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Planet of Boiled Frogs: Factors influencing the future environment of design education

Piers Carey: Durban University of Technology

Abstract

This paper compares selected analyses of the likely sustainability of society and the factors affecting it, including social, environmental, economic, and political. It examines the likely effects of these factors on South Africa, including possible interactions between them, cumulative effects and feedback loops. The literature increasingly suggests that these effects are likely to be extreme for the South African environment, society and economy, to say nothing of the rest of the world, within the working lives of current or near-future students, i.e. the next forty to fifty years.

Likely consequences for design education are then discussed, and possible responses in terms of adaptation or mitigation, from tertiary education as a whole, and from design education in particular. Education for resilience, sustainability, mental health under stress, adaptability, and innovation is necessary.

In focusing on graphic design, the contention is that graphic designers and educators may be required to communicate the issues, the inevitability or necessity of changes they cause, and how best to adapt to them, to South African audiences. Numerous responses have already been suggested, including sustainable design, design for sustainability, zero waste, among others, but it seems probable that these concepts will be ignored until both the mighty and the masses can change their minds: i.e. until they leap out of the warming water. Designers' roles thus expand beyond existing responses, and may be termed 'design for survival'.

The paper concludes by proposing that design for survival enter the curriculum urgently, and briefly examines two recent graphic design BTech projects at a South African university of technology as examples of student engagement with these issues. Students are increasingly motivated to engage in design for these purposes. The paper contends that awareness of and response to these factors, in the changing context of design and design education, is crucial to the future of our disciplines.

Keywords: Climate change, design for survival, bidirectional coupling, content normalisation, climate change social stress, forest bathing

Introduction

This paper examines possible effects of climate change on South African society, and how these effects may influence design education and the role of graphic designers in the next forty to fifty years. Social, environmental, economic and political factors are discussed, and comparisons are made between examples from other parts of the world and South Africa. Literature suggests that these effects are likely to be significant for the South African environment, society and economy within the working lives of current or near-future students.

Possible responses from design education in terms of adaptation or mitigation are discussed. Education for resilience, sustainability, mental health under stress, adaptability and innovation is necessary. Graphic designers and educators may be required to communicate to South African audiences the issues and effects of climate change, the inevitability or necessity of changes caused, and how best to cope. Numerous responses have been suggested, including such concepts as sustainable design, design for sustainability, zero waste, cradle to cradle, among others, but it seems probable that these concepts will be substantially ignored until both the mighty and the masses change their minds, that is. Until they leap out of the warming water. Designers' roles may then expand beyond existing functions, and may be termed 'design for survival'.

The paper concludes by recommending that environmental content and design for survival enter the curriculum urgently, and briefly discusses two recent graphic design BTech projects at a South African University of Technology as examples of increasingly self-motivated student engagement with these issues. The paper contends that awareness of and response to these factors, in the changing context of design and design education, is crucial to the future of our disciplines.

Climate change issues and interactions

A myth exists that frogs dropped into boiling water will jump out immediately, but that if they are placed in cool water that is heated slowly, they will sit there placidly until the water boils and kills them. Of course, real frogs would leap out of the water as soon as it became uncomfortable, but the story can be an apt metaphor for humanity's current behaviour.

This paper contends that although numerous individual academics and designers are concerned about the deteriorating conditions of both 'natural' and human social environments, little change has so far taken place to alter the overall global mindset away from the short term, profit-hungry, exploitative relationship between humanity and the natural world, or between the rich and powerful and the rest of the population. These relationships have been 'normalised' in most people's minds. In other words, we are the frogs in the pot, ignoring the warming water, until it is too late.

Researchers have identified numerous factors that affect the current and future viability of the human species and its society, and of the planet as a life-support mechanism (e.g. United Nations Environmental Programme (UNEP) (2012); International Panel on Climate Change (IPCC 2014); Worldwide Fund for Nature (WWF) (2018); and others). The literature on climate change is far too voluminous to survey adequately here, but in terms of the possible future context of design education, certain approaches and issues can be highlighted.

Different organisations and researchers have different emphases, naturally. Some identify quite specifically focused factors affecting the planet's near term future: the UNEP (2012) provides 21, whereas Motasharrei, Rivas and Kalnay (2014) focus on just two that nevertheless seem to cover all the bases. Others have sectoral foci: the WWF focuses primarily on the risk to living species (Grooten & Almond 2018), whereas the IPCC (2014) examines risks of climate

change and possible responses to it worldwide. The literature generally acknowledges the extent to which different factors interact, compound, cancel out or feed back into each other. Likewise, the literature agrees that the earth's climate is changing beyond possible natural variation, that this change is primarily manufactured (IPCC 2014, pp. 3) and that it may no longer be prevented completely. Researchers now examine how much change will happen, how it will affect us, and what we can do about it. Their predictions are generally dismaying, given their basis on existing climate change.

