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Policy briefing

Our planet and its people

What scientists are saying about the threats to a sustainable future

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Introduction

At the end of June, many of the world's leaders[1] will be in Rio de Janeiro to attend the United Nations Conference on Sustainable Development or, as it has come to be known, Rio+20. It is called Rio+20 because it is 20 years since the United Nations Conference on Environment and Development (UNCED). UNCED was seen as humanity's last chance to address the global, and local, environmental challenges that threaten all species that share this fragile planet. Scientists then were warning that we had reached a crisis point and urgent action was required to avert catastrophe. Twenty years on, precious little has been done to reverse the trends that threaten the collapse of civilisation as we know it.

We are facing a very grave situation. Unless we take action immediately, we are heading towards what John Beddington, the UK Government's Chief Scientific Adviser, speaking in 2009, termed a 'perfect storm'.[2] This 'storm' is the result of a growing human population with ever increasing demands for food, water and energy resources in a world experiencing intensifying ecological stress and climate change.

A 'perfect storm'

According to Beddington, by 2030:

- The world's population will rise from 6bn to 8bn – a 33% rise
- Demand for food will increase by 50%
- Demand for water will increase by at least 30%
- Demand for energy will increase by 50%

If we add to this mix: growing inequalities between rich and poor, the continued loss of the Earth's biodiversity and the impacts of a changing climate, then the future looks increasingly complex.[3]

Urgency

Obviously, something needs to be done and with great urgency. In response to the challenges we face, and as a contribution to Rio+20, many of the world's leading environmental scientists met in London at the end of March 2012 to share the latest science on the state of the planet. The aims of the conference – titled Planet Under Pressure (PUP) – were to "provide a comprehensive update of … the pressure our planet is now under.… The conference will discuss solutions, at all scales, to move societies on to a sustainable pathway. It will provide scientific leadership towards the 2012 UN Rio +20 conference."[4]

Planet under pressure

The opening paper at the conference, co-authored by former Blue Planet Prize laureates,[5] and delivered by Bob Watson, Chief Scientific Adviser to the UK Department of Environment and Rural Affairs (DEFRA), 'set the scene' for PUP. The laureates state:

> The Earth's environment is changing on all scales from local to global, in large measure due to human activities. The stratospheric ozone layer has been damaged, the climate is warming at a rate faster than at any time during the last 10,000 years, biodiversity is being lost at an unprecedented rate, fisheries are in decline in most of the world's oceans, air pollution is an increasing problem in and around many major cities, large numbers of people live in water stressed or water scarce areas, and large areas of land are being degraded. Much of this environmental degradation is due to the unsustainable production and use of energy, water and food and other biological resources, and is already undermining efforts to alleviate poverty and stimulate sustainable development, and worse, the future projected changes in the environment are likely to have even more severe consequences.[6]

The laureates identify the most important threats to sustainability coming from: climate change; loss of biodiversity, ecosystems and their services; food security; water security; and human security. These issues were the focus of much attention at PUP and, as such, will be the focus of this short paper (with the exception of human security, which is not discussed in this paper).

Climate change

"First, I worry about climate change. It's the only thing that I believe has the power to fundamentally end the march of civilization as we know it, and make a lot of the other efforts that we're making irrelevant and impossible."

Bill Clinton, 2006[7]

Climate change, as one would expect, took centre stage at PUP. The Intergovernmental Panel on Climate Change (IPCC) general findings from their Fourth Assessment report (2007)[8] were reiterated:

> Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level….
>
> Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases….
>
> Other effects of regional climate change on natural and human environments are emerging, although many are difficult to discern due to adaptation and non-climatic drivers.[9]

Since the Copenhagen Climate Change Conference in 2009, the issue of climate change seems to have dropped off the environmental agenda/radar. This is largely the result of a small community of sceptics who, with corporate backing, have been relatively successful in creating a degree of public uncertainty around the issue of climate change and a loss of faith in climate science. Now, more than ever, is the time to get the public re-energised around the issue of climate change for, as the Blue Planet laureates point out:

> Emissions of GHG [greenhouse gases] are one of the greatest threats to our future prosperity. World emissions (flows) are currently around 50 billion tonnes of carbon dioxide-equivalent (CO_2e) per annum and are growing rapidly. As the terrestrial and oceanic ecosystems are unable to absorb all of the world's annual emissions, concentrations (stocks) of GHG emissions in the atmosphere have increased, to around 445ppm of CO_2e today and increasing at a rate of around 2.5ppm per year. Thus we have a flow-stock problem. Without strong action to reduce emissions, over the course of this century we would likely add at least 300 ppm CO_2e, taking concentrations to

