than for most other methods, and they could probably be readily implemented. However, there are potentially significant side effects and risks associated with these methods that would require detailed investigation, even before large-scale experiments were undertaken [35].

One would have no difficulty in agreeing with Gardiner that "Geoengineering ethics, like geoengineering science, is still in its early, exploratory days". The overall alignment of the opportunities and challenges in geoengineering suggest that the ethical debate spanning over two decades may be classified into two generations. Considering technology-specific analysis to be the norm for classification, several of the sources available since 2014 may be coded under the second generation of ethical arguments. In the first generation of the debate, there was very little demarcation between the purely scientific, social, political, and ethical problems. However, the second generation of papers reflect a more distinctive analysis of the social, scientific, political, and ethical issues. Baatz et al. (2016 call it the second wave approach. The review by Flegal et al. (2019 shows that a rich categorisation of the social, legal, and ethical constituencies of the debate is possible for a geoengineering scheme like SRM alone. This review seems to disagree with the observation of Wong (2015 that in the existing discussion on the ethics of geoengineering only first order and second order questions are raised, overlooking the problems of post implementation scenarios. Global efforts to reduce emissions have not yet been sufficiently successful to provide confidence that the reductions needed to avoid dangerous climate change will be achieved. There is a serious risk that sufficient mitigation actions will not be introduced in time, even though the technologies required are both available and affordable. The acceptability of geoengineering is likely to be determined as much by social, legal, ethical, and political issues as by scientific and technical factors [33-35].

There is a considerable distrust against understanding Climate Engineering as a technological innovation, as such options could leave aside possible solutions on the social level. Furthermore, Climate Engineering has been linked to a deep-rooted habit of Western cultures to solve problems with technology, rather by responding more directly to the failure of people to behave in an appropriate way. The techno-fix framing is therefore often used negatively by connoting an inadequate and morally problematic solution for the underlying behavioral problem. The uncertainties remain, and the conclusions reached by the Royal Society study remain valid: The safest and most predictable method of moderating climate change is to take early and effective action to reduce emissions of greenhouse gases. No geoengineering method can provide an easy or readily acceptable alternative solution to the problem of climate change. Geoengineering is not a magic bullet, and it is not an alternative to emissions reductions. [33-35]

Artificial Intelligence (Ai and Climate Change

AI can help improve and expand current understanding of climate change; and AI is increasingly part of a package of responses that are essential to combatting the climate crisis effectively, by delivering much greener, more sustainable, and effective solutions. First, despite scientific consensus about the basic facts of climate change, many aspects of the environmental crisis remain uncertain. This includes the explanation of past and present events and observations, and the accurate prediction of future outcomes. The ability of AI to process enormous amounts of non-structured, multi-dimensional data using sophisticated optimization techniques is already facilitating the understanding of high-dimensional climate datasets and forecasting of future trends. AI tools can also help anticipate the extreme weather events that are more common because of global climate change, for example heavy rain damage. In many cases, AI techniques can help to improve or expedite existing forecasting and prediction systems.

Second, combating climate change effectively requires a vast array of responses to the crisis, which broadly include both mitigating existing effects of climate change and reduc-

ing emissions through decarbonisation to prevent further warming. For example, a 2018 Microsoft/PwC report estimated that using AI for environmental applications could boost global GDP by between 3.1 and 4.4%, while reducing greenhouse gas emissions anywhere from 1.5 to 4% by 2030 compared to a "business as usual" scenario (Microsoft 2018, 8). Leveraging the opportunities offered by AI for global climate change is both feasible and desirable, but it involves a sacrifice (ethical risks and potentially an increased carbon footprint in view of a very significant gain (a more effective response to climate change). Introduction of AI into the climate domain risks amplifying several social and ethical challenges already associated with AI more generally, such as unfair bias, discrimination, or opacity in decision-making. Yet, AI (both in the sense of training models and of uses can consume vast amounts of energy and generate green House gas (GHG emissions. We find that the carbon footprint of AI research may be significant and highlight the need for more evidence concerning the trade-off between the GHG emissions generated by AI research and the energy and resource efficiency gains that AI can offer [37].