For example, the upper target limit of temperature increase of 1.5˚ C agreed as the greatest sustainable without catastrophic damage (e.g. IPCC 2018) would see one-third of the glaciers in the Himalaya melt. At current rates of temperature increase, however, they will lose two-thirds of their volume by 2100 (International Centre for Integrated Mountain Development 2019). These glaciers are a primary source of water for much of the Indian sub-continent, South-East Asia, and China, home to nearly half the global population. Wars over water supply would be a probable consequence.

Such predictions have mostly emphasised climatic and environmental consequences, without fully integrating the socio-political, economic or cultural intersections with climate and environment. Motasharrei et al. (2016, p. 470) refer to the broad interaction between people and the environment as between the 'human system' and the 'natural system", claim that "current models do not incorporate these critical feed backs," and argue that,

> [I]n order to understand the dynamics of either system, Earth System Models must be coupled with Human System Models through bidirectional couplings representing the positive, negative, and delayed feedbacks that exist in the real systems.

('Bidirectional coupling', in this context, refers to a binary relationship in which both components influence each other, either independently, as a result of the other's influence, and/or as part of a feedback loop.)

Motasharrei et al. (2016, p. 470) suggest that in most analyses, "key human system variables, such as demographics, inequality, economic growth, and migration, are not coupled with the Earth system" (Motasharrei et al. 2016, p. 470), which thus ignores the potential for humanity to exacerbate the situation even further by non-environment-related actions. Motasharrei, Rivas and Kalnay (2014) use the human relationship with the natural world as one of two factors in predicting sustainability or otherwise. The other is social inequality. Too high a level of either environmental exploitation or social inequality can cause civilisation collapse, and both together virtually guarantee it, according to their model. Inequality has been the result, if not the intention of recent economic policies, to the extent that as of 2017 three individuals "now own more wealth than the entire bottom half of the American population combined, a total of 160 million people" (Institute for Policy Studies 2017).

The Nobel Prize-winning economist, Joseph Stiglitz, critiques this situation as indicating that "something is fundamentally wrong with modern capitalism […] the system as currently constructed is neither efficient nor stable" (Stiglitz 2019). Referring to modern capitalism, he states that "the promises made by its most reductive advocates – that deregulation, privatisation and globalisation will bring wellbeing to most citizens in all countries – have proven to be horribly wrong" (Stiglitz 2019).

Examples of the dangerous effects of interactions between the human system and the natural system are not hard to find. The case of Syria's current desperate situation (Kelley, Mohtadi, Cane, Seager & Kushnir 2015) demonstrates not just potential parallels with South Africa, but also the risk of crises in one part of the world spilling over into others, as the refugee crisis in Europe demonstrates. Kelley et al. discuss the role of catastrophic drought in leading to the

Syrian uprising and civil war, noting a wide range of factors exacerbating both drought and unrest: the Middle East, as the original location of agriculture in the Western world, has had longer than elsewhere (some 12,000 years) to exhaust its environment, and one of the consequences is increased vulnerability to drought. Overuse of groundwater, encouraged by government agricultural policies, combined with lower rainfall caused by anthropogenic climate change, led to agricultural collapse and mass migration to cities. Long-term food and fuel subsidies were removed. Approximately 7% of the Syrian population moved to the cities: the equivalent for South Africa of the entire populations of the Free State and Northern Cape, or of the whole of greater Cape Town (± 4 million) moving elsewhere within two or three years. These climate refugees gathered in the Syrian version of squatter camps on the outskirts of cities, with the usual consequences of "illegal settlements, overcrowding, poor infrastructure, unemployment and crime" (Kelley et al. 2015, p. 3242), along with pre-existing factors such as "corruption and rampant inequality" (Kelley et al. 2015, p. 3242). Kelley et al. (2015, p. 3245) further claim "a statistical link between climate and conflict". While the civil war in Syria may be an indirect result of climate change, O'Connell (2019) cites Wallace-Wells' claim of the effect of temperature increase alone "for every half-degree of warming societies see between a 10% and 20% increase in the likelihood of armed conflict".