> around 750 ppm CO_2e or higher at the end of the century or early in the next. The world's current commitments to reduce emissions are consistent with at least a 3°C rise (50-50 chance) in temperature: a temperature not seen on the planet for around 3 million years, with serious risks of 5°C rise: a temperature not seen on the planet for around 30 million years. Given there are some uncertainties present in all steps of the scientific chain (flows to stocks to temperatures to climate change and impacts), this a problem of risk management and public action on a great scale.[10]

Understanding the impacts of these 'high-end' predictions is not easy as there really is no historical precedent to go on – at least on human time scales. In order to help the public understand temperature rises that have not been experienced for millions of years the Met Office Hadley Centre has produced a map which describes some of the impacts that may occur should global average temperature rise by 4°C (7°F) above the pre-industrial climate average.[11]

The Met Office website states:

> Although the average temperature rise over the globe is 4°C (7°F) the projection on the map shows that this average rise will not be spread uniformly across the globe. The land will heat up more quickly than the sea, and high latitudes, particularly the Arctic, will have larger temperature increases. The average land temperature will be 5.5°C above pre-industrial levels.[12]

An issue that was discussed alongside climate change was that of ocean acidification.[13] Whilst climate change is worrying, ocean acidification – the ugly twin of climate change – is terrifying! Ocean acidification occurs when the sea absorbs excess CO_2 from the atmosphere. The process lowers the pH of seawater making it more acidic. The ocean has already removed about 30% of anthropogenic CO_2 over the last 250 years, decreasing pH at a rate not seen for around 60 million years.[14]

According to Doney et al: "Acidification will directly impact a wide range of marine organisms that build shells from calcium carbonate..." They add: "Acidification impacts processes so fundamental to the overall structure and function of marine ecosystems that any significant changes could have far-reaching consequences for the oceans of the future and the millions of people that depend on its food and other resources for their livelihoods."[15]

Ocean acidification is simply another good reason why humanity has to stop releasing CO_2 into the atmosphere.

Biodiversity, ecosystems and their services

"Destroying rainforest for economic gain is like burning a Renaissance painting to cook a meal."

E.O. Wilson[16]

Biodiversity was another theme that received a great deal of attention at PUP, primarily because, as the Blue Planet laureates noted, biodiversity loss is occurring at rates that have not been seen in the last 65 million years[17] – indeed, since the dinosaurs died out!

Perhaps the most definitive assessment of biodiversity is the Millennium Ecosystem Assessment,[18] the main findings of which are:

- Over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history, largely to meet rapidly growing demands for food, fresh water, timber, fiber, and fuel. This has resulted in a substantial and largely irreversible loss in the diversity of life on Earth.
- The changes that have been made to ecosystems have contributed to substantial net gains in human well-being and economic development, but these gains have been achieved at growing costs in the form of the degradation of many ecosystem services, increased risks of nonlinear changes, and the exacerbation of poverty for some groups of people. These problems, unless addressed, will substantially diminish the benefits that future generations obtain from ecosystems.

- The degradation of ecosystem services could grow significantly worse during the first half of this century and is a barrier to achieving the Millennium Development Goals.

- The challenge of reversing the degradation of ecosystems while meeting increasing demands for their services can be partially met under some scenarios that the MA has considered, but these involve significant changes in policies, institutions, and practices that are not currently under way. Many options exist to conserve or enhance specific ecosystem services in ways that reduce negative trade-offs or that provide positive synergies with other ecosystem services.[19]

The report also states that "approximately 60% (15 out of 24) of the ecosystem services" it examined "are being degraded or used unsustainably".[20] These findings suggest that the human species is undermining the ecosystem services that make life on Earth possible with, potentially, catastrophic implications. It is interesting, and a little worrying, to note (according to the Blue Planet laureates) "that for every 1°C increase in global mean surface temperature, up to 5°C, 10% of species are threatened with extinction."[21] This is clear evidence of the links between all dimensions of global environmental change. As such, it is imperative that we see the Earth system as a whole – something our mechanistic approach to scientific investigation does not facilitate.[22]

Food security[23]

"Food and nutritional security are the foundations of a decent life, a sound education and the achievement of the Millennium Development Goals"

UN Secretary-General Ban Ki-moon[24]