Politics and Climate Change

In the United States, public discussions of climate change have generally focused on scientific, economic, and political aspects. Ethics has been relatively neglected. That trend was reinforced by President George W. Bush, who said. We will not do anything that harms our economy, because first things first are the people who live in America' (Bush 2001). Yet the question of what the world's largest emitter of greenhouse gases should do in respect of climate change is above all a moral question, and the failure of the United States to meet its responsibilities to the rest of the world is a moral failure of the most serious kind [26-37].

Between 2001 and 2011 the United States handed out around $2 billion a year in subsidies to the five biggest U.S. oil firms, even though these firm had profits of approximately $1 trillion over the same period. There is even a serious legal prospect of corporate executives of major fossil fuel companies facing personal liability for opposing policies to fight climate change and funding climate change deniers. As reserves dwindle, evermore extreme fossil fuels—such as the tar sands in Canada or the oil in the Arctic—are being pursued, and many challenging the extraction of these commodities are increasingly under threat. In 2013 for example, thirty Greenpeace activists spent two months in Russian jails after peacefully protesting at the first oil rig to deliver oil from the icy waters of the Arctic. They were freed only after an unprecedented wave of support from senior politicians, diplomats, and Noble Prize winners [8-32].

The author presented that how pandemic served as a mechanism for powerful incumbent interests to usurp various regulatory processes that back their own narrow interests at the expense of the public good. One example is Enbridge "taking advantage of divided public attention and a fraught financial situation during the Covid-19 crisis to push forward permit applications" for a major change in the routes of one of their pipelines. Such attempts at regulatory manipulation are not limited to North America; Kalyani writes how vested interests in India were using the pandemic as an excuse to increase employment in the coal and gas sectors, even though these sectors operate contrary to India's stated climate policies. Even when the majority agreed with the Corona restrictions, a significant minority not adhering to them was enough for the pandemic to worsen. Similarly, even when the majority in a country decides that burning of fossil fuels must be reduced, demand for cheap energy might keep CO2 emissions high. It is important to win majorities voting for changed legislation. [16-32].

Powerful economic and political forces, such as oil, coal, and electric companies, as well as leaders from states or regions likely to be harmed by the phasing out of fossil fuels, are likely to oppose just transition policies every step of the way. [33]

Climate Justice/Environmental Justice

Climate justice is a concept that refers to the ethical and human rights issues that occur because of climate change. The issues of justice—particularly social justice, environmental justice, and advocacy—are integrally linked to the movement to address climate change. Inherent in the concept of climate justice is the recognition that those least responsible for climate change experience the greatest negative impacts to their well-being. The environmental justice movement is a powerful social and political force and environmental justice considerations have been incorporated into US government laws and policies at the federal and state level. Since the early 2000s, climate change has emerged as an important environmental justice issue because (a it is caused, in part, by human activities that produce greenhouse gas emissions (such as combustion of fossil fuels or reduce the biosphere's capacity to remove carbon dioxide from the atmosphere (such as deforestation); and (b it disproportionally burdens low-income populations and countries, which tend to produce fewer greenhouse gas emissions than high-income populations and countries [11-33].

In 2004, Hurricane Katrina brought climate justice issues to the forefront of public policy discussions, when it decimated the US Gulf Coast, killing 986 people and causing billions of dollars in property damage. Scholars and advocates argued that Hurricane Katrina exposed injustices related to race, ethnicity, and income and that mitigating and adapting to climate change should be a key objective in the struggle for social and economic justice. Both health disparities and climate injustices must be addressed together if we are to move forward equitably in protecting all people from the harmful effects of a rapidly changing climate. Research suggests that the drivers behind climate injustice and health disparities are fundamentally the same—social inequities, institutional power, and the need for broader systems changes in our health systems, transportation infrastructure, and the production and distribution of energy [33-38].

Inequity in Climate Change Impact and Climate Change Policy

The hurricane Katrina did most of its damage by causing

massive flooding, which disproportionally impacted low-income communities and communities of color because they were living in flood-prone areas and lacked the social and economic resources to protect themselves from harm or recover from it. People at greatest risk from global warming, at least in the near future, are poor farmers in the low-lying delta regions of Bangladesh and Egypt, and the inhabitants of Pacific Island nations like Tuvalu, where most of the land is barely above sea level. These lands will be inundated by rising sea levels [26-33].

