Institute for Public Policy Research

THIS IS A CRISIS

FACING UP TO THE AGE OF ENVIRONMENTAL BREAKDOWN

Initial report

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ABOUT THIS PAPER

This paper explores the processes of environmental change at a global and national level and consequences for societies and economies. It supports education in the economic, social and political sciences by informing the public of the state of environmental change, the growing impacts on societies and economies around the world, and the role of social and economic systems in driving environmental change. In doing so, it seeks to help advance environmental protection and improvement, sustainable development, and relieve poverty and other disadvantage.

SUMMARY

Mainstream political and policy debates have failed to recognise that human impacts on the environment have reached a critical stage, potentially eroding the conditions upon which socioeconomic stability is possible. Human-induced environmental change is occurring at an unprecedented scale and pace and the window of opportunity to avoid catastrophic outcomes in societies around the world is rapidly closing. These outcomes include economic instability, large-scale involuntary migration, conflict, famine and the potential collapse of social and economic systems. The historical disregard of environmental considerations in most areas of policy has been a catastrophic mistake.

In response, this paper argues that three shifts in understanding across political and policy communities are required: of the scale and pace of environmental breakdown, the implications for societies, and the subsequent need for transformative change.

1. Scale and pace of environmental change – the age of environmental breakdown
Negative human impacts on the environment go ‘beyond’ climate change to encompass most other natural systems, driving a complex, dynamic process of environmental destabilisation that has reached critical levels. This destabilisation is occurring at speeds unprecedented in human history and, in some cases, over billions of years.

Global natural systems are undergoing destabilisation at an unprecedented scale.

- The 20 warmest years since records began in 1850 have been in the past 22 years, with the past four years the warmest ever recorded.
- Vertebrate populations have fallen by an average of 60 per cent since the 1970s.
- More than 75 per cent of the Earth’s land is substantially degraded.

Destabilisation of natural systems is occurring at unprecedented speed.

- Since 1950, changes in many extreme weather and climate events have been observed, including a likely increase in the frequency of heat waves over large parts of Europe, Asia and Australia, and the frequency or intensity of heavy precipitation events in North America and Europe.
- Extinction rates have increased to between 100–1,000 times the ‘background rate’ of extinction.
- Topsoil is now being lost 10 to 40 times faster than it is being replenished by natural processes, and, since the mid-20th century, 30 per cent of the world’s arable land has become unproductive due to erosion; 95 per cent of the Earth’s land areas could become degraded by 2050.

The UK is also experiencing environmental destabilisation.

- The average population sizes of the most threatened species in the UK have decreased by two-thirds since 1970.
- The UK is described as one of the “most nature-depleted countries in the world”.
- 2.2 million tonnes of UK topsoil is eroded annually, and over 17 per cent of arable land shows signs of erosion.
- Nearly 85 per cent of fertile peat topsoil in East Anglia has been lost since 1850, with the remainder at risk of being lost over the next 30 years.

Though there is uncertainty as to how this process will unfold – ranging from linear change to abrupt, potentially catastrophic non-linear events – the extent, severity, pace and closing window of opportunity to avoid potentially catastrophic outcomes has led many scientists to conclude that we have entered a new era of rapid environmental change. We define this as the 'age of environmental breakdown' to better highlight the severity of the scale, pace and implications of environmental destabilisation resulting from aggregate human activity.

2. Implications of environmental breakdown – a new domain of risk facing policymakers

The consequences of the age of environmental breakdown on societies and economies are more serious than is currently being recognised by mainstream political and policy debates. As complex natural systems become more destabilised, the consequences of this destabilisation – from extreme weather to soil infertility – will impact human systems from local to global levels, interacting with existing social and economic trends such as inequality, compounding and exacerbating them. This process is already underway, damaging human health and driving forced migration and conflict around the world, and is set to accelerate as breakdown increases.

All in all, a new, highly complex and destabilised 'domain of risk' is emerging – which includes the risk of the collapse of key social and economic systems, at local and potentially even global levels. This new risk domain affects virtually all areas of policy and politics, and it is doubtful that societies around the world are adequately prepared to manage this risk. Due to the high levels of complexity, the scale of breakdown and systemic nature of the problem, responding to the age of environmental breakdown may be the greatest challenge that humans have faced in their history.

3. A transformational response is required

The consequences of environmental breakdown will fall hardest on the poorest, who are most vulnerable to its effects and least responsible for the problem. It is estimated that the poorest half of the global population are responsible for around 10 per cent of yearly global greenhouse gas emissions, with half of emissions attributed to the richest 10 per cent of people. Within rich countries, the wealthiest 10 per cent of people contribute far more to greenhouse gas emissions than other income groups. In the UK, per capita emissions of the wealthiest 10 per cent are up to five times higher than those of the bottom half. In addition, environmental breakdown interacts with other inequalities, such as class, ethnicity and gender. This makes environmental breakdown a fundamental issue of justice.

Environmental breakdown is a result of the structures and dynamics of social and economic systems, which drive unsustainable human impacts on the environment. While providing high living standards to many people, these systems fail to provide for all, and by driving environmental breakdown, these systems are eroding the conditions upon which human needs can be met at all. In response, two overall transformations are needed, to make societies:

- **sustainable and just**: a socioeconomic transformation to bring human activity to within environmentally sustainable limits while tackling inequalities and providing a high quality life to all
- **prepared**: increased levels of resilience to the impacts of environmental breakdown resulting from past and any future activity, covering all areas of society, including infrastructure, markets, political processes, social cohesion and global cooperation.

RESPONDING TO ENVIRONMENTAL BREAKDOWN

While some progress has been made toward realising these transformations, most efforts have neither adequately focussed on all elements of environmental breakdown, nor sought to fundamentally transform key social and economic systems. Little attention has been given to ensuring societies are robust enough to face the increasingly severe consequences of breakdown. This lack of progress partly results from a lack of agency over the problem experienced by policymakers, resulting from factors including: the difficulties faced by decision-making systems in understanding and responding to highly complex, system-wide problems; the problems inherent in developing a political project under such conditions; the power of vested interests, many of which have blocked progress in understanding and responding to breakdown; and the limited ability of current economic systems to undergo rapid transformations. These problems manifest acutely between generations, with millennial and younger generations – the politicians and policymakers of tomorrow – faced with the daunting twin tasks of preventing environmental breakdown while adequately responding to its growing negative impacts and the failure of policy to date.

IPPR is undertaking a programme of work to better understand and develop solutions to these problems. Over the next year, we will assess what progress has been made toward responding to environmental breakdown, using the UK as a case study within the global context. We will then develop policies that can realise a sustainable, just and prepared world and seek to understand how political and policy communities can develop the sense of agency needed to overcome environmental breakdown.

INTRODUCTION

> ***"In relation to nature, as to society, the present mode of production is predominantly concerned only about the first, tangible success; and then surprise is expressed that the more remote effects of actions directed to this end turn out to be of quite a different, mainly even of quite an opposite, character."***
> Friedrich Engels, *Dialectics of Nature*, 1883[1]

> ***"Mr President: don't listen to the swamp. Keep your promise. Withdraw from the Paris climate treaty."***
> Competitive Enterprise Institute campaign, 2017[2]

There is a contradiction between the warnings of environmental scientists and the actions of politicians. In October 2018, the Intergovernmental Panel on Climate Change (IPCC) warned that global greenhouse gas emissions must be reduced by 45 per cent by 2030 in order to keep warming below 1.5 °C, above which damaging impacts become increasingly dangerous and unmanageable (IPCC 2018).[3] This warning came as the global temperature rise exceeded 1 °C above pre-industrial levels, summer heatwaves broke temperature records, and scientists warned of runaway climate breakdown toward a 'Hothouse Earth' in which "serious disruptions to ecosystems, society, and economies" could occur (Steffen et al 2018). The authors joined groups ranging from Greenpeace to the Ministry of Defence in recognising that preventing climate breakdown requires rapid transitions of unprecedented scale in economic, social and political systems (Hope 2018; MOD 2018).

Nevertheless, the US president has concluded that "I don't know that [climate change is] manmade", is seeking his country's withdrawal from the Paris Agreement, and has cancelled many domestic policies intended to reduce greenhouse gas emissions (Holden 2018). In Brazil, new president Jair Bolsonaro threatens to open the Amazon and Cerrado – rainforests of global importance – to greater levels of development, with deforestation levels already increasing (MMA 2018). In the UK, the government's official climate advisor has warned that the country is not on track to meet its legally binding decarbonisation targets due to a lack of policies and funding (CCC 2018). Overall, current commitments to reduce emissions are likely to lead to warming in excess of 3 °C – an outcome described as 'catastrophic' in a 2017 letter signed by over 15,300 scientists across 184 nations (CAT 2018; Ripple et al 2017).

It has now been 28 years since the IPCC published its first report, and yet decades of warnings have not stimulated the action required to prevent climate breakdown and its increasingly severe consequences, notwithstanding the progress made in reducing greenhouse gas emissions across the world. This failure has led the UN secretary general to warn that "we still lack… the leadership and the ambition to do what is needed", and that "we face a direct existential threat" (Guterres

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1 Engels F and Dutt C P (1955) *Dialectics of nature*, Foreign Languages Publishing House

2 Competitive Enterprise Institute (2017) 'Mr President: Stop the Paris Climate Treaty', webpage. https://cei.org/stopparisclimatetreaty

3 The IPCC has stated that: "In model pathways with no or limited overshoot of 1.5°C, global net anthropogenic CO2 emissions decline by about 45 percent from 2010 levels by 2030, reaching net zero around 2050" (IPCC 2018).

2018). Crucially, a lack of leadership and ambition also limits the response to other, related forms of environmental breakdown, from accelerating rates of soil degradation to the precipitous collapse of global biodiversity (WWF 2018). Human activity has pushed natural systems into "unsafe operating spaces", threatening the biophysical preconditions upon which societies can exist, let alone flourish (Steffan et al 2015).

