Drought risk in the Anthropocene: from the Jaws of Death to the Waters of Life

Thank you. Let me start with a disclaimer: I'm heavily outgunned by the expertise here today. Some of what I'm about to say is deliberately simplified so that I and our wider external audience can understand it. I apologise if it's oversimplified. Your analysis of the issues I'm going to touch on will be much more sophisticated than mine. And some of what I say you may want to contest, which is welcome. But I hope and expect that we will have little argument over what the biggest problem we face today is – it's the climate emergency.

It is an honour to speak to an organisation as prestigious and historic as the Royal Society. So historic that some would argue than when it was founded in 1660, we were in a previous epoch – the Holocene – to the one we are in now, the Anthropocene.

New epochs don't come around that often. The Holocene began more than 11,000 years ago after the last glacial period and saw the dawn of human civilisation. Before that the Pleistocene lasted for 2.5 million years. It saw both major climate change and a massive extinction of life forms: those two facts are connected.

The Anthropocene – the epoch which started when humans first began to have a significant impact on Earth's climate, geology and ecosystems – is itself a much-contested concept. There's a live debate about when it started. Some argue that we should go as far back as 10,000 or so years to the shift from hunter-gatherers to settled farmers. Others say the Anthropocene truly began about 250 years ago with the industrial revolution, as the western world's new fossil fuel-powered economy began to drive up global temperatures. And there are those who prefer to wait until the 1950s, when the acceleration of fossil fuel use, deforestation, ocean acidification, urbanisation, industrial-scale agriculture, habitat destruction, species extinction and wide-scale natural resource extraction made it finally incontestable that we had now significantly modified our planet. But whenever the Anthropocene did start, what no-one seriously contests is that we're in it now.

Greenhouse gases and (the wrong kind of) climate change

Nor does anyone worth listening to contest the basic science of the most important feature of the Anthropocene, which is climate change caused by human activity.

We know there is a natural greenhouse effect: water vapour, carbon dioxide and certain other naturally-occurring gasses in our atmosphere allow sunlight to pass through the atmosphere, providing the light that we and most other life forms need; and at the same time those gasses prevent the heat the

sunlight brings from leaving the atmosphere, keeping the planet warm enough for life.

This process makes the Earth's temperature some 33°C warmer than it would otherwise be, which allows human life on Earth to exist. Mars is inhospitable for humans because it doesn't have a big enough greenhouse effect and thus has a largely frozen surface. Venus is the opposite: it has about 150,000 times more carbon dioxide in its atmosphere than Earth, which has produced a runaway greenhouse effect and a surface temperature hot enough to melt lead.

What we are worried about is not the natural greenhouse effect, which is benign for life on Earth, but the enhanced effect caused by humans, which is the opposite. Burning fossil fuels and cutting down forests is increasing the concentration of greenhouse gases in our atmosphere. This is trapping extra heat, causing the Earth's temperature to rise and the climate to change.

The impacts of the changing climate

We are seeing that change in the climate already.

Temperatures are rising. The 21st century has so far been warmer overall than any of the previous three centuries. The UK's top 10 warmest years since records began have all occurred since 2002. Those rising temperatures are causing rising sea levels as glaciers and the ice caps melt. And they are causing more extreme weather, including more violent, frequent and longer lasting rainfalls, droughts, fires, flooding and coastal erosion.

In England, three of the five wettest winters on record have happened in the last eight years. In the last decade our winters have been 12% wetter than they were in the three decades from 1961 to 1990. In the storms of 2020 and early 2021, water levels on many of our major rivers smashed previous records. Which is why on 16 February 2021, the Environment Agency had more flood warnings in force (594) across the country than ever before. Meanwhile in other parts of the world this summer we've seen further violent weather, with catastrophic flooding in Germany that killed some 200 people, deadly Hurricane Ida in America and devastating wildfires in Siberia, Canada, Greece and the United States.

Drought risk is rising

Climate change is also increasing drought risk, the subject of our debate today.

In England, May 2020 was the driest on record The Environment Agency's estimate is that summer rainfall is expected to decrease by approximately 15% by the 2050s in England, and by up to 22% by the 2080s; and that by 2100 in the south-east we will increasingly see temperatures above 35°C, and sometimes 40°C.

Hotter drier summers and less predictable rainfall – two effects of a changing climate – plus over-abstraction of water for industry, agriculture and the public water supply as the population grows, is a toxic combination.

It means that if we don’t take action, by 2050 the amount of water available in England could be reduced by up to 15%; that some rivers will have up to 80% less water in summer; and that we will need around 3.4 billion extra litres of water a day to meet the needs of people, industry and agriculture. Welcome to drought risk in the Anthropocene, UK-style.

The Domino Effect of climate breakdown

Nature is interconnected. As climate change is causing more extremes in one part of our environment these are colliding with other effects. So drought risk brings other risks as this domino effect plays out.