The question of how to feed 9 billion people by 2050 was posed at PUP. This is an important question considering demand for food is set to increase by 50% by 2050[25] and because it is estimated that 1 billion people worldwide – one in six people – are already undernourished.[26] The question of how to feed a growing population is one that many scientists are grappling with, especially seeing as:

- Farming accounts for 70% of the world's use of fresh water that is extracted globally for human use.[27]

- Agriculture is estimated to account for 10-12% of total greenhouse gas emissions.[28]

- There could be a 12-14% decline in world rice production by 2050 due to effects of climate change.[29]

- It is estimated that 12 million hectares of agricultural land is lost to land degradation each year – enough to produce up to 20 million tonnes of grain.[30]

A report by the Commission on Sustainable Agriculture and Climate Change[31] uses robust scientific evidence to identify "critical leverage points and high-priority policy actions ... to achieve food security in the face of climate change".[32] The report identifies seven essential steps to achieving food security:

1. Integrate food security and sustainable agriculture into global and national policies;

2. Significantly raise the level of global investment in sustainable agriculture and food systems in the next decade;

3. Sustainably intensify agricultural production while reducing greenhouse gas emissions and other negative environmental impacts of agriculture;

4. Target populations and sectors that are most vulnerable to climate changes and food insecurity;

5. Reshape food access and consumption patterns to ensure basic nutritional needs are met and to foster healthy and sustainable eating patterns worldwide;

6. Reduce loss and waste in food systems, targeting infrastructure, farming practices, processing, distribution and household habits; and

7. Create comprehensive, shared, integrated information systems that encompass human and ecological dimensions.[33]

In the food policy brief released at PUP,[34] it is suggested that the only way food security could be guaranteed into the future is through the adoption of what is called "a food systems approach".[35] According to the policy brief, food systems involve:

- a set of activities related to producing, processing, distributing, marketing, preparing and consuming food; and
- the outcomes of these activities contributing to food security (food availability, food access and food utilization, all stable over time) and to other socioeconomic (e.g., wealth) and environmental (e.g., greenhouse gas emissions) issues.

A food systems approach systematically connects the activities of food producers, processors, distributors, retailers and consumers involved in food systems with food security and other outcomes. This helps in a number of ways by:

1. Providing a checklist to help ensure the necessary issues are included in dialogues aimed at enhancing food security (especially in the context of other goals) and identifying the range of actors and other interested parties who should be involved.

2. Assessing the impacts of GEC [Global Environmental Changes] on food systems by focusing on multiple vulnerabilities in the context of socioeconomic stresses.

3. Determining the main limiting factors that lead to food insecurity, thereby identifying intervention points for enhancing food security.[36]

The policy brief continues:

> By systematically connecting the food system activities with the food security and other outcomes, the approach helps unravel the complexity inherent in food systems: it frames the interactions as dynamic and interdependent processes that are embedded in social, political, economic, historical and environmental contexts. Adopting a food systems approach improves understanding of the interactions between food security and environmental or other stresses, thereby clarifying decision making regarding appropriate policy options.[37]

Food security is, of course, closely linked to the issue of freshwater availability; another theme that received a great deal of attention at PUP.

Water security[38]

"During the past century, the global population has tripled, but our use of water has increased six-fold. At the same time, the quality of available water resources has been degraded through human activities, including the excessive use of agrochemicals and the release of untreated sewage and industrial wastewater."

Planet Under Pressure conference, 2012[39]

The current drought in the UK is a stark reminder that freshwater cannot be taken for granted even in parts of the world where it is tacitly assumed that there is enough water to supply demand. In this regard, it is interesting to note that, when population density is taken into account, there is actually less water per person in South East England than countries such as Morocco and Egypt.[40] This means, regardless of where we live in the world, we have to take care of this precious resource. The need to protect freshwater resources from over-exploitation and pollution was a central theme at the PUP conference especially with regard to the impacts of climate change, over-abstraction and pollution.