This report is the first output of an IPPR programme that seeks to understand the implications of environmental breakdown for policy and politics, and to develop the narratives and policy needed to manage risk in this new era and enable current and future generations to flourish. It aims to stimulate three shifts in understanding and action across political and policy communities: of the scale and pace of environmental breakdown, the implications for societies, and the subsequent need for transformative change.

This initial report examines each element in turn, using the UK as a domestic case study within a global context. It concludes that in interacting with existing and emergent social and economic trends, environmental breakdown is increasingly presenting decision-makers with a new 'domain of risk' of unprecedented complexity and speed. Overall, our new age of environmental breakdown presents a uniquely serious threat, with unprecedented implications for virtually all areas of policy and politics.

Fundamentally, environmental breakdown is an issue of justice. The problem has been predominantly caused by the activities of a minority of nations, companies and sections of society, and its consequences fall most severely on poorer nations and populations, who have a limited ability to respond. In response, prosperity will only be possible if two interrelated transformations are undertaken: bringing human activity to within sustainable limits while meeting the needs of humanity; and to accelerate preparation for the consequences of environmental breakdown. Crucially, many of the actions needed to prevent and prepare for environmental breakdown can improve economic and social outcomes, creating a fairer society.

This report finishes by arguing that a deficit of agency over environmental breakdown acts as a major barrier to progress, constituted by factors ranging from inadequate decision-making processes to the power of vested interests. These manifest acutely between generations, with millennial and younger generations – the politicians and policymakers of tomorrow – faced with a daunting challenge. This report inaugurates a programme of work to better equip current and future generations with the understanding and means to act on environmental breakdown and strive for a more just and equitable world in the process.

1.
THE SCALE AND PACE OF ENVIRONMENTAL BREAKDOWN

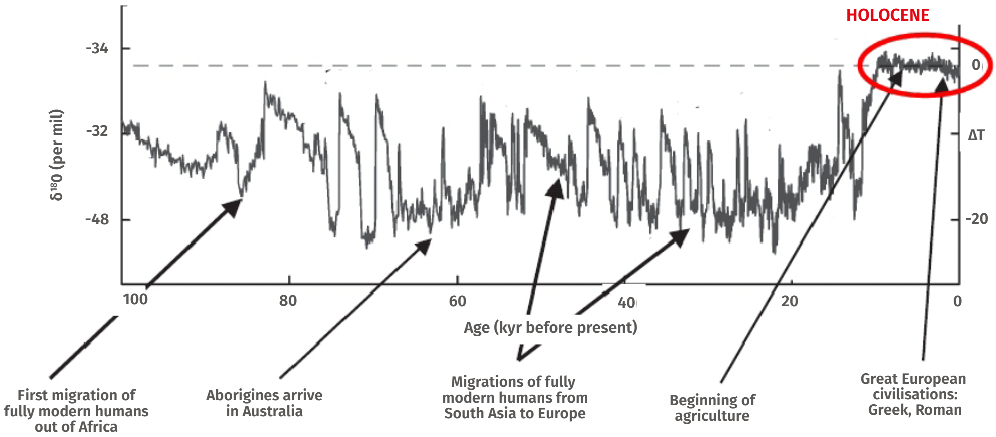
Environmental change resulting from human activity has reached a global scale and is occurring at unprecedented speed. Aggregate human impacts on the environment range from local to global scales and are overwhelmingly negative, altering and destabilising the function of the natural systems on which human societies depend. This chapter reviews the status of these impacts at the global scale and at the UK level, as a case study of one country.

GLOBAL NATURAL SYSTEMS ARE COMPLEX AND HIGHLY INTERDEPENDENT

Over the last 11,700 years, global environmental conditions have remained remarkably stable, with little temperature variability and a warmer climate relative to the preceding ice ages, as figure 1.1 shows. This epoch is identified as the 'Holocene' in the geological literature and is characterised by stability of key natural systems, which enabled the rise of modern human societies; the Holocene epoch encompasses the entirety of written history (Young and Steffen 2009).

FIGURE 1.1: RECORDED HUMAN HISTORY HAS OCCURRED OVER A PERIOD OF UNIQUE ENVIRONMENTAL STABILITY

Delta-O-18 (an indicator of temperature) over the previous 100,000 years. The stable Holocene epoch occurred over the last 11,700 years.

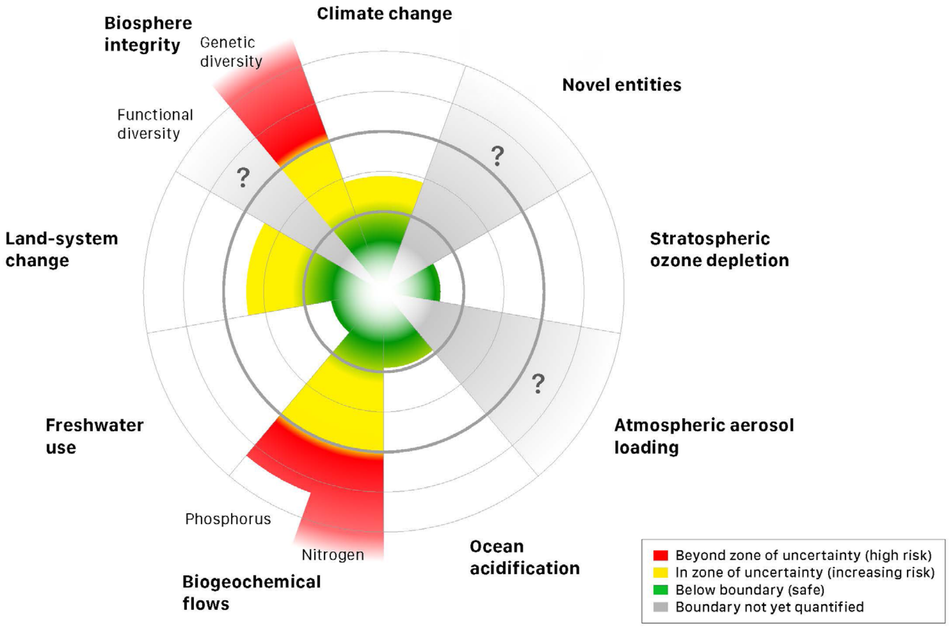


Source: Rockström et al 2009, adapted from Young and Steffen 2009

This stability has now ended. Human activity has altered the functioning of key natural systems that regulate the Earth's life support systems and many Earth system scientists argue that humans are now the dominant driver of the overall environmental state of the planet (Crutzen 2002; Steffen et al 2007). This disruption risks triggering abrupt and irreversible environmental change, which could undermine the viability of human society.

FIGURE 1.2: THREE NATURAL SYSTEMS SIT WITHIN A SAFE OPERATING SPACE WHILE FIVE SYSTEMS HAVE BEEN DANGEROUSLY DISRUPTED

The current status of the nine planetary boundaries.



Source: Steffen et al 2015, modified from Rockström et al 2009

The ‘planetary boundaries’ framework developed by the Stockholm Resilience Centre is a useful tool to understand the status of this disruption. The framework defines the ‘safe operating space for humanity’ across key natural systems, as shown in figure 1.2. The planetary boundaries framework uses three central concepts to describe the risks of human impacts on natural systems (Rockström et al 2009; Steffen et al 2015).[4]

1. **Threshold**: A ‘tipping point’ can be triggered if human activity pushes a natural system beyond the threshold of its stable state, causing an abrupt and possibly irreversible change in the functioning of the system. Those systems most at risk of passing a threshold are marked in red in figure 1.2.
2. **Boundary**: An estimate of the ‘safe distance’ from a threshold. Systems exceeding boundaries and entering an unsafe space are marked in yellow, while those yet to breach the safe boundary are marked in green.
3. **Uncertainty**: The behaviour of natural systems is highly complex and uncertain. For example, it is impossible to quantify and anticipate the point at which a natural system could pass a tipping point. So, the framework uses three zones – safe, increasing risk and high risk – to give an overall indication of the health of natural systems.

Natural systems are highly interdependent. For example, habitat loss – including land use changes such as deforestation and desertification resulting from farming – is the primary cause of species extinctions (IPBES 2018). As such, too much damage in one area can disrupt other systems, potentially triggering large-scale environmental change at a regional or global level which is unpredictable, abrupt, greater than the sum of individual hazards and not easily reversed. In the case of climate change, for example, the IPCC has warned that warming of 2 °C could transform ecosystems over 13 per cent of the world’s land area, increasing the risk of extinction for many insects, plants and animals (IPCC 2018). Therefore, pushing one natural system into an unsafe space can do the same to others.

4 The planetary boundaries framework is widely used as a communications tool of Earth system science. It has been criticised as too simplistic and uncertain – for example, because the thresholds are arbitrary and that there are not enough data to establish the boundaries (Nordhaus et al 2012), and because it is misleading to define global boundaries for systems that have immense local variability. Nonetheless, the framework is a useful means to understand the scope of natural systems, our impact on them, and the ramifications.

GLOBAL NATURAL SYSTEMS ARE UNDERGOING DESTABILISATION AT AN UNPRECEDENTED SCALE

Human activity has altered natural systems at the global scale. We explore the state of these key natural systems in turn.

Climate change

Increased concentrations of greenhouse gases in the atmosphere are leading to rising global surface temperatures, which results in ocean acidification, melting ice sheets, rising sea levels, and ecosystem change. An atmospheric CO_2 concentration of 350 parts per million (ppm) is considered the limit above which increasingly dangerous destabilisation could occur (Hansen et al 2008). This boundary has been crossed; current CO_2 concentration levels are around 405 ppm (Blunden et al 2018), the highest level since the Pliocene era 3–5 million years ago, when the temperature was 2–3 °C warmer and sea level was 10–20 metres higher (WMO 2018a). Average temperatures in 2017 were 1 °C above pre-industrial temperatures and, because of time lags in natural systems, the Earth is already 'locked in' to further warming (IPCC 2018). The 20 warmest years since records began in 1850 have been in the past 22 years, with the past four years the warmest ever (WMO 2018b). On current emission trends, 1.5 °C of warming is likely to be reached as early as 2030 (IPCC 2018).