While there is little doubt that climate change raises issues of environmental justice, policy proposals designed to address climate change may impede the goals of the environmental justice movement if they are not developed and implemented with an eye toward reducing socioeconomic inequalities. Mitigating anthropogenic climate change is a complex problem involving many heterogeneous actors with different agendas and socioeconomic conditions. For instance, increasing green spaces and similar actions that improve urban environmental health are part of the Nationally Determined Contributions (NDCs within the Paris Agreement (COP21). However, these actions impact differently more and less affluent citizens and, in fact, such actions have also been questioned from the perspective of environmental justice [33-39].

According to Schlosberg and Collins: "In any climate policy debate, environmental justice activists are suspicious of corporate or consumerist responses to climate change; they see such approaches as catering to those with wealth, rather than the already vulnerable. More specifically, there has been tension around the key policy suggested by mainstream environmental organizations—to raise the price and/or limit the supply of carbon-based energy. The concern is that any policy to reduce carbon emissions. will inevitably raise the price of energy. That, of course, hurts the poor most." For example, In South Africa, the state-owned power utility Eskom is getting the government to support its coal and nuclear expansion while charging consumers increasing amounts for their energy. If the government were serving the public interest, it would force Eskom to move to renewable energy rapidly. Instead, South Africans, especially the poor, are paying the price for Eskom's outdated business model through polluted air, water shortages, and an increasingly erratic and dangerous climate [8-33].

Between 2011 and 2015, during the Durban Platform for Enhanced Action, the focus of the UNFCCC negotiations was on a new climate agreement, to achieve long-term cooperation. A major change that has been discussed in that phase was a shift away from negotiating targets for developed countries toward building the global climate effort through contributions from all countries around the world on a long-term basis, through the so-called Intended Nationally Determined Contributions (INDCs). This shift gave rise to new questions about equity, which is the focus of Boran's paper. Boran contends, calls for a move away from substantive considerations of burden allocation toward procedural considerations of public reason, to develop guiding principles specially designed for enhancing ambition on an equitable footing over the long term. Steve Vanderheiden's (2017 paper 'Territorial Rights and Carbon Sinks' nicely links to Boran's paper, in that he also discusses ethical issues involved with the different roles of developing and industrialized nations, specifically in the context of territorial carbon sinks. He starts with the idea of ''resource privilege'', according to which the governments of developing states are claimed to have national sovereignty over the natural resources that lie within their borders. This global justice idea is also applied in the context of climate change to justify a right to extract and combust fossil fuels. However, this provides for a challenge for global climate change mitigation imperatives. Furthermore, if one were to grant national sovereignty over territorial carbon sinks this could be in tension with equitable sharing of climate mitigation burdens [40].

Human Rights

The debate on rights is also an important topic to be taken into consideration. If climate change is regarded as a human rights issue, then how would it be considered? There is debate about whether climate change can be regarded as a human rights issue, and if so, how? Two prom-inent lines of argument can be distinguished: one treats the use of the planet's carbon absorption capacity as a necessary good that humans have a right to share; the other focuses on how harms to the planet's capacities can undermine goods that humans have a right to see protected. The environmental and health consequences of climate change, which disproportionately affect low-income countries and poor people in high-income countries, have profound effects on human rights and social justice. These consequences threaten rights embodied in the Universal Declaration of Human Rights, such as the right to security and the right to a standard of living adequate for health and well-being, including food, clothing, housing, medical care, and necessary social services. (The Universal Declaration of Human Rights. Adopted by the United Nations General Assembly, Paris, December 10, 1948). They threaten civil and political rights, such as "the inherent right to life" and rights related to culture, religion, and language, as embodied in the International Covenant on Civil and Political Rights. They threaten economic, social, and cultural rights, as embodied in the International Covenant on Economic, Social, and Cultural rights, including the following (International Covenant on Economic, Social and Cultural Rights. Adopted by the United Nations General Assembly, New York, December 16, 1966):

The Right of Self-Determination.

- The rights to freely determine one's political status and freely pursue one's economic, social, and cultural Development.
- The right "to the enjoyment of the highest attainable
- Standard of physical and mental health". The right to education [12-21].