Several factors or risks appear common to Syria and South Africa. Kendon, Stratton, Tucker, Marsham, Berthou, Rowell and Senior (2019) are confident that the African climate, in general, will become both more unstable and more extreme, with more extreme temperatures, drought and flood events becoming more common, as the average temperatures rise. Some of the factors relevant in the case of Syria, and which will sound familiar to South Africans, include:

Table 1: Factors affecting the lead-up to civil war in Syria (from Kelley et al. 2015).

	Primary category	**Effect**
1	Climate	Significant decrease in rainfall as a result of climate change
2	Climate	Extreme multi-year drought
3	Environment	Decline of groundwater, due to overexploitation
4	Agriculture	Unsustainable land-use practices
5	Agriculture	Farmers thus dependent strongly on year-to-year rainfall
6	Agriculture	Leading to greater vulnerability to drought
7	Political	Liberalisation of the economy
8	Political	Policies increasing agricultural production, including land redistribution and irrigation projects
9	Social	Rapid population growth
10	Social	Burgeoning urban peripheries, leading to illegal settlements, overcrowding, poor infrastructure, unemployment, and crime
11	Social (pre-existing)	Unemployment
12	Social (pre-existing)	Corruption
13	Social (pre-existing)	Rampant inequality

Population growth led to a disproportionately greater demand for available resources than in the 1950s. Population growth, its consequences and the need to curb it, do not appear to be given sufficient prominence in the literature covered for this paper (the IPCC report only mentions the increased effects of population growth once in forty-four pages, regarding coastal systems). Virtually all the measures used to indicate global risks show a turning point around 1950 (e.g. Grooten & Almond 2018, pp. 24-25), at which time the global population was about 2.5 billion (www.infoplease.com) and as the global population took a sharp turn upwards, so did all the other measures of risk.

Syria's population increased between 1950 and 2010 from 4,5 million to 21 million in 2010, an increase of approximately 460% (dates used because Syria has since lost ± 3 million people) (www.infoplease.com). South Africa's population, by comparison, increased from about 13.5 million in 1950 to 51 million in 2010, a 375% increase (www.infoplease.com). The proportionately smaller population increase in South Africa means that resulting stresses have not been as extreme. Some areas of South Africa have gentler climates than Syria, so the whole country is less likely to be at risk at the same time. Inhabitants of Cape Town will nonetheless be familiar with the attendant risks of drought, as the city came within days of completely running out of water in 2017 (de Lille 2017).

Indirect and wider consequences of Syrian drought, agricultural collapse, uprising, and civil war include mass migration, primarily to Europe; and further indirect consequences, far from Syria itself, of an increase in xenophobia, nationalism, populism, Islamophobia, right-wing extremism, among others, in most of the countries of Europe (hate crime in the UK increased by over 200% in over the last five years [CNN, 2019]). South Africa still has a far more democratic system of government than Syria had, which is also more responsive to some of its population's concerns, but it is also susceptible to consequences of distant events. The xenophobic riots of May 2008 and xenophobic attacks both before and since show that South Africans can be as tempted as Europeans to take out their frustrations on rapidly increasing populations of immigrants (Powell 2019). As of 2017, South Africa hosted some 4 million immigrants (Tamir & Budiman 2019), approximately 7% of the population, an increase of nearly 400 % since 1990 and 200% since 2010. While xenophobic attacks are currently fewer than in 2008, a large and sudden further migrant influx could cause such attacks to recur. Were the current Ebola virus epidemic in the DRC (World Health Organization 2019) to spread internationally, or were there a multi-year drought across the Southern African region comparable to Syria's, it is not difficult to imagine the consequences.

These catastrophic consequences would be in line with Homer-Dixon's results, which emphasise the following interacting factors: 1) Environmental scarcities, 2) Resource scarcities, 3) Predatory behaviour by elites, and 4) Reduced state capacity/collapse (Homer-Dixon: 1997). Also, Motasharrei, Rivas and Kalnay's predict civilisation collapse when high inequality meets environmental strain (2014). The risk of civilisation collapse has been highlighted in other recent articles, mostly journalistic, but all based on research (e.g. Spratt & Dunlop 2019; Nuwer 2017; Kemp 2019; Cockburn 2019, O'Connell 2019).

Adaptation and mitigation: recommendations

This paper considers that it still possible for the worst consequences of climate change to be warded off. Current trends can be extrapolated, likely consequences foreseen, and corrective measures attempted. With higher temperatures, and lower and more spasmodic rainfall both in South Africa and across the region, South African society is likely to come under great stress. Table 1 lists factors likely to influence South African society and the design education sector within the lifetimes of current and future students. The more we engage with these factors in advance, the more resilience we can achieve when they occur.