The Blue Planet laureates give a dire warning in their paper, stating that:

> Projections show that by 2025 over half of the world's population will live in places that are subject to severe water stress, and by 2040 demand is projected to exceed supply. This is irrespective of climate change, which will likely exacerbate the situation. Water quality is declining in many parts of the world, and 50 to 60% of wetlands have been lost. Human-induced climate change is projected to decrease water quality and availability in many arid- and semi-arid regions and increase the threats posed by floods and droughts in most parts of the world. This will have far-reaching implications, including for agriculture: 70% of all freshwater withdrawn from rivers and aquifers is currently used for irrigation. Of all irrigation water use 15 to 35% of irrigation water use already exceeds supply and is thus unsustainable.[41]

The impacts of climate change on freshwater availability water is particularly worrying. According to the IPCC:

- Observed warming over several decades has been linked to changes in the large-scale hydrological cycle such as: increasing atmospheric water vapour content; changing precipitation patterns, intensity and extremes; reduced snow cover and widespread melting of ice; and changes in soil moisture and runoff.
- Climate model simulations for the 21st century are consistent in projecting precipitation increases in high latitudes (very likely) and parts of the tropics, and decreases in some subtropical and lower mid-latitude regions (likely).
- By the middle of the 21st century, annual average river runoff and water availability are projected to increase as a result of climate change at high latitudes and in some wet tropical areas, and decrease over some dry regions at mid-latitudes and in the dry tropics.
- Increased precipitation intensity and variability are projected to increase the risks of flooding and drought in many areas.
- Water supplies stored in glaciers and snow cover are projected to decline in the course of the century, thus reducing water availability during warm and dry periods (through a seasonal shift in streamflow, an increase in the ratio of winter to annual flows, and reductions in low flows) in regions supplied by melt water from major mountain ranges, where more than one-sixth of the world's population currently live (high confidence).
- Higher water temperatures and changes in extremes, including floods and droughts, are projected to affect water quality and exacerbate many forms of water pollution – from sediments, nutrients, dissolved organic carbon, pathogens, pesticides and salt, as well as thermal pollution, with possible negative impacts on ecosystems, human health, and water system reliability and operating costs (high confidence).
- Globally, the negative impacts of future climate change on freshwater systems are expected to outweigh the benefits (high confidence).
- Changes in water quantity and quality due to climate change are expected to affect food availability, stability, access and utilisation.[42]

As the IPCC point out, the impacts of climate change are going to have profound impacts, and present huge challenges, to current water management practices. To deal with threats to water security from climate change, over-abstraction and pollution, scientists and policy makers are working together to develop new water management approaches, some of which were discussed at PUP. Importantly, the point was made that "science cannot solve the water crisis without societal engagement and political will".[43] This suggests the need for a more integrated approach to water management. With this in mind, the concept of Integrated Water Resources Management (IWRM) has been developed. According to the PUP water policy brief, IWRM is:

> ... a process that promotes the coordinated development and management of water, land and related resources in order to maximize economic and social welfare without

compromising the sustainability of ecosystems and the environment. It is internationally acknowledged as the way forward in dealing with issues of water security, and is in strong alignment with initiatives aimed at 'greening the economy'. However, IWRM will not deliver the expected results unless it is supported by strong political will, a flexible policy framework, strong institutions and an inclusive approach.[44]

Conclusion

PUP was a wake-up call to all those who had become slightly complacent about the state of the world environment. At the beginning of the conference there were stark reminders from some of the world's leading environmental scientists that we had finally entered the Anthropocene – a geological period with characteristics fundamentally defined and shaped by one species: humans.[45]

There is little doubt that the human species is undermining the biophysical systems that make life on Earth possible. Unless we change our relationship with nature, from one of violence to one of peace, then we will reach a tipping point – a point beyond which there is no turning back; a point that will signify global catastrophe. This world will be characterised by extreme food and water shortages, runaway climate change and lack of birdsong.

The irony is, the very species that is set to destroy its resource base is the same species that can create a truly sustainable future. We are both the planet's most destructive, and its most creative, species and, as such, we have a moral responsibility to use our creativity to develop new ways of living; ways of living that are not defined by an economic paradigm that makes the few richer and the masses poorer and by a system that sees economic 'growth' as the pinnacle of human endeavour and achievement. Importantly, we need economic systems and governance structures that value nature – which care for that which is not currently valued but that allows us to live, breathe and flourish.

The time for action is now; it is not too late to do something really bold to address the global environmental changes which threaten life on Earth. However, these changes are not going to occur by tweaking the political and economic systems that have created the problem; rather, we need radical transformation. As Einstein observed: "You cannot solve a problem from the same consciousness that created it. You must learn to see the world anew."

It is time for our leaders to be brave! [46] Let's hope they are up to the challenge when they get to Rio!