We see the domino effect when extreme heat causes wildfires, waste fires, soil damage and flash flooding. We see it in the perfect storm faced by wildlife which lives in or depends on freshwater, which is most of it: rising water temperatures, lower flows, less oxygen, deteriorating water quality are all damaging that wildlife. And thus we see how the climate emergency is also a key driver of the biodiversity crisis.

The scariest part of all of this is that we are seeing such big climate shocks today at just over 1 degree of warming above pre-industrial levels. On our present course temperature rise will soon be teetering on the edge of +1.5°C, with +2°C or more in sight, which means these shocks will intensify.

How to respond to the challenges

That’s the bad news. The good news is that we still have time to avert climate catastrophe. Even better, we know exactly what we have to do to succeed – mitigate the extent of future climate change by reducing the emissions that cause it, and adapt to our changing climate so that we are resilient to its effects.

Mitigation, adaptation and COP

The United Nations Climate Summit, COP26, starts in Glasgow in less than a fortnight. The Government is putting massive effort into making it a success. We have good foundations on which to build: the historic commitments made at the Paris summit in 2015 to seek to limit global warming to 1.5 degrees above pre-industrial levels and (equally important) to help all countries adapt to the impacts of a changing climate. Those are the right aims. The hope for Glasgow is that the international community will agree on the measures that are necessary to actually achieve them.

So the UK’s first goal in Glasgow is stronger mitigation. We want to secure global net zero by 2050 and keep the 1.5 degree target within reach. That matters hugely, because the effects of global warming are exponential: stabilising at +1.5 ° C is much safer than +2 °C, and 2 degrees is much much safer than 3 degrees. That’s why all countries are being asked at Glasgow to set ambitious emissions reductions targets for 2030. That will require them to phase out coal, invest in renewable energy, stop deforestation and accelerate the move to electric vehicles. The current commitments made by the international community will deliver a projected decrease in global emissions

of 12% by 2030 (compared to 2010 levels). But a 25% decrease is needed to deliver a 2°C world and a 45% decrease to keep us on track for 1.5°C.

The UK's second goal for COP is effective adaptation. We want agreement on action that will shield communities and natural habitats from the effects of climate change. That means protecting and restoring ecosystems, building flood and other defences, putting warning systems in place for environmental emergencies like flood and fire, and protecting our lives and livelihoods by making our infrastructure, our agriculture and our communities more resilient.

But however successful COP26 is, it won't stop the climate changing or all the effects of that change, because human activity to date means that some irrevocable climate change has already happened and that more will continue to happen, even if the world stopped all carbon emissions tonight. That is why as a nation we need to be climate ready – resilient to the future hazards and potential shocks that we already know will impact on all our lives.

What the Environment Agency is already doing to tackle the climate emergency

The Environment Agency is already playing a central role in this country's efforts to tackle the climate emergency.

We regulate most of the activities – energy, industry, farming, waste management – that emit the greenhouse gases which cause climate change, and are working with those industries to progressively reduce emissions. We run the new UK Emissions Trading Scheme which caps, trades and reduces emissions. We are supporting renewable and low carbon technology in the industries we regulate. And we are trying to walk the walk ourselves through our own commitment to make the EA a net zero organisation by 2030. All that is helping reduce the extent of future climate change.

We are also playing a key role in helping the country adapt to the impacts of that change. We protect people against one of its major effects, more frequent and more violent flooding, by building and maintaining the nation's flood defences, by warning and informing communities when flooding threatens, and by coming to their aid when it happens. We help design places for people to live and work that are more resilient to climate shocks, including through our role as a statutory consultee on all major developments. We create and restore habitats – wetlands, woods, marshes, peat bogs – which both help absorb carbon to reduce climate change and protect people and wildlife from its effects – drought, flood, extreme heat etc. And we are seeking to reduce drought risk by reforming our water abstraction licencing to stop people taking unsustainable amounts of water from rivers or the ground.

Escaping the Jaws of Death: how we are reducing drought risk in the Anthropocene

The strategic answer to how we tackle drought risk in the Anthropocene is that we tackle the climate change that is driving it. But there are also specific measures that we can take and are taking to ensure we do have

plentiful water for all in future.

Enough water for all: that's something that is not talked about nearly enough. When the media and NGOs in this country talk about water their focus is almost all about water quality: cleaning up our rivers, lakes and bathing waters for people and wildlife. That's important, and while we've seen massive progress over the last two decades, with most of our rivers in a better state now than at any time during the Industrial Revolution, there is a lot more for all of us to do.

But the other really big issue about water, and the one on which I'd like to see the media and NGOs campaigning equally hard, is water quantity – simply having enough for people and wildlife. Good water quality is essential, but the right water quantity is existential. We need as much emphasis on the latter in the future as we have now on the former.

In a speech a while ago I talked about the Jaws of Death – the point on water companies' planning charts some 20 years from now when if we don't intervene, the demand for water in this country will outstrip supply and there will simply not be enough. We know what to do to avoid those jaws: reduce demand, by using less water more efficiently; and improve supply, including by investing in the right infrastructure.