In response to the overall climatic crisis, researchers and the media have made many recommendations for the mitigation and adaptation to climate change. The recommendations range from well-known to obscure, and from small-scale individual efforts to a national and global scale. The most significant, of course, would be to limit the extent of CO_2 emissions and thus the extent of global warming. Spratt and Dunlop (2019) go as far as recommending a massive global mobilisation of resources to build a 'zero-emissions industrial system' to restore a safe world climate. However, this change would also require a wholesale modification of the economic, industrial and social organisation of global society, so it is unlikely to be easily achieved. Randers (2102, pp. 13–14) recommends: 1) having fewer children, particularly the rich, because the rich consume much more than the poor: a middle-class western child consumes 10–30 times as much as an Indian child, and generates 10–30 times as much waste; 2) reducing the CO_2 footprint: smaller cars, shorter journeys, less flying, more house insulation (I'd add less long-distance food and other imports); 3) supporting strong government: not dictatorships, but effective government able to make things happen, 4) similarly to Spratt and Dunlop (2019), the rich should build and pay for "a completely clean energy infrastructure in the poor world". It is difficult to believe that this last recommendation will be taken up.

A more realistic approach for the design education sector might be to encourage students to focus on the achievable or at least comprehensible within their personal lives. Such an approach could extend as far as issues at the governmental level, where researchers' efforts might aim at communicating and influencing decision-making and execution. The IPCC report lists dozens of potential areas for vulnerability reduction, adaptation and transformation (2014, p. 31). Graphic design research projects could address many of these, including:

Table 2: Sample risks from climate change and related potential research/design areas

Risk	Response
CO_2 from fossil fuel energy continues to increase	Raise awareness, promote renewable energy sources
Increased likelihood of drought, floods, extreme weather	Information campaigns, promotion of safety, improved disaster preparedness
Risk to water supplies	Promotion of water economy
Lack of absorption of CO_2 due to deforestation	Promote and/or engage in tree planting[1]
Risk of species extinction	Promote conservation efforts
Risk to fish populations due to oceanic deterioration and increased temperatures	Promotion of improved sewage disposal, pressure for international co-operation on improvement of ocean conditions
Risks to food security, food prices, agricultural employment and income	Promotion of individual growth, vegetarianism, sustainable farming practices
Threats to urban life: heat stress, extreme weather, flooding	Campaign for improved infrastructure, housing (strength and insulation), promote civil engagement with sustainability processes
Health risks from expanded disease expanse, or extreme weather	Promote improved basic health care, clean water and sanitation, awareness of disease

[1]: Bastin et al. (2019) suggest that as many as 1,2 trillion trees could be grown across the world on 1.7 billion hectares of treeless land, without loss of existing agricultural land. They claim that tree-planting at that scale could absorb up to 200 billion tonnes of carbon over 50–100 years.

These samples of risks and responses apply globally. Increases in food and water insecurity and disease are predicted to affect Africa particularly. The South African National Climate Change Adaptation Strategy (Draft 2019) indicates the government's aims and planning intentions in this area but appears to focus heavily on a top-down process. The draft strategy refers to civil society participation in adapting to climate change in only one nine-line paragraph (2019, p. 30), although it does later admit the necessity for research into "operational strategies and approaches to adaptation" (2019, p. 34). Adaptation and survival of climate change may be more successful if 'owned' by ordinary people acting at whatever level suits their capabilities. Trust in authority, government and politicians, in general, is at an all-time low internationally, as well as in South Africa (Tamir & Budiman 2019), and it might only take a few missteps by government to turn sections of society against what are likely to be far-reaching, fundamental and possibly wrenching changes.

Likely consequences for South African design education

What will it be like to train or work as a designer in these circumstances, or to teach a discipline like graphic design? Designers can contribute to communicating and/or promoting adaptation responses such as in Table 2, and it appears that in addition to the critical, strategic, technical and research skills that designers and design educators possess, a wide range of non-discipline-specific skills will be vital, such as critical thinking, research skills, flexibility, psychological resilience, problem-solving abilities, and broad general knowledge.

All of these skills and capabilities will be useful in promoting and facilitating the sort of low-level responses (individuals and small groups) that will enable popular ownership of the adaptation process. Such responses should acknowledge and incorporate local and indigenous knowledge, combined with improved scientific understanding. However, to achieve this latter aim, communication of scientific or climate issues with the public must also be improved: much scientific literature is impenetrable to ordinary people and must be translated into everyday language before useful communication can occur. In addition, awareness needs to be raised among design students and designers of the environmental effects of their work, materials and processes, and low-impact materials and recyclables encouraged. Designers would further need to improve their own scientific knowledge, which would be significant, as design students have, stereotypically, not favoured the science subjects. All of these emphases may be termed 'design for survival', and one way or another need urgently to enter our curriculum.