Biodiversity

Human activity is directly killing an increasing number of plants and animals and accelerating the extinction rate of species. This loss of biodiversity has reached critical levels, threatening the collapse of entire ecosystems. Current extinction rates are unseen since the extinction of the dinosaurs; the Earth is undergoing the sixth mass extinction in its history (Ceballos et al 2017). Up to 58,000 species are believed to be lost each year (Dirzo et al 2014) and vertebrate populations declined by 60 per cent between 1970–2014 (WWF 2018). Loss of vertebrate populations in some countries exceeds 85 per cent, while freshwater vertebrate populations have declined by 83 per cent across the world (WWF 2018). More than 40 per cent of insect species are declining and a third of species are endangered; the total mass of insects is being lost at 2.5 per cent per year (Sánchez-Bayo and Wyckhuys 2019). Overall, it is estimated that population declines since the emergence of human civilisation constitute 83 per cent of wild mammals, 80 per cent of marine mammals, 50 per cent of plants, and 15 per cent of fish (Bar-On et al 2018; Carrington 2018).

Ocean acidification

A quarter of CO_2 emissions dissolve in the oceans, making the water more acidic and damaging marine organisms and ecosystems. Ocean acidification is therefore intimately related to climate change. Ocean acidity has increased by 26 per cent since the beginning of the industrial revolution due to increases in atmospheric CO_2. In some 'business as usual' scenarios, rising emissions could make the oceans 170 per cent more acidic by 2100 (IGBP et al 2013), and more acidic than any time in the last 14 million years (Sosdian et al 2018).

Land use

Forests help regulate the climate by absorbing CO_2 and provide ecosystems for other plants and animals to thrive. Around 15 billion trees are cut down each year (Crowther et al 2015), and the total number of trees globally has halved since the agricultural revolution (Crowther et al 2015). More than 75 per cent of Earth's land is substantially degraded (IPBES 2018). By 2050 – together with climate change – land degradation is predicted to reduce crop yields by an average of 10 per cent globally and up to 50 per cent in some regions, increasing levels of malnutrition and starvation and driving conflict and displacement (IBPES 2018).

Biogeochemical flows

Phosphorus and nitrogen are fundamental to life and are essential to functioning of the food system. Agricultural inefficiencies mean that high levels of phosphorous and nitrogen run off into rivers, lakes and seas, leading to over-enrichment of the water with minerals and nutrients. This induces excessive growth of plants and algae, resulting in oxygen depletion and 'dead zones', where other marine life dies due to lack of oxygen. It is estimated that marine dead zones span 245,000 km2 of oceans globally – an area the same size as the UK (Diaz and Rosenberg 2008).

Ozone layer

Stratospheric ozone filters ultraviolet radiation from the Sun, too much of which harms organisms. Human-made substances emitted in the 20th century, such as chlorofluorocarbons (CFCs), have created a hole in the ozone layer, which appears over the Antarctic every spring. Due to a ban on these substances, this hole is reducing in size – a rare example of reversal in natural system destabilisation (Strahan and Douglass 2018).

Pollution and new substances

Both air pollution from vehicles and industrial processes, and smoke and dust from land use, can influence the climate system and have adverse effects on human health. Human use of other chemicals, radioactive materials and pollutants can also negatively impact the environment. The use of pesticides is thought to be a major driver of the 75 per cent decrease in flying insects observed in Germany since 1989 (Hallmann et al 2017). The scale of non-biodegradable plastic waste, found almost everywhere on Earth, is likely to have wide-reaching health implications for people and marine life (MOD 2018).

Overall, these changes likely indicate that environmental systems have exited the stable conditions of the Holocene epoch and have entered a new era of environmental change and instability, unprecedented in recorded human history. In response, leading Earth scientists have proposed that we have entered a new geological epoch – the Anthropocene – in recognition that human activity has become a greater driver than any natural system in determining the state of the environment from local to global levels (Lewis and Maslin 2015).

DESTABILISATION OF NATURAL SYSTEMS IS OCCURRING AT UNPRECEDENTED SPEED

Not only is the scale of environmental change driven by human activity unprecedented in recorded history, but it is also occurring remarkably quickly, with sharp acceleration since around 1950 (Steffen et al 2015b). Some aspects of change are progressing at paces not seen in hundreds of thousands, millions, or billions of years, or at all in Earth's history.

- **Climate change**: Average global surface temperature increases have accelerated, from an average of 0.007 °C per year from 1900–1950 to 0.025 °C from 1998–2016 (Grantham 2018). Oceans are absorbing around 90 per cent of excess heat as the Earth warms (Cheng et al 2019), with heating rates quadrupling from 1960–1991 to 1992–2015 (Cheng et al 2017). Since 1950, changes in many extreme weather and climate events have been observed, including a likely increase in the frequency of heat waves over large parts of Europe, Asia and Australia, and the frequency or intensity of heavy precipitation events in North America and Europe (IPCC 2014). What is described as a 'quick survey' of extreme weather events in the EM-DAT database (which records the human impact of disasters),[5] found that the number of reported floods across the world has increased by 15 times, extreme temperature events by 20 times, and wildfires sevenfold (GMO analysis of EM-DAT 2018). Although the IPCC has said that there is 'strong evidence' that warming has led to changes in temperature extremes (including heatwaves), these figures should be used with caution. For instance, in the case of flooding, the IPCC says there is "low confidence" that anthropogenic climate change has affected the global frequency and magnitude of fluvial floods, mainly as the strength of evidence is limited by a lack of long-term records (IPCC 2014). Atmospheric CO_2 concentrations are increasing more quickly than any other documented change in Earth's history (WMO 2017), and under business-as-usual scenarios, the Earth could warm to a climate not seen in 50 million years over the next 120 years, reversing a multi-million year cooling trend in less than two centuries (Burke et al 2018).
- **Ocean acidification**: Ocean acidification is occurring faster than at any time in the last 300 million years (Tanhua et al 2015). Since 1950, dead zones have quadrupled and low-oxygen sites in coastal water bodies have increased more than tenfold since 1950 (Breitburg et al 2018).
- **Biodiversity**: Extinction rates have increased to between 100–1,000 times the 'background rate' of extinction under normal conditions (Pimm et al 2014). Over the last 50 years, it is estimated that humans have changed ecosystems more and faster than any time in human history (Millennium Ecosystem Assessment 2005). At current rates, insects could potentially be extinct within a century (Sánchez-Bayo and Wyckhuys 2019).
- **Land-use**. Topsoil is now being lost 10 to 40 times faster than it is being replenished by natural processes (Pimentel and Burgess 2013), and, since the mid-20th century, 30 per cent of the world's arable land has become unproductive due to erosion (University of Sheffield 2015). Some studies estimate that between half to 1 per cent of arable land is lost per year (Grantham 2018; Montgomery 2007). If current land degradation trends continue, 95 per cent of the Earth's land areas could become degraded by 2050 (IPBES 2018).
- **Nitrogen:** It is estimated that human activity has caused more change in the nitrogen cycle over the last 100 years than in the preceding 2.5 billion years (Canfield et al 2010).
- **Pollution and new substances:** Global production of some plastics has increased from around 2 million metric tons (Mt) a year in 1950 to 380 Mt in 2015, with roughly half produced in the last 13 years (Geyer et al 2017).

5 Figures derived from the EM-DAT database do not provide a complete record of natural disasters. Criteria that must be fulfilled to be recorded are: 10 or more people reported killed; 100 or more people reported affected; declaration of a state of emergency; call for international assistance. The database focuses on human impact as the determining characteristic of a disaster, so many extreme weather events are excluded. Other factors such as population growth mean the number of people who could have been affected has increased.

It is difficult to predict the behaviour of highly complex and inter-related natural systems under conditions of rapid change. However, many Earth system scientists are increasingly warning of the potential for non-linear changes to occur in natural systems, pushing them into highly destabilised states that may be difficult or impossible to reverse. One example, explored in a 2018 paper, is the concept of a 'Hothouse Earth', in which rising temperatures could trigger feedback processes that further accelerate warming, ranging from the thaw of permafrost releasing greenhouse gases, to the loss of Arctic summer sea ice that reflects sunlight. The authors conclude that: "these tipping elements can potentially act like a row of dominoes. Once one is pushed over, it pushes Earth towards another. It may be very difficult or impossible to stop the whole row of dominoes from tumbling over. Places on Earth will become uninhabitable if 'Hothouse Earth' becomes the reality" (Steffen et al 2018b).

Environmental breakdown may be approaching a point of no return

Overall, the scale and pace of the destabilisation of natural systems means the window of opportunity for avoiding catastrophic outcomes, including tipping points, is likely to be closing. The IPCC has concluded that global greenhouse gas emissions must be reduced by 45 per cent from 2010 levels by 2030 to avoid catastrophic warming. As the UN secretary general warned: "If we do not change course by 2020, we risk missing the point where we can avoid runaway climate change, with disastrous consequences for people and all the natural systems that sustain us" (Guterres 2018). Cristiana Pașca Palmer, the executive secretary of the UN's Convention on Biological Diversity, has similarly warned that biodiversity loss has exceeded critical levels, threatening the collapse of ecosystems upon which societies are reliant, and that time is running out (CPP 2018).

THE UK IS EXPERIENCING RAPID AND LARGE-SCALE NEGATIVE ENVIRONMENTAL CHANGE

In this section, we use the UK as a case study of environmental change at the domestic level. In doing so, we draw on the findings of the University of Leeds 'A Good Life For All Within Planetary Boundaries' project, which translates the planetary boundaries approach to a nation state context (O'Neill et al 2018). The analysis downscales four[6] planetary boundary indicators (climate change, biogeochemical flows, freshwater use, and land-use change) to per capita (per person) equivalents and compares these to national footprints. Two separate footprint indicators – ecological footprint and material footprint – are also included and compared to their suggested maximum sustainable levels. The result is seven biophysical indicators in comparison to their respective boundaries.[7] The analysis shows that the UK exceeds five of its seven per capita sustainability boundaries, using in excess of seven or eight times its share in some cases, as shown in table 1.1.