Notes

1 It is interesting to note that neither Barack Obama nor David Cameron are likely to attend Rio+20.

2 Video interview with John Beddington, BBC website, 19 March 2009, http://news.bbc.co.uk/1/hi/sci/tech/7952348.stm; Guardian newspaper report, 18 March 2009, http://www.guardian.co.uk/science/2009/mar/18/perfect-storm-john-beddington-energy-food-climate

3 Beddington, J, Food, energy, water and the climate: A perfect storm of global events? UK Government Office for Science, undated, http://www.bis.gov.uk/assets/goscience/docs/p/perfect-storm-paper.pdf

4 Taken from the Conference Vision page of the Planet Under Pressure website, http://www.planetunderpressure2012.net/conferencevision.asp

5 See http://www.af-info.or.jp/en/bpplaureates/index.html. For a list of Blue Planet Prize laureates go to http://www.af-info.or.jp/en/blueplanet/list.html

6 Blue Planet Prize laureates, Environment and development challenges: The imperative to act, Asahi Glass Foundation, 20 February 2012, p11, http://www.af-info.or.jp/en/bpplaureates/doc/2012jp_fp_en.pdf

7 Bill Clinton speaking at the World Economic Forum in Davos, 30 January 2006, quoted at http://www.earthchildinstitute.org/our-programs/climate-change-children

8 See http://www.ipcc.ch/publications_and_data/ar4/syr/en/contents.html

9 Intergovernmental Panel on Climate Change, Climate Change 2007: Synthesis Report, section 1, Observed changes in climate and their effects, at http://www.ipcc.ch/publications_and_data/ar4/syr/en/mains1.html and http://www.ipcc.ch/publications_and_data/ar4/syr/en/mains1-2.html

10 Blue Planet Prize laureates, Environment and development challenges: The imperative to act, Asahi Glass Foundation, 20 February 2012, p5, http://www.af-info.or.jp/en/bpplaureates/doc/2012jp_fp_en.pdf

11 To view the map go to http://www.metoffice.gov.uk/climate-change/guide/impacts/high-end/map

12 Kirsty Lewis (Principal Climate Change Consultant), Impacts of 'high end' climate change, Met Office website, http://www.metoffice.gov.uk/climate-change/guide/impacts/high-end

13 See Acid test: The global challenge of ocean acidification, a video produced by the Natural Resources Defense Council, at http://www.nrdc.org/oceans/acidification/aboutthefilm.asp

14 See Turley, C, Ocean acidification, presentation to symposium at the European Parliament, 6 March 2012, http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/pdf/Turley_Ocean_EP_event_6March2012.pdf and Turley, C, et al, Hot, sour and breathless – Ocean under stress, Plymouth Marine Laboratory, UK Ocean Acidification Research Programme, European Project on Ocean Acidification, Mediterranean Sea Acidification in a Changing Climate project, Scripps Institution of Oceanography at UC San Diego, OCEANA, 2011, http://www.pml.ac.uk/PDF/Ocean%20under%20stress.pdf

15 Doney, S, et al, Ocean acidification: The other CO2 problem, Annual Review of Marine Science, 2009.1:169-192, p184, http://www.annualreviews.org/doi/pdf/10.1146/annurev.marine.010908.163834 and http://reefresilience.org/pdf/Doney_etal_2009.pdf

16 Source: http://greenlandoceanblue.com/2009/06/14/destroying-rainforest-for-economic-gain-is-like-burning-a-renaissance-painting-to-cook-a-meal-edward-o-wilson/

17 Blue Planet Prize laureates, Environment and development challenges: The imperative to act, Asahi Glass Foundation, 20 February 2012, http://www.af-info.or.jp/en/bpplaureates/doc/2012jp_fp_en.pdf

18 See http://www.maweb.org/en/index.aspx

19 Millennium Ecosystem Assessment, Ecosystems and human wellbeing: Synthesis, 2005, p1, http://www.maweb.org/documents/document.356.aspx.pdf

20 As above.

21 Blue Planet Prize laureates, Environment and development challenges: The imperative to act, Asahi Glass Foundation, 20 February 2012, p13, http://www.af-info.or.jp/en/bpplaureates/doc/2012jp_fp_en.pdf

22 For a more comprehensive analysis of this mechanistic approach see http://www.ukcds.org.uk/publication-Envisioning_a_Truly_Sustainable_World-1491.html

23 On how to feed the world's population by 2050 watch this video produced by the Commission on Sustainable Agriculture and Climate Change: http://www.youtube.com/watch?feature=player_embedded&v=gjtll5B1zXI For more information on food security see http://www.foodsecurity.ac.uk/ See also the Rio+20 conference issues brief 9 on food security and sustainable agriculture, http://www.uncsd2012.org/rio20/index.php?page=view&type=400&nr=227&menu=45