That means we need to think strategically, radically and long term. An initiative the Environment Agency launched last year, the National Framework for Water Resources, seeks to do just that. It identifies England's long-term water needs up to 2050 and beyond, estimates how much water users in each region will need then, and which sectors (agriculture, industry, power) will use the most. Most important of all, it identifies the actions needed to ensure resilient water supplies are available to meet the needs of all users in future.

What gets measured gets done. Which is why the initiative includes important targets which the water companies have endorsed: that by 2050 they will have achieved a 1:500 drought resilience standard (ie that the chances of needing severe water restrictions will be limited to no more than 0.2% in any given year); that they will get water consumption down to 110 litres of water per person per day from the current average of 150 litres or more; that they will halve leakage, which currently loses around 20% of water put into the public water supply; that they will develop new supplies through reservoirs, water reuse schemes and desalination plants; that they will move more water to where it's needed through more transfers; and that they will reduce the use of drought measures that damage the environment. We have set up mechanisms to deliver these goals and are working with the water companies, the other regulators and the government to ensure they get done.

While we plan and act for the longer term we also need to manage drought risk in the here and now. We are doing that too.

The Environment Agency has a duty to safeguard water resources in England. When drought threatens we seek to reduce the impact on the environment and water users. We coordinate the efforts of the water companies, government and

others to manage drought risk, at national and local level. We regulate water companies to ensure they have up to date drought plans that show how they will effectively maintain supplies without placing unnecessary burdens on the environment. We plan for drought ourselves and exercise our response to it. We seek to predict it, by monitoring the weather, surface and groundwater levels and the environment; and by analysing the effects and the prospects. We advise the government, water companies, farmers and the public on how to use water wisely. We manage the nation's use of water by regulating abstraction through permits which limit the amount people can take from the ground or our rivers and we reduce or stop abstraction when water is scarce. We help ensure the water companies have the water they need for public supply by operating our own water transfer schemes which move water between catchments. And we respond to drought incidents like fish kills to protect wildlife and re-oxygenate rivers.

What more we will do

The EA is also stepping up action to adapt to the broader climate risks the country faces. Last week we published a new report on those risks and our plans for managing them.

It contains some sobering analysis. We judge that we will see more and worse droughts and other environmental incidents, and increasing flood risks; that the EA will not be able to protect everyone by working on its own; that climate change is making it harder to ensure the clean and plentiful water we all want; that our ecosystems cannot adapt as fast as the climate is changing; and that environmental regulation designed for a status quo world is not yet ready for a changing climate.

But our report also contains answers to these challenges. We think we can meet them all, as an organisation and as a country, if we:

- think differently: and our thinking needs to change faster than the climate.
- collaborate better: mitigation and adaptation work best through partnerships.
- invest early in adaptive change: which pays for itself, both in terms of damage avoided and innovation unlocked.
- work with nature not against it: where we can, for example, by using trees and wetlands to reduce flood risk and absorb carbon.
- support the development of a low carbon economy.
- help businesses prepare.
- strengthen the resilience of individual communities.
- scale up all our efforts.

Our report lays out a detailed action plan for all this which we will take forward over the next five years.

How you can help

You can help us. As scientists, researchers, writers and problem-solvers, you can help us and the rest of the world understand better what is happening to

our climate and our drought risk and what interventions will be most successful; you can help us identify new techniques to reduce carbon and enhance resilience; you can tell the world what's happening and what we need to do now to tackle it. And we and the world will listen.

The Royal Society and its members have been at the forefront of so many breakthrough moments for humanity: Newton's Principia Mathematica; Benjamin Franklin's kite experiment; Cook's journey to Tahiti to track the Transit of Venus; the first English report of inoculation against disease; Dorothy Hodgkin's confirmation of the structure of penicillin; Crick and Watson's discovery of DNA. A hundred years from now, I'd like future generations to add that another of the historic achievements of the Royal Society was the role it played in successfully ending the climate crisis.

Conclusion: Reasons to be cheerful

Let me conclude on an upbeat note. I am optimistic that we will succeed in tackling the climate emergency and reducing drought risk in the Anthropocene.

First, because doing so makes political sense. There is now mass public pressure around the world to solve the climate crisis. That is driving governments to take action they were not prepared to take before, such as the recent commitments from the United States on green finance and from China on coal. The UK Government is leading the way with its ambitious strategy to reach net zero.

Second, because solving the crisis makes business sense. As a water company CEO said to me recently, "if I don't have any water, I don't have a business". The cost of cheap renewable energy continues to decline and the price – financial and reputational – of carbon continues to rise. The market will help us get where we need to be.

And the third reason I'm an optimist about this is because I believe in humanity. Since the last ice age receded, we humans have done a lot of very stupid things, and causing global warning that threatens to destroy us as species has to be top of that long list. But humans have also done remarkable things that have made the world we live in a far better place. Our ingenuity as a species caused this mess, and it can get us out of it.

So let's embrace the Anthropocene for what it is: the epoch of humans. If we channel the best parts of what makes us human: not only reason, innovation and logic, but also courage, empathy and a desire for justice, we can protect our planet and make it a better place for all.