Increasingly severe environmental impacts are observed at the UK level. In the case of biodiversity, one in seven species in the UK are at risk of extinction or already extinct (State of Nature 2016), and the average population sizes of the most threatened species in the UK have decreased by two-thirds since 1970 (DEFRA 2018). As such, the UK is described as one of the "most nature-depleted countries in the world" (State of Nature 2016). Regarding land use change, 2.2 million tonnes

6 Biosphere integrity is represented, to some degree, by the indicator used to measure land-system change (eHANPP).

7 The per capita boundaries assume a global population of seven billion people and all seven indicators account for international trade. Straightforward per capita allocations omit considerations of justice. Other methods include differentiated environmental allocations, taking into account nations' differing historical responsibility (contribution to the problem) and capacity (ability to pay) (Baer 2012), or allocations that promote active repairing of environmental damage (Raworth 2017).

of UK topsoil is eroded annually, and over 17 per cent of arable land shows signs of erosion (Environment Agency 2004; SSLRC 2000). Nearly 85 per cent of fertile peat topsoil in East Anglia has been lost since 1850, with the remainder at risk of being lost over next 30 years (Graves and Morris 2013).

TABLE 1.1

The UK's environmental sustainability performance relative to the 'safe and just space' framework

Biophysical indicator	Unit	UK	Per capita boundary	% use of allocation
CO_2 emissions	tonnes CO_2 per year	12.1	1.6	756%
Phosphorus	kilograms P per year mined and applied to erodible (agricultural) soils	5.2	0.9	578%
Nitrogen	kilograms N per year from industrial and intentional biological fixation	72.9	8.9	819%
Freshwater use	cubic metres H2O per year	240	574	42%
Embodied human appropriation of net primary production (eHANPP)[8]	tonnes C per year	2.4	2.6	92%
Ecological footprint[9]	global hectares (gha) per year	4.2	1.7	247%
Material footprint[10]	tonnes per year	24.3	7.2	338%

Source: O'Neill et al 2018

CONCLUSION: WE HAVE ENTERED THE AGE OF ENVIRONMENTAL BREAKDOWN

Across the world, our negative impact on the environment extends 'beyond' climate change to encompass most other natural systems, driving a complex, dynamic process of environmental change that has reached severe levels. Though there is uncertainty as to how this process will unfold – ranging from linear change to abrupt, potentially catastrophic non-linear events – the extent, severity, pace and closing window of opportunity to avoid potentially catastrophic outcomes has led many scientists to conclude we have entered a new age of rapid environmental change. As such, we define this as the 'age of environmental breakdown' to better highlight the severity of the scale, pace and implications of altered functioning of the climate and other key natural systems resulting from aggregate human activity. The impacts of this new age on societies are considered in the next chapter.

8 The land use intensity anywhere on earth resulting from a nation's domestic biomass consumption

9 How much biologically productive land and sea area a population requires to produce the biotic resources it consumes and absorb the CO2 emissions it generates

10 Raw material consumption, regardless of where the material is extracted

2.
THE IMPLICATIONS OF ENVIRONMENTAL BREAKDOWN

Many mainstream political and policy debates around the negative impact of human activity on the environment focus on a narrow understanding of the consequences for societies and economies. These debates can often focus on high profile, emotive causes. These include the threat to charismatic animals, campaigns to highlight the intrinsic value of nature and the aesthetic or psychological loss suffered as a result of its destruction, alongside efforts to consider the local impacts of environmental degradation, such as air pollution or plastics. These areas of focus are important, but they belie the broad range and severity of negative impacts that environmental breakdown is having and will increasingly have on societies and economies around the world. Furthermore, they do not necessarily promote understanding of and action on the systemic nature of these impacts, which, ultimately, can erode the conditions upon which socioeconomic stability is possible. This chapter explores the consequences of environmental breakdown for societies.

ENVIRONMENTAL BREAKDOWN IMPACTS SOCIETY FROM LOCAL TO GLOBAL LEVELS

As the last chapter showed, natural systems are highly complex, dynamic systems. As these systems become more destabilised, the consequences of this destabilisation – from extreme weather events to the loss of arable land – will impact social and economic systems from a local to global level: a process that is already underway (IPCC 2018). In turn, social and economic systems are themselves highly complex, operate dynamically across geographies, and are intimately dependent on natural systems.

In order to better understand this complex process, we separate the key consequences of environmental breakdown for human systems into three areas.

1. **Localised impacts:** Environmental breakdown will have, and is already having, direct impacts on societies and economies around through, for example, extreme weather events driving impacts such as disruption of infrastructure and ill health, with significant social and economic costs.
2. **Systemic consequences:** The consequences of breakdown are systemic and uncontained by the boundaries of the nation state. Globalised economic systems transmit the impacts of local events across national borders. Food shocks,[11] for example, do not just affect those countries in which the agricultural system is impacted, but are experienced across supply chains through shortages and increased prices.
3. **Interaction with socioeconomic context:** The consequences of environmental breakdown will interact with existing social and economic trends, such as inequality – compounding and exacerbating them.

11 A 'food shock' occurs, for example, when one or more major food producing regions experiences a shock to production, often from extreme weather, resulting in food price increases.

Overall, environmental breakdown will act as a 'threat multiplier', increasing the risks and amplifying the impact of social and economic disruption (Brown et al 2007). Key examples include increases in migration and conflict, with far-ranging consequences for social and political stability. The complex and dynamic interplay of local impacts, systemic consequences and interactions with wider socioeconomic forces is creating a new 'domain of risk' unlike anything in recent history. Ultimately, these dynamics could erode the conditions upon which socioeconomic stability is possible (Attenborough 2018).

1. The local impacts of environmental breakdown are growing

The consequences of environmental breakdown are increasingly impacting societies and economies around the world, driving negative outcomes. These impacts can occur directly or indirectly. Direct impacts are those which occur in the first instance as a result of environmental breakdown, such as economic losses from working hours lost due to extreme heat resulting from climate change (Watts et al 2018). Indirect impacts include the consequences that emerge from direct impacts, such as malnutrition resulting from population displacement, itself a result of environmental degradation (Diamond 2017). Direct and indirect impacts are, and will increasingly be, significant and wide-ranging, and driven by a range of environmental factors.

One example is the direct and indirect impacts of climate change on human health, which include extreme weather events, sea levels rises, and increasing temperatures (Watts et al 2018). Temperature rises resulting from climate change are increasing heat-related ill health and death. Globally, 157 million more people experienced heatwave events in 2017 than in 2000, generating a large health burden and a loss of 153 billion hours of work. The incidence of other extreme weather events is increasing, including floods and droughts (IPCC 2014). Around 15 per cent of natural disaster deaths result from floods, often as a result of destruction of property, with longer-term impacts including psychological distress and increased transmission of infectious disease (Watts et al 2018). Sea level rise and extreme weather threaten physical infrastructure such as property, energy systems, transport and communication networks (HMG 2011). Globally, extreme weather events were responsible for US$326 billion of economic losses in 2017 – nearly triple those in 2016 (Watts et al 2018). Drought is one of the most dangerous direct drivers of ill health, causing malnutrition and starvation by increasing falls in crop yields, reversing a decade-long improvement in food production in nations around the world (ibid).

In the UK, extreme flooding is set to increase in coming decades, which will create significant economic costs. If no action is taken, a repeat of the 2013/14 winter floods in 2050 could have economic costs in the region of £2.2 billion (WWF 2017a). At the same time a changing climate, through poor air quality, flooding, extreme heat and an increased prevalence of disease and infection, will impact negatively on mental and physical health in the UK (Kovats 2015). For example, heat-related deaths could reach 7,000 a year by 2050 if no action is taken (EAC 2018).

In all, climate change is estimated to cause up to 400,000 deaths a year globally, mainly linked to hunger and communicable diseases – a figure that could rise to 700,000 deaths a year by 2030 (Dara 2012). It is also one of the causes of migration, exposing people to greater risk of ill health (Watts et al 2018). Furthermore, it is difficult to anticipate the effects of different forms of environmental breakdown, as they can interact with and exacerbate each other. For example, the interrelation of climate change and deforestation can increase the likelihood of flooding and landslides, through increased rainfall and the decreased ability of land to deal with excess water, which, in turn, leads to direct and indirect effects on human systems, including damage to infrastructure, loss of crops and ill health resulting from both.

2. Environmental breakdown has systemic consequences
The impacts of environmental breakdown on societies and economies around the world are not constrained by borders. Rather, these impacts affect economic systems which can transmit and amplify their effects across borders. The case of food supply chains serves to illustrate this. A destabilising environment poses a major risk to food production (FAO 2018). Extreme weather events such as floods or extreme heat can undermine the ability of regions to grow crops and food systems are designed to rely on the global trade of crops, so these impacts are transmitted abroad. This is a significant issue to all nations, particularly to those who import and export large quantities of food (EIU 2018).

Over recent decades, global supply chains have been optimised for efficiency, with buffer stocks reduced in line with an understanding of supply volatility that is consistent with a stable natural environment (Dellink et al 2017). As such, the increasing prevalence of extreme weather events exposes these networks to increased risks. Production of the biggest global crops is concentrated in a relatively small number of major producing countries, often referred to as 'breadbasket regions' (Met Office 2017). Weather events impacting one or more of these regions have the potential to severely impact the availability and therefore the price of crops across the globe. These production shocks are likely to become more common over time. What was once regarded as a one-in-100-year production shock is likely to become a one-in-30-year event over the coming decades (GFS 2015), while it is estimated that there is a one-in-20 chance per decade that extreme flood, drought and heat will result in a simultaneous failure of maize production in the USA and China, which provide 60 per cent of the global maize supply (Kent et al 2017).

The reliance of the global food system on a small number of crops also heightens vulnerability to catastrophic breakdowns. More than 75 per cent of global food supply currently comes from five animal and 12 plant species (WEF 2018). Meanwhile, the impact of accelerating levels of biodiversity loss on food production, such as the collapse in excess of 75 per cent of insect populations critical to food production, is poorly understood, and could critically impair food production. Indeed, the UN has found that land degradation, and associated bio-diversity loss, is impacting 3.2 billion people globally already (IPBES 2018). Meanwhile, unsustainable water use and climate change impacts, among others, mean that four-fifths of world's population are now living in areas where there is a threat that demand for water will outstrip supply (IPBES 2018).

