Humans: the real threat to life on Earth

If population levels continue to rise at the current rate, our grandchildren will see the Earth plunged into an unprecedented environmental crisis, argues computational scientist Stephen Emmott in this extract from his book Ten Billion

Stephen Emmott Sunday 30 June 2013 Last modified on Thursday 18 July 2013

Earth is home to millions of species. Just one dominates it. Us. Our cleverness, our inventiveness and our activities have modified almost every part of our planet. In fact, we are having a profound impact on it. Indeed, our cleverness, our inventiveness and our activities are now the drivers of every global problem we face. And every one of these problems is accelerating as we continue to grow towards a global population of 10 billion. In fact, I believe we can rightly call the situation we're in right now an emergency – an unprecedented planetary emergency.

We humans emerged as a species about 200,000 years ago. In geological time, that is really incredibly recent. Just 10,000 years ago, there were one million of us. By 1800, just over 200 years ago, there were 1 billion of us. By 1960, 50 years ago, there were 3 billion of us. There are now over 7 billion of us. By 2050, your children, or your children's children, will be living on a planet with at least 9 billion other people. Some time towards the end of this century, there will be at least 10 billion of us. Possibly more.

We got to where we are now through a number of civilisation- and society-shaping "events", most notably the agricultural revolution, the scientific revolution, the industrial revolution and – in the West – the public-health revolution. By 1980, there were 4 billion of us on the planet. Just 10 years later, in 1990, there were 5 billion of us. By this point initial signs of the consequences of our growth were starting to show. Not the least of these was on water. Our demand for water – not just the water we drank but the water we needed for food production and to make all the stuff we were consuming – was going through the roof. But something was starting to happen to water.

Back in 1984, journalists reported from Ethiopia about a famine of biblical proportions caused by widespread drought. Unusual drought, and unusual flooding, was increasing everywhere: Australia, Asia, the US, Europe. Water, a vital resource we had thought of as abundant, was now suddenly something that had the potential to be scarce.

By 2000 there were 6 billion of us. It was becoming clear to the world's scientific community that the accumulation of CO_2, methane and other greenhouse gases in the atmosphere – as a result of increasing agriculture, land use and the production, processing and transportation of

everything we were consuming – was changing the climate. And that, as a result, we had a serious problem on our hands; 1998 had been the warmest year on record. The 10 warmest years on record have occurred since 1998.

We hear the term "climate" every day, so it is worth thinking about what we actually mean by it. Obviously, "climate" is not the same as weather. The climate is one of the Earth's fundamental life support systems, one that determines whether or not we humans are able to live on this planet. It is generated by four components: the atmosphere (the air we breathe); the hydrosphere (the planet's water); the cryosphere (the ice sheets and glaciers); the biosphere (the planet's plants and animals). By now, our activities had started to modify every one of these components.

Our emissions of CO_2 modify our atmosphere. Our increasing water use had started to modify our hydrosphere. Rising atmospheric and sea-surface temperature had started to modify the cryosphere, most notably in the unexpected shrinking of the Arctic and Greenland ice sheets. Our increasing use of land, for agriculture, cities, roads, mining – as well as all the pollution we were creating – had started to modify our biosphere. Or, to put it another way: we had started to change our climate.

There are now more than 7 billion of us on Earth. As our numbers continue to grow, we continue to increase our need for far more water, far more food, far more land, far more transport and far more energy. As a result, we are accelerating the rate at which we're changing our climate. In fact, our activities are not only completely interconnected with but now also interact with, the complex system we live on: Earth. It is important to understand how all this is connected.

Let's take one important, yet little known, aspect of increasing water use: "hidden water". Hidden water is water used to produce things we consume but typically do not think of as containing water. Such things include chicken, beef, cotton, cars, chocolate and mobile phones. For example: it takes around 3,000 litres of water to produce a burger. In 2012 around five billion burgers were consumed in the UK alone. That's 15 trillion litres of water – on burgers. Just in the UK. Something like 14 billion burgers were consumed in the United States in 2012. That's around 42 trillion litres of water. To produce burgers in the US. In one year. It takes around 9,000 litres of water to produce a chicken. In the UK alone we consumed around one billion chickens in 2012. It takes around 27,000 litres of water to produce one kilogram of chocolate. That's roughly 2,700 litres of water per bar of chocolate. This should surely be something to think about while you're curled up on the sofa eating it in your pyjamas.