It was argued that an international agreement on a benchmark on greenhouse gas emissions per capita entitlement should be set. Some have argued that there is an entitlement to equal or minimum emissions. A right to minimum emis-

sions risks exacerbating rather than resolving the problem of excessive emissions. What the rich owe to the poor should be seen not as 'more emissions' but as an equitable share of the benefits that they have derived from their own excess use of the atmosphere—and, indeed, other environmental services and natural resources, or 'ecological space' [21-41].

Covid -19 and Climate Change

The COVID-19 pandemic has brought profound social, political, economic, and environmental challenges to the world. The virus may have emerged from wildlife reservoirs linked to environmental disruption, was transmitted to humans via the wildlife trade, and its spread was facilitated by economic globalization. The pandemic arrived at a time when wildfires, high temperatures, floods, and storms amplified human suffering. Climate change can affect the transmission of vector-borne diseases with some speculating that COVID-19 may be linked to a warming planet and hotspots of the human-animal interphases [10-13].

Some of the restrictions designed to address COVID-19 have led to environmental benefits such as a remarkable, if transitory, improvement of air quality, especially in cities. Data collected by Apple and Google found that more than half of the world's population reduced travel by more than 50% in April 2020 and mobility declined by at least 10% in almost all the 125 countries tracked, with some countries showing a decline of 80% or more. This decline in transportation and commercial demand for electricity significantly reduced consumption of globally traded greenhouse gas-producing fossil fuels (oil, gas, coal and increased the share of energy provided by local sources such as solar and wind power (IEA 2020a [13].

Even though, never intended as measures to reduce energy consumption, air pollution, or climate change directly, responses to the virus have had substantial connections with energy demand and greenhouse gas emissions. The most prominent drivers of these have been mandatory lockdowns or quarantines for households (people are only permitted to leave for essential reasons and the related severe restrictions on travel. In late April 2020, more than half of the entire global population (54% was under some form of a coronavirus lock down, with their movement actively restricted and controlled by their respective governments. The share of energy use that was exposed to containment measures reached 50%. Canada not only did civil aviation activities drop by 71% compared to business-as-usual in late 2019, but also military aviation activities were down by a significant 27% in 2020. They also projected that for 2021, greenhouse gas emissions for the Canadian transport sector will be nearly 25% lower than in 2019 [32].

On the downside, Covid-19 has not only affected travel and the energy involved in providing it, but also global energy supply chains and the viability of energy firms. The most affected renewable energy sector has been solar energy and remarks that indeed, "the COVID-19 pandemic has struck the renewable energy manufacturing facilities, supply chains, and companies and slowed down the transition to the sustainable energy world". The off-grid renewable energy sector could face even more dire circumstances, with the World Bank noting that the pandemic has seriously disrupted electrifications efforts, meaning that SDG 7 (that encompasses universal energy access by 2030 is now unlikely to be met. Also, recent research noted that the immediate effect of COVID-19 restrictions on global CO2 emissions was negligible and there were no lasting effects [13-32].

Gaps in Research

Important research gaps on previously neglected climate-sensitive health outcomes, however, are beginning to be filled, including climate change impacts on mental health, nutrition, and foodborne disease. We also observed progress in research that included future projections of climate-health risks; however, projection research is still relatively nascent and under-studied for many climate-sensitive health outcomes in North America and would benefit from considering social and demographic variables in models. Important research disparities in geographical coverage were noted, including research gaps in Canada and Mexico, and in rural and remote regions. Transdisciplinary and cross-sector research, that includes the social sciences, examining current and future climate-health adaptation, mitigation, and the adaptation-mitigation nexus should become a top priority for research, given the urgent need for this evidence to inform climate change policies, actions, and interventions. However, the present body of (published research is incomplete. Specifically, nearly all work completed to date on the 'ethics of climate change' has approached the issue from a normative perspective, relying primarily on philosophical claims about harms, rights and duties held by various stakeholders (e.g., rich individuals, future generations to make the case that climate change is indeed an ethical issue. This approach can provide useful insights, e.g., about why we might very well fail to act before it is 'too late' (Gardiner 2006), but it fails to ask whether, how and to what extent non-experts (i.e., members of the public [22-42].

Researchers need to shift toward an integrated Geo-Health approach with sustained inclusion of and communication with the community. As the environmental problems being faced are complex, and research teams need to tackle these issues from a multidisciplinary approach, it is critical that communication is part of the process. [43]

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