Conversely, it has been argued that the globalisation of trade provides a crucial mechanism for ensuring resilience against food insecurity (Bouët and Laborde 2017). While the food system can act as a transmission mechanism for food shocks, international markets also act to dampen their impacts. Some, including the Food and Agriculture Organization of the United Nations (FAO), have argued that trade and agricultural policy should increasingly focus on the role of trade in supporting countries to adapt to the effects of environmental breakdown, redistributing food from areas of deficit – potentially due to extreme weather events – from areas of surplus (FAO 2018).

The systemic effects of environmental breakdown as they relate to agricultural trade could also be felt in the UK. The UK does not have a self-sufficient food system and imports 48 per cent of total food consumed (GFS 2019). This proportion is rising, with a UK cross-government programme on food security research arguing that the UK is particularly vulnerable to environmental shocks to the food supply chain.

3. Environmental breakdown interacts with the wider socioeconomic context
The wider social and economic context faced by nations acts as a key factor in determining the severity and nature of environmental breakdown. These

include the impacts of technological change, geopolitical tensions, population and demographic change, social and political cohesion, and the stability of economic systems (WEF 2018).

In the case of food, the impacts of environmental breakdown come at a time when food systems are already experiencing high levels of stress. Levels of global hunger are rising, increasing to nearly 821 million in 2017, from around 804 million in 2016, levels last seen around a decade ago (FAO 2018). Under current diet trends, the FAO predicts that food production must increase by 60 per cent by 2050 (Alexandratos and Bruinsma 2012), which would require 120 per cent more water and 42 per cent more cropland by 2050 and a 77 per cent increase in greenhouse gas emissions (Bajželj et al 2014; Godfray et al 2010). Others contextualise this increase by arguing that more food will have to be produced in the next 50 years than has been produced in all of human history (Ja 2009). These threats come at a time when the food system is failing to meet the needs of populations, with high levels of obesity as well as malnutrition recorded across the world. Crucially, hunger is caused by an unequal distribution of food and artificial scarcity, with the global food production exceeding that needed to feed the world population (Holt-Giménez et al 2012). Climate-related disasters interact with these factors and natural disasters are pushing 26 million people into poverty a year, by worsening malnutrition and further limiting access to scarce resources (CRED and UNISDR 2017).

Overall, the UN has concluded that, in interacting with the existing socioeconomic context, environmental breakdown undermines the ability for nations to achieve sustainable development and that, therefore, the "survival of many societies… is at risk" (UN 2015).

THE HUMAN IMPACTS OF ENVIRONMENTAL BREAKDOWN WILL PUSH SOCIETIES TO THE LIMIT

Overall, environmental breakdown acts as a 'threat multiplier', driving and amplifying social and economic disruption, with far-ranging consequences for stability (WEF 2018). As the previous sections of this report have shown, impacts of environmental breakdown are transmitted through socioeconomic systems and interact with the existing context. This complex process creates 'slow onset crises': for example, environmental degradation can impact on the availability of food or other resources, which interacts with population growth, underdevelopment, weak governance, existing political tension and conflict and violence, and other factors to drive internal and external displacement. In 2017, a Cornell University study estimated that in excess of 1.4 billion people could be forced into involuntary migration as a result of climate breakdown by 2100 (Cornell University 2017; Geisler and Currens 2017). The UN Global Compact for Safe, Orderly and Regular Migration (GCM) recognises climate change as a driver for migration and has developed an international framework for managing the anticipated increase in migration resulting from environmental breakdown and the resultant crises, including conflict (GCM 2018).

Recent analysis by the G7 has found that environmental events, in interaction with other social and economic pressures, can drive conflict through local resource competition, migration and volatile food prices and provision, among other factors (Ruttinger et al 2015). A recent UN report finds direct examples of environmental degradation driving conflict. For example, the non-state armed groups Al-Shabaab and the Islamic State of Iraq and Syria (ISIS) were found to be focusing recruitment efforts in locations where communities were no longer able to sustain agricultural lifestyles as result of pressures on the natural environment, which were in part due to climate change (UNDP 2018). These consequences are not confined to individual states, with conflicts also impacting surrounding countries, driving instability and requiring humanitarian and disaster relief interventions, which further increases the number of countries involved (MOD 2018).

In the extreme, environmental breakdown could trigger catastrophic breakdown of human systems, driving a rapid process of 'runaway collapse' in which economic, social and political shocks cascade through the globally linked system – in much the same way as occurred in the wake of the global financial crisis of 2007/08 (WEF 2018). For example, continued investment in fossil fuels, which must remain unexploited to avoid climate breakdown, has led the governor of the Bank of England, Mark Carney, to warn of a climate 'Minsky moment' which would involve a rapid, system-wide (downward) repricing of carbon assets which would threaten financial stability (Carney 2015; NEF 2017).

In practice, this means that investors may be exposed to the risks of the falling value of carbon assets that must occur if carbon budgets are to be met.

Furthermore, greater stress resulting from the increased severity and frequency of environmental shocks could erode the capacity of human systems to respond to and recover from instability, leading to permanent failure or a new, sub-optimal level of functioning (WEF 2018). In the case of the financial crisis, while the collapse of the global economic system was averted, the crisis caused numerous "economic, societal, political and geopolitical disruptions" (ibid). Environmental breakdown has similar potential to interact with global and local economic, social and political systems, pushing them into disrupted states. While the potential for catastrophic outcomes is poorly understood in political communities, the risks are increasing; as Sir David Attenborough argued in December 2018: "If we don't take action, the collapse of our civilisations and the extinction of much of the natural world is on the horizon".

CONCLUSION: ENVIRONMENTAL BREAKDOWN HAS CREATED A NEW DOMAIN OF RISK

The consequences of environmental breakdown for societies and economies are unprecedented in their scale, speed, severity and complexity. As the IPCC has noted in the case of climate change, the actions required to mitigate breakdown are structural, involving deep and rapid economic, social and political change across all of society and every nation on Earth (IPCC 2018). This scale of structural change is unprecedented in human history. All the while, these changes will have to occur at a time of growing socioeconomic instability, including a changing international order, the development of new technologies, shifting consumer habits and the rise of nativist and nationalist politics – all of which will interact with the consequences of environmental breakdown (WEF 2018).

Taken together, these factors are creating a new, complex, interrelated 'domain of risk' facing decision-makers, which is systemic, compounding, and non-linear (Cole 2010). This new risk domain has considerable consequences for virtually all areas of policy and politics at all levels, from local communities to international institutions. It is different to previous risk domains – such as that experienced in the Cold War, with the risk of political standoff leading to a nuclear exchange, or the present growing risk of another major financial crisis – because it is largely driven by natural processes that are, increasingly, out of the control of human action and which are characterised by large levels of uncertainty. It will interact with existing risk, multiplying the chance and severity of crisis, potentially driving a 'perfect storm' of interrelated challenges. As such, adequality responding to the domain of risk created by the age of environmental breakdown may be the greatest challenge ever faced by global society. Yet the emergence of such a domain of risk and how to respond to it is almost entirely absent from mainstream political and policy debates. The next chapter of this report explores the necessary response.

3.
TRANSFORMATION

Socioeconomic systems are intimately related to environmental breakdown. On one hand, it is through the disruption of these systems that environmental breakdown will increasingly impact the lives of people throughout the world, as the previous chapter showed. Moreover, in interacting with the existing socioeconomic context, environmental breakdown will have a disproportionately severe impact on the most vulnerable (Timmons Roberts and Parks 2006). Environmental breakdown is also a result of the structures and dynamics of social and economic systems, which have driven unsustainable human impacts on the environment.

This chapter will explore the transformational changes that socioeconomic systems should undertake to respond to this breakdown, and map the key areas of focus for IPPR's work in this area.

ENVIRONMENTAL BREAKDOWN IS A PROBLEM OF JUSTICE

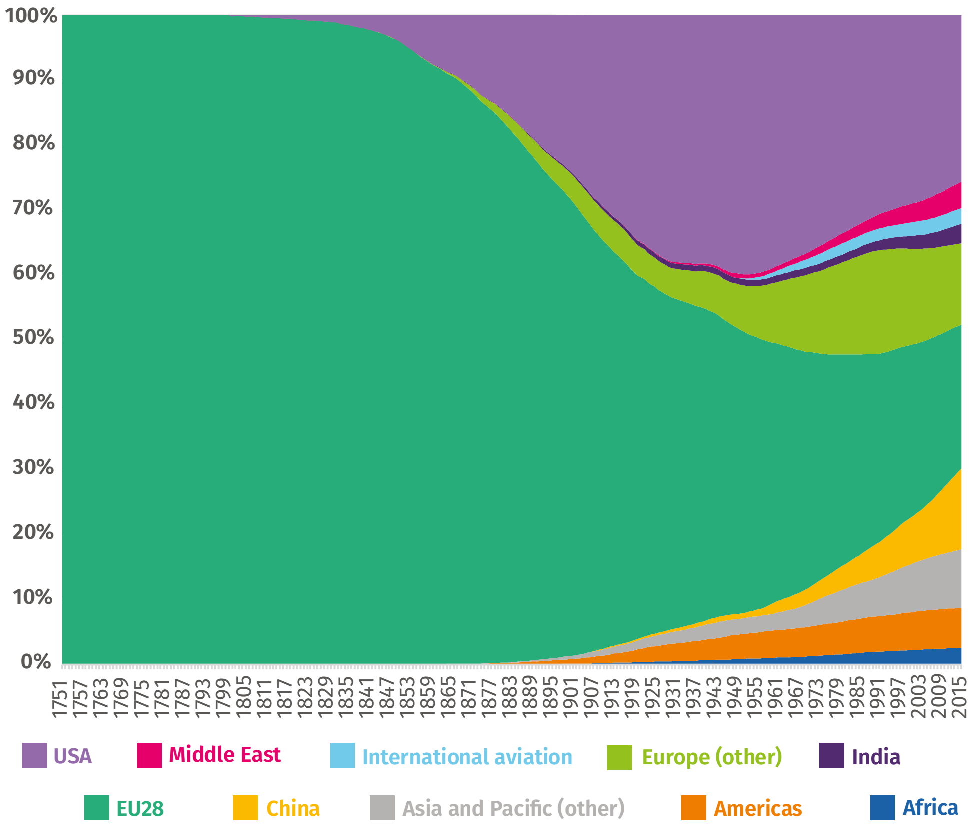
As chapter 2 showed, environmental breakdown is increasingly destabilising social and economic systems and ultimately threatens the natural preconditions upon which social and economic systems can function at all (WEF 2018). Overall, these impacts will increasingly fall more severely on poorer nations than wealthy ones, who are least able to adequately respond to these threats (IMF 2017). For example, in the case of food, over 75 per cent of people experiencing acute, life-threatening food insecurity in 2017 were also affected by extreme weather events and other shocks resulting from climate and other environmental change (FAO 2018). Often, conflict and climate shocks occurred simultaneously, driving significant increases in the severity of food insecurity (ibid).