But I have bad news about pyjamas. Because I'm afraid your cotton pyjamas take 9,000 litres of water to produce. And it takes 100 litres of water to produce a cup of coffee. And that's before any water has actually been added to your coffee. We probably drank about 20 billion cups of coffee last year in the UK. And – irony of ironies – it takes something like four litres of water to produce a one-litre plastic bottle of water. Last year, in the UK alone, we bought, drank and threw away nine billion plastic water bottles. That is 36 billion litres of water, used completely unnecessarily. Water wasted to produce bottles – for water. And it takes around 72,000 litres of water to produce one of the 'chips' that typically powers your laptop, Sat Nav, phone, iPad and your car. There were over two billion such chips produced in 2012. That is at least 145 trillion litres of water. On semiconductor chips. In short, we're consuming water, like food, at a rate that is completely unsustainable.

Demand for land for food is going to double – at least – by 2050, and triple – at least – by the end of this century. This means that pressure to clear many of the world's remaining tropical rainforests for human use is going to intensify every decade, because this is predominantly the only available land that is left for expanding agriculture at scale. Unless Siberia thaws out before we finish deforestation. By 2050, 1bn hectares of land is likely to be cleared to meet rising food demands from a growing population. This is an area greater than the US. And accompanying this will be three gigatons per year extra CO_2 emissions.If Siberia does thaw out before we finish our deforestation, it would result in a vast amount of new land being available for agriculture, as well as opening up a very rich source of minerals, metals, oil and gas. In the process this would almost certainly completely change global geopolitics. Siberia thawing would turn Russia into a remarkable economic and political force this century because of its newly uncovered mineral, agricultural and energy resources. It would also inevitably be accompanied by vast stores of methane – currently sealed under the Siberian permafrost tundra – being released, greatly accelerating our climate problem even further.

Meanwhile, another 3 billion people are going to need somewhere to live. By 2050, 70% of us are going to be living in cities. This century will see the rapid expansion of cities, as well as the emergence of entirely new cities that do not yet exist. It's worth mentioning that of the 19 Brazilian cities that have doubled in population in the past decade, 10 are in the Amazon. All this is going to use yet more land.

We currently have no known means of being able to feed 10 billion of us at our current rate of consumption and with our current agricultural system. Indeed, simply to feed ourselves in the next 40 years, we will need to produce more food than the entire agricultural output of the past

10,000 years combined. Yet food productivity is set to decline, possibly very sharply, over the coming decades due to: climate change; soil degradation and desertification – both of which are increasing rapidly in many parts of the world; and water stress. By the end of this century, large parts of the planet will not have any usable water.

At the same time, the global shipping and airline sectors are projected to continue to expand rapidly every year, transporting more of us, and more of the stuff we want to consume, around the planet year on year. That is going to cause enormous problems for us in terms of more CO_2 emissions, more black carbon, and more pollution from mining and processing to make all this stuff.

But think about this. In transporting us and our stuff all over the planet, we are also creating a highly efficient network for the global spread of potentially catastrophic diseases. There was a global pandemic just 95 years ago – the Spanish flu pandemic, which is now estimated to have killed up to 100 million people. And that's before one of our more questionable innovations – the budget airline – was invented. The combination of millions of people travelling around the world every day, plus millions more people living in extremely close proximity to pigs and poultry – often in the same room, making a new virus jumping the species barrier more likely – means we are increasing, significantly, the probability of a new global pandemic. So no wonder then that epidemiologists increasingly agree that a new global pandemic is now a matter of "when" not "if".

We are going to have to triple – at least – energy production by the end of this century to meet expected demand. To meet that demand, we will need to build, roughly speaking, something like: 1,800 of the world's largest dams, or 23,000 nuclear power stations, 14m wind turbines, 36bn solar panels, or just keep going with predominantly oil, coal and gas – and build the 36,000 new power stations that means we will need.Our existing oil, coal and gas reserves alone are worth trillions of dollars. Are governments and the world's major oil, coal and gas companies – some of the most influential corporations on Earth – really going to decide to leave the money in the ground, as demand for energy increases relentlessly? I doubt it.