24 Source: http://www.un.org/en/issues/food/taskforce/

25 Beddington, J, Food, energy, water and the climate: A perfect storm of global events? UK Government Office for Science, undated, p1, http://www.bis.gov.uk/assets/goscience/docs/p/perfect-storm-paper.pdf

26 See website of the UN Secretary-General's High-Level Task Force on the Global Food Security Crisis, http://www.un.org/en/issues/food/taskforce/background.shtml

27 Biotechnology and Biological Sciences Research Council, Future directions in research relating to food security, consultation document, May 2009, p7, http://www.bbsrc.ac.uk/web/FILES/Reviews/0905_food_security_consultation.pdf (source: http://www.foodsecurity.ac.uk/issue/facts.html#refs)

28 Smith, P, et al, Agriculture, in Climate Change 2007: Mitigation, contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007, p499, http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-chapter8.pdf

29 Beddington, J, et al, Achieving food security in the face of climate change: Summary for policy makers from the Commission on Sustainable Agriculture and Climate Change, CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), 2011, p17, http://ccafs.cgiar.org/sites/default/files/assets/docs/climate_food_commission-spm-nov2011.pdf (source: http://www.foodsecurity.ac.uk/issue/facts.html#refs)

30 As above, p3.

31 As above, p3.

32 As above, p9.

33 As above, pp9-11.

34 Food security for a planet under pressure, Planet Under Pressure Rio+20 Policy Brief No. 2, http://www.icsu.org/rio20/policy-briefs/FoodSecurityLowRes.pdf

35 As above, p2.

36 As above, p6.

37 As above, p6.

38 See the Rio+20 Issues Brief No. 11 – Water, http://www.uncsd2012.org/rio20/index.php?page=view&type=400&nr=231&menu=45

39 Water security for a planet under pressure, Planet Under Pressure Rio+20 Policy Brief No. 1, p3, http://www.icsu.org/rio20/policy-briefs/WaterSecurityLowRes%20-1.pdf

40 Water resources in England and Wales - current state and future pressures, Environment Agency, December 2008, p11, http://publications.environment-agency.gov.uk/PDF/GEHO1208BPAS-E-E.pdf

41 Blue Planet Prize laureates, Environment and development challenges: The imperative to act, Asahi Glass Foundation, 20 February 2012, p14, http://www.af-info.or.jp/en/bpplaureates/doc/2012jp_fp_en.pdf

42 Bates, B, et al (eds), Climate change and water, IPCC Technical Paper VI, Intergovernmental Panel on Climate Change, June 2008, p3, http://www.ipcc.ch/pdf/technical-papers/climate-change-water-en.pdf

43 Water security for a planet under pressure, Planet Under Pressure Rio+20 Policy Brief No. 1, p2, http://www.icsu.org/rio20/policy-briefs/WaterSecurityLowRes%20-1.pdf. An interesting article on how science can help address water insecurity: http://www.scidev.net/en/editorials/water-security-and-climate-change-how-science-can-help.html. An interesting podcast: http://www.thenakedscientists.com/HTML/podcasts/show/2010.02.28/

44 Water security for a planet under pressure, Planet Under Pressure Rio+20 Policy Brief No. 1, p5, http://www.icsu.org/rio20/policy-briefs/WaterSecurityLowRes%20-1.pdf

45 See 'Welcome to the Anthropocene – what now?' by Richard Black, 26 March 2012, at http://www.bbc.co.uk/news/science-environment-17513660. The term 'Anthropocene' was first coined by Nobel Laureate chemist, Paul Crutzen (see http://www.bbc.co.uk/news/science-environment-13335683). PUP organisers put together the following video to describe the Anthropocene: http://vimeo.com/39048998

46 For a new perspective on 'bravery' in an environmental context see http://bravecollaboration.tumblr.com/

About the author

Dr Michael Edwards is an environmental educator and musician who works on a variety of initiatives which aim to raise awareness of environmental issues. Michael has over 20 years experience working on global environmental change and development issues. His research on the impacts of climate change in the island states of the Southwest Pacific was referenced by the Intergovernmental Panel on Climate Change (IPCC). Michael is currently working with 'The Brave Collaboration' championing the importance of visionary thinking around sustainability and is a member of BCI - Biomimicry for Creative Innovation. He is founding founding member of Didjitalis - the 'sound of sustainability'.

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