The impacts of environmental breakdown fall unequally across countries for a range of reasons. Poorer nations are often located in regions experiencing higher levels of environmental stress and can have a greater reliance on sectors more at risk of disruption, such as small-scale farming (IMF 2017). Moreover, these nations often suffer from an underdevelopment of public goods that can impair effective responses to shocks, such as resilient infrastructure and democratic institutions, and many are burdened with the damaging economic, social and environmental legacy of colonialism (Weiss et al 2018). In turn, high-income nations are better able to prepare for the impacts of environmental breakdown, with, for example, per capita spending on health adaptation measures vastly higher in wealthier nations, while around 99 per cent of economic losses in low income nations due to climate-related extreme weather events remain uninsured (Watts et al 2018). Furthermore, within countries – both rich and poor – lower-income and disadvantaged groups are more heavily impacted by environmental breakdown, with these groups most at risk of the resultant socioeconomic instability (Hallegatte et al 2016).

Poorer nations and poorer populations are least responsible for environmental breakdown (Ivanova et al 2015). In the case of climate change, low-income nations have made a negligible contribution to cumulative greenhouse gas emissions, with most emissions since 1870 coming from a few wealthy nations, as figure 3.1 shows (IMF 2017). It is estimated that the poorest half of the global population are responsible for around 10 per cent of yearly global emissions, with half of emissions attributed to the richest 10 per cent of people (Oxfam 2015). Overall, wealthier nations often have a large negative impact on the environment; it is estimated that many European nations have an ecological footprint exceeding safe limits by over 150 per cent (Global Footprint Network 2018). Within rich countries, the wealthiest 10 per cent of people contribute far more to greenhouse gas emissions than other income groups, as figure 3.2 shows (Oxfam 2015). In the UK, per capita CO_2 emissions of the wealthiest 10 per cent are up to five times higher than those of the bottom half (ibid).

FIGURE 3.1: WEALTHY NATIONS HAVE EMITTED THE MOST CO_2 EMISSIONS SINCE THE INDUSTRIAL REVOLUTION

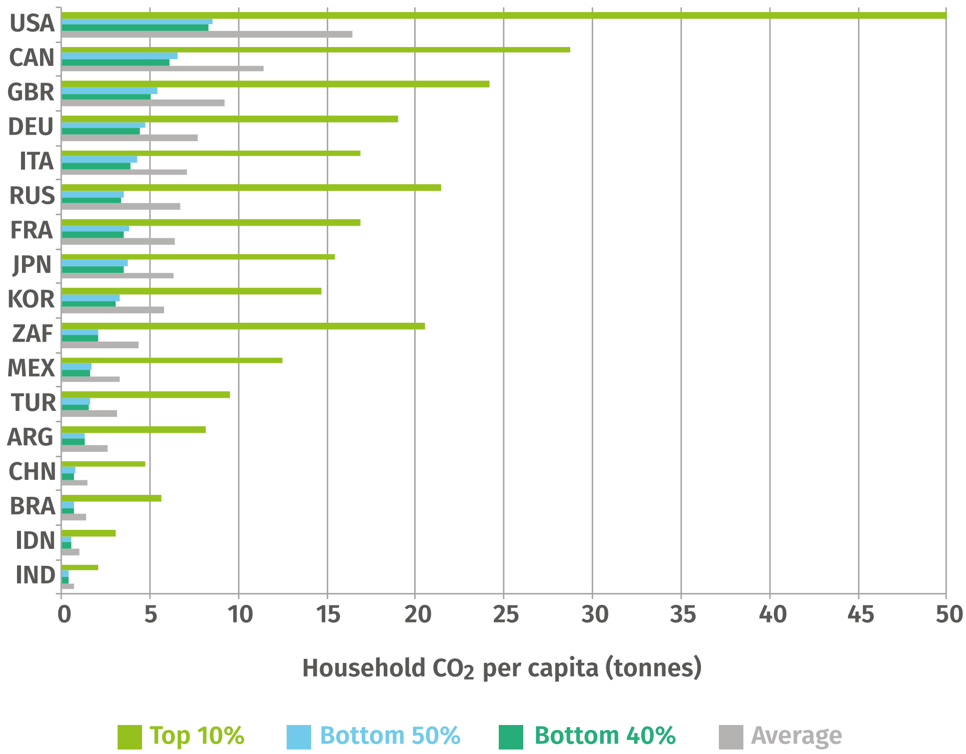
Cumulative CO_2 emissions by region from 1751 based on production-based territorial emissions and do not account for emissions embedded in trade



Source: Ritchie H and Roser M 2017

FIGURE 3.2: WEALTHIER HOUSEHOLDS HAVE HIGHER EMISSIONS THAN LESS WEALTHY HOUSEHOLDS

Per capita lifestyle consumption CO_2 emissions in G20 countries for which data is available (household CO_2 per capita in tonnes vs income per group in each G20 nation)



Source: Oxfam 2015

As well as class and poverty, environmental injustice affects other vulnerable groups and interacts with inequalities such as ethnicity and gender – considerations that will sit at the heart of IPPR's future work on environmental breakdown (Newell 2005, Neumayer and Plümper 2007). Environmental breakdown is having, and will increasingly have, vastly unequal effects across the world, falling hardest on those who are least able to respond and who are least responsible for the problem. Therefore, environmental breakdown is fundamentally an issue of justice.

ENVIRONMENTAL BREAKDOWN IS DRIVEN BY SOCIOECONOMIC STRUCTURES AND DYNAMICS

Aggregate human activity is the primary driver of environmental breakdown (Ceballos et al 2017). Climate change, for example, results from the combustion of fossil fuels and the removal of natural carbon sinks through deforestation (among other, primarily anthropogenic factors), while the main drivers of biodiversity loss are unsustainable exploitation of species, farming practices and land use changes, including deforestation (WWF 2018).

Humans have always impacted the environment, with significant human-induced extinction of animals and plants likely to have begun as early as 12,000 years ago as humans spread around the world and populations increased (*Science* 2014). Successive waves of socioeconomic development have increased the scale and pace of human activity, from the localised impact of hunter gatherer societies to the globalised industrial economy of today (Lewis and Maslin 2018). Since 1950 (a period known as the 'Great Acceleration'), many measures of human activity – including energy production, water use, fertiliser consumption and land use and deforestation – have increased dramatically, if not exponentially (Steffen et al 2007). Between 1900–2010, total global resource consumption increased by over 800 per cent, and resource use per person nearly tripled (Mayer et al 2017). It is estimated that each year, human activity is, on average, consuming 70 per cent more ecological resources than nature can regenerate (Global Footprint Network 2018).

This unsustainable increase in consumption has been driven by a number of structures and the dynamics of socioeconomic systems, including the following.

- **Compounding growth**. The promotion of economic growth is the stated goal of governments around the world, and continued growth is foundational to processes of investment and profit-making in capitalist economies and to the tax and spending policies of governments (Coyle 2015). Compounding economic growth can negatively impact the environment through increases in resource use, with even relatively small rates of growth increasing the size and material throughput of an economy over many years. Conversely, it has been argued that economic growth alongside other measures of social and economic development can decrease environmental impact (Thiago et al 2017).
- **Consumerism**. Many social and economic systems promote the acquisition and consumption of goods and services in ever greater quantities (Cross and Gary 2000). This process is both cause and effect of a policy focus on economic growth, with the business strategies of many firms predicated on rising levels of consumption, which are then promoted by advertising and social pressures toward conspicuous consumption, among other factors (White 2002). One estimate attributes responsibility for more than 60 per cent of global greenhouse emissions and between 50 and 80 per cent of total land, material, and water use to household consumption – with wealthier countries generating the most significant impacts per capita (Ivanova et al 2015).
- **Measurement.** Overall economic growth is almost exclusively measured in terms of gross domestic product (GDP), which records the market value of all final goods and services produced on an annual or quarterly basis (Coyle 2015). In doing so, GDP does not incorporate a measure of environmental degradation, nor other measures of social and economic progress, such as child mortality or poverty. By recording only flows of economic activity, not stocks of economic assets, such an approach arguably drives short-termist policy decisions (Pushpam 2016).
- **Other factors.** A number of other factors interrelate with those above to drive unsustainable human activity. These include population growth (O'Neill et al 2005), historical circumstances (including war) which have favoured a carbon-centric economic development model (Malm 2016), short-termist corporate and political governance structures (Smith School of Enterprise and the Environment 2017), and large power imbalances in the decision-making systems commanding governments and private firms (Beder 2014). We will further explore and understand the structures and dynamics of socioeconomic systems that are driving environmental breakdown over the course of IPPR's forthcoming work in this area.