Meanwhile the emerging climate problem is on an entirely different scale. The problem is that we may well be heading towards a number of critical "tipping points" in the global climate system. There is a politically agreed global target – driven by the Intergovernmental Panel on Climate Change (IPCC) – to limit the global average temperature rise to 2C. The rationale for this target is that a rise above 2C carries a significant risk of catastrophic climate change that

would almost certainly lead to irreversible planetary "tipping points", caused by events such as the melting of the Greenland ice shelf, the release of frozen methane deposits from Arctic tundra, or dieback of the Amazon. In fact, the first two are happening now – at below the 2C threshold.

As for the third, we're not waiting for climate change to do this: we're doing it right now through deforestation. And recent research shows that we look certain to be heading for a larger rise in global average temperatures than 2C – a far larger rise. It is now very likely that we are looking at a future global average rise of 4C – and we can't rule out a rise of 6C. This will be absolutely catastrophic. It will lead to runaway climate change, capable of tipping the planet into an entirely different state, rapidly. Earth will become a hellhole. In the decades along the way, we will witness unprecedented extremes in weather, fires, floods, heatwaves, loss of crops and forests, water stress and catastrophic sea-level rises. Large parts of Africa will become permanent disaster areas. The Amazon could be turned into savannah or even desert. And the entire agricultural system will be faced with an unprecedented threat.

More "fortunate" countries, such as the UK, the US and most of Europe, may well look like something approaching militarised countries, with heavily defended border controls designed to prevent millions of people from entering, people who are on the move because their own country is no longer habitable, or has insufficient water or food, or is experiencing conflict over increasingly scarce resources. These people will be "climate migrants". The term "climate migrants" is one we will increasingly have to get used to. Indeed, anyone who thinks that the emerging global state of affairs does not have great potential for civil and international conflict is deluding themselves. It is no coincidence that almost every scientific conference that I go to about climate change now has a new type of attendee: the military.

Every which way you look at it, a planet of 10 billion looks like a nightmare. What, then, are our options?

The only solution left to us is to change our behaviour, radically and globally, on every level. In short, we urgently need to consume less. A lot less. Radically less. And we need to conserve more. A lot more. To accomplish such a radical change in behaviour would also need radical government action. But as far as this kind of change is concerned, politicians are currently part of the problem, not part of the solution, because the decisions that need to be taken to implement significant behaviour change inevitably make politicians very unpopular – as they are all too aware.

So what politicians have opted for instead is failed diplomacy. For example: The UN Framework Convention on Climate Change, whose job it has been for 20 years to ensure the stabilisation of greenhouse gases in the Earth's atmosphere: Failed. The UN Convention to Combat Desertification, whose job it's been for 20 years to stop land degrading and becoming desert: Failed. The Convention on Biological Diversity, whose job it's been for 20 years to reduce the rate of biodiversity loss: Failed. Those are only three examples of failed global initiatives. The list is a depressingly long one. And the way governments justify this level of inaction is by exploiting public opinion and scientific uncertainty. It used to be a case of, "We need to wait for science to prove climate change is happening". This is now beyond doubt. So now it's, "We need to wait for scientists to be able to tell us what the impact will be and the costs". And, "We need to wait for public opinion to get behind action". But climate models will never be free from uncertainties. And as for public opinion, politicians feel remarkably free to ignore it when it suits them – wars, bankers' bonuses and healthcare reforms, to give just three examples.

What politicians and governments say about their commitment to tackling climate change is completely different from what they are doing about it.

What about business? In 2008 a group of highly respected economists and scientists led by Pavan Sukhdev, then a senior Deutsche Bank economist, conducted an authoritative economic analysis of the value of biodiversity. Their conclusion? The cost of the business activities of the world's 3,000 largest corporations in loss or damage to nature and the environment now stands at $2.2tn per year. And rising. These costs will have to be paid for in the future. By your children and your grandchildren. To quote Sukhdev: "The rules of business urgently need to be changed, so corporations compete on the basis of innovation, resource conservation and satisfaction of multiple stakeholder demands, rather than on the basis of who is most effective in influencing government regulation, avoiding taxes and obtaining subsidies for harmful activities to maximise the return for shareholders." Do I think that will happen? No. What about us?