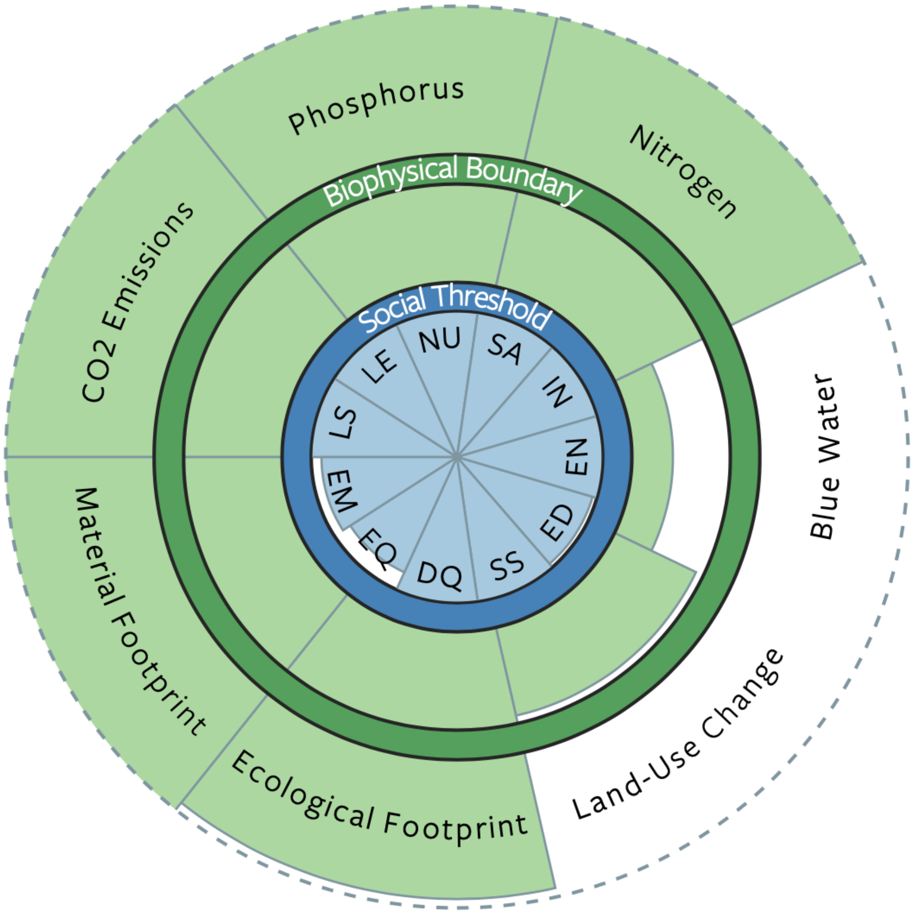
While driving unsustainable impacts on the environment, socioeconomic systems with these elements have presided over significant improvements in many measures of social and economic outcomes. These include increases in average global life expectancy, rising from 48 years in 1950 and to in excess of 70 years in 2015 (GHO no date), a 58 per cent decrease in the global under-five mortality rate since 1990 (WHO 2018), and a reduction in absolute poverty; fewer than 10 per cent of people now live in poverty, compared to 72 per cent in

1950 (Roser and Ortiz-Ospina 2017). However, these systems still fail to provide adequate social and economic opportunities to all or even meet basic needs. For example, children in parts of Africa are more than 15 times more likely to die before the age of five than children in high-income countries (WHO 2018), global undernourishment is increasing while obesity is increasing (FAO 2018), and extreme poverty is also increasing, a trend that, by 2030, could see nearly nine out of 10 of those in extreme poverty living in parts of Africa (World Bank no date). In the UK, non-communicable diseases, such as diabetes and heart disease, are increasing (The King's Fund no date), poverty is increasing, with around 4.1 million children and 4 million workers in poverty (JRF Analysis Unit 2018), and economic rewards are increasingly distributed highly unequally (Jacobs et al 2016).

Overall, many countries are failing to meet key economic and social needs while simultaneously contributing to critical levels of environmental breakdown. This observation sits at the heart of the concept of a 'safe and just space', a state in which a high quality of life is provided to people across the world without destabilising critical natural processes (Raworth 2012). The Good Life For All project at Leeds University (discussed in chapter 1) combines measures of social progress with resource use relative to a biophysical boundary to develop an approximation of whether countries are operating within the 'safe and just space' (O'Neill et al 2018). As figure 3.3 shows, the UK population benefits from a strong socioeconomic foundation, but, in providing this, the UK is having an unsustainable impact on the environment. Overall, no nation is providing an adequate socioeconomic foundation while keeping environmental impacts to within sustainable limits, as figure 3.4 illustrates.

FIGURE 3.3: THE UK HAS AN UNSUSTAINABLE IMPACT ON THE ENVIRONMENT WHILE PROVIDING A RELATIVELY STRONG SOCIAL AND ECONOMIC FOUNDATION

Measures of social and economic provision on comparison to per capita biophysical impact for the UK



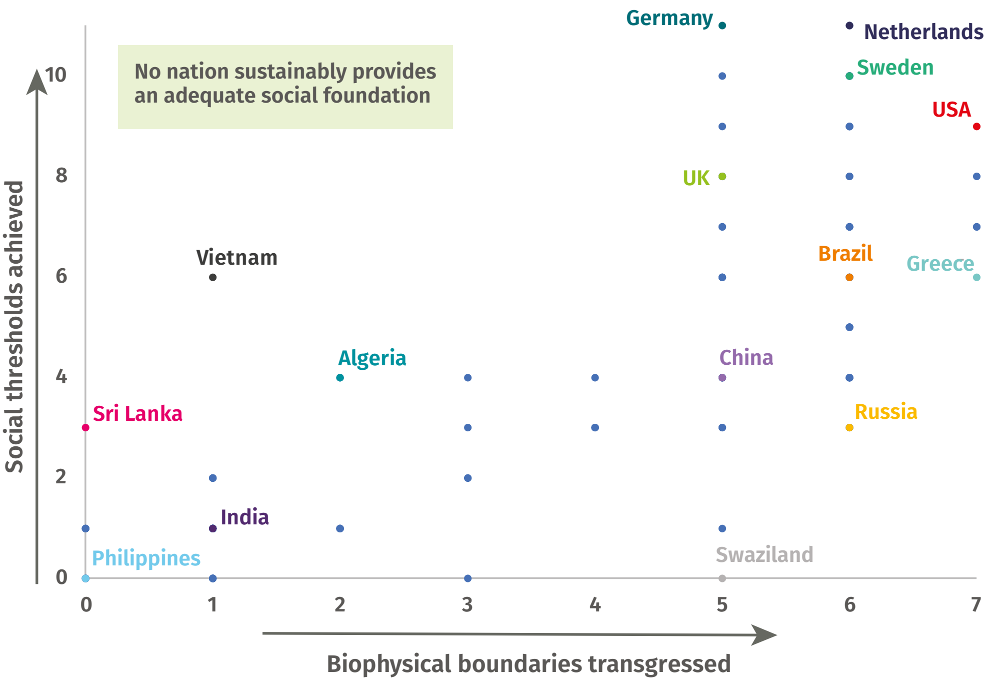
LS: Life satisfaction
LE: Healthy life expectancy
NU: Nutrition
SA: Sanitation
IN: Income
EN: Access to energy
ED: Education
SS: Social support
DQ: Democratic quality
EQ: Equality
EM: Employment

Source: A Good Life for All Within Planetary Boundaries 2019[12]

12 For data, see: https://goodlife.leeds.ac.uk/countries/

FIGURE 3.4: NO NATION IS SUSTAINABLY PROVIDING AN ADEQUATE SOCIAL AND ECONOMIC FOUNDATION

Social thresholds achieved versus biophysical boundaries transgressed



Source: A Good Life for All Within Planetary Boundaries 2019[13]

A TRANSFORMATIONAL RESPONSE IS REQUIRED – SUSTAINABLE, JUST, PREPARED

The safe and just space concept summarises two major challenges facing humanity: meeting human needs, while bringing human impacts to within environmentally sustainable limits. The scale and speed of environmental breakdown adds an important additional dimension to these challenges – that societies and economies must accelerate efforts to adapt. Adaptation has always been at the heart of responses to climate and other environmental change, with a particular focus on lower-income nations, which will bear the greater burden and have the least capacity to respond, and key sectors, such as agricultural production and adapting flood barriers and other key infrastructure. But the concept of adaptation also needs to encompass the impacts of other environmental changes and the new risk domain created by overall environmental breakdown. Adaptation processes also need to ensure that political and social structures are resilient to the pace and scale of socioeconomic change required to ensure environmental sustainability and to more severe impacts resulting from environmental change, including mass migration, conflict and economic instability (MOD 2018).

Therefore, two overall transformations to the structure of socioeconomic systems are needed in response to environmental breakdown, to make societies:

- **sustainable and just**: a socioeconomic transformation to achieve a 'safe and just space' for human activity, bringing it within environmentally sustainable limits while tackling inequalities and providing a high quality of life to all. Achieving environmental sustainability requires restoration of natural systems

13 For data, see: https://goodlife.leeds.ac.uk/countries/

to, where possible, undo the damage that has pushed natural systems into unsafe operating spaces (Ellen MacArthur Foundation 2018)

- **prepared**: increased levels of resilience to the impacts of environmental breakdown, covering all areas of society, including infrastructure, markets, political processes, social cohesion and global cooperation. These impacts are expected to grow in frequency and severity as a result of the high levels of environmental breakdown already underway as well as to the increasing levels of breakdown resulting from previous activity which, due to inertias in natural systems, are yet to impact. For example, current temperature rises do not reflect contemporary greenhouse gas emissions but are a result of historical emissions (IPCC 2018).

These two transformations – to prevent and mitigate environmental breakdown while increasingly preparing for its impacts – are interrelated processes. For example, in the case of climate change, increased deployment of renewable energy can reduce greenhouse gas emissions while improving energy system resilience by reducing reliance on energy imports and exposure to fluctuations in fossil fuel markets (World Bank 2018). In turn, reducing investments in fossil fuel companies can both increase resilience to economic shocks resulting from devaluation in these companies, and also discourage a business model that necessitates unsustainable emission of greenhouse gases (Carney 2015).

Furthermore, the measures needed to combat environmental breakdown can be those that improve social and economic outcomes. For example, reductions in the production and consumption of red meat can improve environmental outcomes, including lowering greenhouse gas emissions, deforestation rates and soil degradation, while improving health, through a more varied and nutritious diet (WWF 2017b). In the case of transport, increases in shared mobility options, such as public transport and car share services, can increase the efficiency of vehicle movements around cities, lowering congestion and air pollution while increasing access to social and economic opportunities (ITF 2016).

Risks also exist from action to reduce environmental degradation, including potential job losses and other potential negative social and economic impacts of rapid transitions, though resolving these tensions is often highly achievable through the implementation of policies that avoid false trade-offs (CCC 2018). For example, pathways to decarbonise the UK could prioritise the burning of biomass for energy, with attendant increases in air pollution and negative health impacts, or instead focus on reductions in energy demand, including through reductions in vehicles, that would lower air pollution (UKHACC 2018).

Over the next year, IPPR will seek to understand the policy and political responses that can realise the complementarities between actions to limit environmental breakdown and those to realise a more prosperous and healthy society, maximising social and economic justice in the process.

RESPONDING TO ENVIRONMENTAL BREAKDOWN

To date, some progress has been made toward realising these two transformations, including the following.

- **Understanding environmental breakdown**: Scientists have been warning of the impact of environmental degradation for many decades, and recent developments – such as the international process for understanding the science and impacts of climate change facilitated by the IPCC and the development of the planetary boundaries framework – have enabled a more holistic understanding of environmental breakdown (Bonneuil and Fressoz 2016). Many of these developments have been made possible by improvements in measuring equipment and data collection and analysis.

- **Policy frameworks**: In the UK, the 2008 Climate Change Act has provided a powerful legislative framework for limiting and reducing the impact of human activity on the climate system within one nation (Fankhauser et al 2018). Similar laws have been adopted around the world and the UN's sustainable development goals (SDGs) provide a framework for understanding the policy priorities of bringing human activity to within a safe and just space (Raworth 2012). These frameworks also include assessment and planning for adaptation.
- **Restoration of natural systems**: Some natural systems are recovering from damage caused by human activity, including the healing of the ozone layer (WMO et al 2018) and, in the case of biodiversity, forest cover has increased in Asia and marine conservation areas have increased (Watts 2018). These improvements have partly been driven by international treaties, such as the Montreal Protocol in the case of ozone protection.
- **Rapid deployment of clean technology**: The speed and scale of the development and deployment of clean technologies has increased at a rapid pace over the last decade or so (Our World in Data 2018). In the UK, a large reduction in coal use has occurred alongside increases in renewable energy capacity (Carbon Brief 2018).

However, overall progress has been inadequate. It has been too slow, and limited to certain natural systems (particularly climate change), as the growing and broad range of impacts reviewed in chapters 1 and 2 show. Crucially, many efforts to date have not sought to realise the structural social and economic changes that the transformations described above require. For example, bans on leaded fuels and the phase-out of CFCs, while reducing negative impacts on the environment and health, did not succeed in altering the social and economic structures that necessitate polluting fuel and chemical use in general, or the subsequent growth in motorised vehicle transport and refrigeration, both of which exact large negative impacts on natural systems. Indeed, many of these efforts have been disconnected from wider projects of socioeconomic renewal; in the case of motor vehicle transport, reductions in polluting fuels did not occur as part of a wider programme of reductions in private vehicle use and increases in cycling and walking and public transport, which, in turn, can improve health, reduce transport costs, improve socioeconomic opportunity, and reduce the environmental impact of travel (ITF 2016).

Recent policy proposals seeking to reduce environmental impact while improving socioeconomic impacts include the concept of a 'Green New Deal': a major economic stimulus programme to reduce greenhouse gas emissions while simultaneously reducing inequality and other negative economic outcomes through social and economic reforms and public investment (GNDG 2018). The merits of such proposals should be measured against their potential ability to realise the two transformations described above; a Green New Deal should reduce environmental impacts across all planetary boundaries and, crucially, it should also ensure societal preparedness to cope with and adapt to continued environmental breakdown (Hickel 2018a).

It is unclear whether adequate efforts are being made to sufficiently prepare populations to navigate the radical social and economic transitions needed to prevent catastrophic environmental breakdown while ensuring they remain resilient to the growing negative impacts breakdown (Wallace-Wells 2017). Understanding the successes and failures of action to date, assessing levels of preparedness for breakdown, and developing a programme of renewal to realise a sustainable, just and prepared society will be the focus of IPPR's work in this area.

Furthermore, we will explore barriers to progress in realising these transformations, including the following.

- **Decision-making systems**: The complexity, scale, uncertainty and pace at which environmental breakdown and its consequences are occurring may be difficult for decision-making systems that developed under relatively stable conditions and struggle with making rapid, structural changes (Helm and Hepburn 2009).
- **Economic systems**: Preventing environmental breakdown requires rapid transitions of unprecedented scale across all economies (IPCC 2018). It is unclear whether prevailing economic systems are capable of achieving changes of such rapidity and scale while meeting human needs and protecting populations from the growing impacts of environmental breakdown (Hickel 2018b).
- **The political project**: Developing viable political coalitions under conditions of environmental breakdown could be difficult for a number of reasons, including:
  - the existence of inequalities between those affected by environmental breakdown and who contribute the most
  - the need for transformative change in a short amount of time
  - inertias between human impacts on the environment and resultant breakdown masking the severity of the situation to voters
  - the need to maintain and further global cooperation under conditions of increasing stress.
- **Vested interests**: Elite interests in countries across the world, including industries whose business model depends on continued environmental degradation, use their considerable power and wealth to influence political debates and policy decisions on environmental breakdown, with many instances of groups blocking or reversing progress (Brulle 2018; Mayer 2017). It is estimated that 100 companies are responsible for the emission of 71 per cent of industrial greenhouse gases since 1988 (Griffin 2017).
- **The challenge facing younger generations**: Inequalities between those who contributed most to environmental breakdown and those who will experience its consequences manifest acutely between generations, with younger people set to inherit a world of accelerating social and economic destabilisation. In turn, younger generations, starting with the millennial generation, are faced with an unprecedented leadership challenge: they must accelerate the transformation toward a more sustainable and just world while navigating the threats imposed by growing environmental breakdown, the demands placed on societies in undergoing transformation, and the failure of policy and the leaders of previous generations.

CONCLUSION: RESPONDING TO ENVIRONMENTAL BREAKDOWN

> ***"Not everything that is faced can be changed, but nothing can be changed until it is faced."***
> James Baldwin, 1962[14]

Policymakers and politicians are not adequately recognising, let alone responding to the catastrophic threat posed by environmental change. This report has argued that three shifts in understanding are needed across political and policy communities, regarding: the scale and pace of environmental change, the implications for societies, and the need for a socioeconomic transformation.

Negative impacts on the environment go 'beyond just' climate change to encompass most other natural systems, with aggregate human activity pushing these systems into 'unsafe operating spaces'. This is driving a complex, dynamic process of unprecedented environmental change that has reached severe levels, inaugurating a new age of environmental breakdown. These changes are unprecedented in their speed, and historical inaction means there is a closing window of opportunity to avoid catastrophic outcomes. For example, in the case of climate breakdown, even assuming for future deployment of large-scale 'negative emissions' technologies and ignoring the potential for 'tipping points' in the climate system, emissions must be roughly halved over the next decade to avoid severely negative outcomes – an unprecedented societal shift (IPCC 2018). Instead, emissions continue to rise, to levels unseen in millions of years, and at rates unprecedented in Earth's history (WMO 2018a).

The consequences of environmental breakdown for human systems include drought, famine and greater ill health, with their increasing frequency likely to destabilise nations and entire regions, leading to instability, large-scale involuntary migration, conflict and even the collapse of social and economic systems. As such, environmental breakdown presents decision-makers with a new, complex and uniquely dangerous domain of risk. The historical disregard of environmental considerations in most areas of policy has been a catastrophic mistake.

By driving unsustainable human activity, social and economic systems are inextricably linked to environmental breakdown and so profound transformations in these systems are needed to bring human activity to within environmentally sustainable limits while providing a high quality of life to all. Crucially, efforts to achieve these transformations should also increase levels of resilience to the impacts of environmental breakdown resulting from past and any future activity, covering all areas of society, ensuring populations are supported as impacts grow and societies and economies rapidly transform.

14 Baldwin J (1962) 'As Much Truth as One Can Bear', the New York Times, 14th January 1962. https://www.nytimes.com/1962/01/14/archives/as-much-truth-as-one-can-bear-to-speak-out-about-the-world-as-it-is.html

This is an unprecedented challenge. In rising to it, we need a new sense of agency – one that can overcome major barriers to progress, including the constraints of our governing systems, the power of vested interests and the complexities of creating political coalitions across populations who have vastly different experiences of breakdown. In particular, younger generations will need help in finding the energy and a sense of control that often eludes them as they begin to realise the enormity of inheriting a rapidly destabilising world.

Over the coming year, IPPR will seek to better understand and develop solutions to these problems, assessing what progress has been made toward responding to environmental breakdown and developing policies that can drive the required transformations. We aim to develop a vision for a world with the agency required to overcome environmental breakdown and one driven by the need for renewal and justice. Time has nearly run out.

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CORRIGENDUM

This report was amended to reflect a number of clarifications: on pages 4 and 13, amending the year in reference to increases in certain weather events from 2005, the original year stated, to 1950; on pages 4 and 13, adding in references to IPCC analysis in relation to extreme weather events and clarifying the data sourced from the EM-DAT database; amending the rate at which the oceans are heating, referred to on page 13, from 'tripled', as originally stated, to 'quadrupled'; clarifying that the paper is referring to certain plastics and therefore amending the 2015 production figure to 380 Mt from the 407 Mt figure originally used; amending the number of heat-related deaths referred to on page 17 from 7,500 a year, as originally stated, to 7,000 a year; amending the date of the winter floods referred to on page 17 from 2012/13, as originally stated, to 2013/14; and amending the number of people who could be forced into involuntary migration from one-fifth of the global population, as originally stated, to over 1.4 billion people. These amendments have no material impact on the conclusions made by the report.

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