I confess I used to find it amusing, but I am now sick of reading in the weekend papers about some celebrity saying, "I gave up my 4×4 and now I've bought a Prius. Aren't I doing my bit for the environment?" They are not doing their bit for the environment. But it's not their fault. The fact is that they – we – are not being well informed. And that's part of the problem. We're not getting the information we need. The scale and the nature of the problem is simply not being communicated to us. And when we are advised to do something, it barely makes a dent in the problem. Here are some of the changes we've been asked to make recently, by celebrities who

like to pronounce on this sort of thing, and by governments, who should know better than to give out this kind of nonsense as 'solutions': Switch off your mobile phone charger; wee in the shower (my favourite); buy an electric car (no, don't); use two sheets of loo roll rather than three. All of these are token gestures that miss the fundamental fact that the scale and nature of the problems we face are immense, unprecedented and possibly unsolvable.

The behavioural changes that are required of us are so fundamental that no one wants to make them. What are they? We need to consume less. A lot less. Less food, less energy, less stuff. Fewer cars, electric cars, cotton T-shirts, laptops, mobile phone upgrades. Far fewer.And here it is worth pointing out that "we" refers to the people who live in the west and the north of the globe. There are currently almost 3 billion people in the world who urgently need to consume more: more water, more food, more energy. Saying "Don't have children" is utterly ridiculous. It contradicts every genetically coded piece of information we contain, and one of the most important (and fun) impulses we have. That said, the worst thing we can continue to do – globally – is have children at the current rate. If the current global rate of reproduction continues, by the end of this century there will not be 10 billion of us. According to the United Nations, Zambia's population is projected to increase by 941% by the end of this century. The population of Nigeria is projected to grow by 349% – to 730 million people.

Afghanistan by 242%.
Democratic Republic of Congo 213%.
Gambia by 242%.
Guatemala by 369%.
Iraq by 344%.
Kenya by 284%.
Liberia by 300%.
Malawi by 741%.
Mali by 408%.
Niger by 766%.
Somalia by 663%.
Uganda by 396%.
Yemen by 299%.

Even the United States' population is projected to grow by 54% by 2100, from 315 million in 2012 to 478 million. I do just want to point out that if the current global rate of reproduction

continues, by the end of this century there will not be 10 billion of us – there will be 28 billion of us.

Where does this leave us? Let's look at it like this. If we discovered tomorrow that there was an asteroid on a collision course with Earth and – because physics is a fairly simple science – we were able to calculate that it was going to hit Earth on 3 June 2072, and we knew that its impact was going to wipe out 70% of all life on Earth, governments worldwide would marshal the entire planet into unprecedented action. Every scientist, engineer, university and business would be enlisted: half to find a way of stopping it, the other half to find a way for our species to survive and rebuild if the first option proved unsuccessful. We are in almost precisely that situation now, except that there isn't a specific date and there isn't an asteroid. The problem is us. Why are we not doing more about the situation we're in – given the scale of the problem and the urgency needed – I simply cannot understand. We're spending €8bn at Cern to discover evidence of a particle called the Higgs boson, which may or may not eventually explain mass and provide a partial thumbs-up for the standard model of particle physics. And Cern's physicists are keen to tell us it is the biggest, most important experiment on Earth. It isn't. The biggest and most important experiment on Earth is the one we're all conducting, right now, on Earth itself. Only an idiot would deny that there is a limit to how many people our Earth can support. The question is, is it seven billion (our current population), 10 billion or 28 billion? I think we've already gone past it. Well past it.

Science is essentially organised scepticism. I spend my life trying to prove my work wrong or look for alternative explanations for my results. It's called the Popperian condition of falsifiability. I hope I'm wrong. But the science points to my not being wrong. We can rightly call the situation we're in an unprecedented emergency. We urgently need to do – and I mean actually *do* – something radical to avert a global catastrophe. But I don't think we will. I think we're @$*&%. I asked one of the most rational, brightest scientists I know – a scientist working in this area, a young scientist, a scientist in my lab – if there was just one thing he had to do about the situation we face, what would it be? His reply? "Teach my son how to use a gun."

This is an edited extract from Ten Billion, by Stephen Emmott