Contradictorily, it will be important that this sustainability emphasis is not forced on students. A top-down, authority-driven approach may be rejected and backfire, as happened at the height of the HIV/AIDS crisis. Students had already been heavily proselytised in secondary school on the subject by the time they reached the Durban University of Technology, and felt bored and demeaned by the repetition. Because this topic runs a similar risk, it will be necessary to engage students' interest rather than simply impose it on them. The topic is also more likely to be successful if backed by a change in what the students see around them every day: at present consumption is urged upon them virtually wherever they turn, and if that continues, they may well feel that lecturers are 'do-gooding' and pay no more than lip service to the issue. Likewise, it is important that the content is normalised within major modules, rather than being presented as ‘add-on’ or elective modules that imply distance from the core of a course and thus limited value and relevance.

However, these are recommendations for actions and initiatives that designers, educators and students can take themselves, or at least attempt to communicate and promote. What seemed less emphasised in the literature found is the stress on society resulting from climate change, and how societal reactions can be kept within peaceful limits. Nuwer, following both Randers and Homer-Dixon, envisages a failure of the sort of open, tolerant society most democratic nations aim for, and its replacement with:

> [R[estrictions and even bans on immigration; multi-billion dollar walls and border-patrolling drones and troops; heightened security on who and what gets in; and more authoritarian, populist styles of governing (Nuwer 2019).

Anyone who follows the news will know that some of these unpleasant developments have begun. Therefore, an ultimate task for designers maybe how to promote and maintain open, equitable, tolerant and democratic values in both themselves and society in a world that feels turned upside down.

Design/design education: Examples

A future society engaged with adapting to and ameliorating the effects of climate change may no longer be able simultaneously to sustain the current obsession with growth and consumption. If so, the current focus of graphic design on commercial applications is likely to change. Already, when given a choice, a high proportion of BTech graphic design students at Durban University of Technology have developed non-commercial projects: of the 2019 students, only five of 28 chose primarily commercially oriented projects. The remaining projects (82%) relate to social, cultural or environmental issues, although several incorporate commercial elements were included to enhance financial viability. Historically, a far higher proportion developed commercial or purely personal projects. Of projects from 2018 and 2019, two examples demonstrate students' self-derived interests.

Project 1 promoted eco-therapy as a psychotherapeutic method through publication design. It showcased the benefits of experiencing the natural environment in treating psychological conditions such as stress, anxiety and depression, particularly for urban dwellers whose environment is rarely quiet or peaceful in South Africa. This project was an example of the indirect or less obvious benefits of the environment, and thus motivated for the preservation or restoration of the environment. The project aligned neatly with recent media reports of similar therapeutic approaches from elsewhere, including the UK, where time in the natural environment may soon be prescribed by doctors. In Japan, where the concept of 'forest bathing' (Shinrin-yoku), has become popular for the same purposes, and where evidence has demonstrated the benefits for mental well-being, along with improvements to immune system functioning, blood pressure, stress, mood, ability to focus, recovery from illness or surgery, energy levels, and sleep (www.shinrin-yoku.org).

Project 2 took a more direct and less conceptual tack, setting out to promote a long-lasting recycled plastic tote bag for shopping, using current marketing and design techniques. The intentions here are to 1) reduce the quantity of single-use plastic bags used and discarded in the research location, 2) promote recycling by the sale of a useful product made of recycled materials, and 3) in the process discourage, in a tiny way, the current damaging throwaway culture. The huge quantities of plastic now dumped in the environment constitute a major hazard to humans, as well as the natural environment. According to WWF South Africa (www.wwf.org.za/plastic.cfm), more plastic has been produced in the first 18 years of this century than in the whole of the last. By the end of 2017, an estimated total of 8300 million tonnes had been produced, at a 2015 rate of 384 million tonnes a year (Geyer, Jambeck & Law 2017), of which ±60% are discarded and are accumulating in the environment. Because of plastics' permanence in the environment, such quantities have an extremely harmful effect

worldwide, so any project that may reduce the amount used is beneficial. Likewise, the fact that some 42% of plastics are used for packaging (Geyer, Jambeck & Law 2017, p. 1) means that it is an area that graphic designers can potentially influence.

Projects such as these can have at best a minuscule effect. The projects are of short duration (the BTech course only lasts one year full-time, or two part-time) and so the research must necessarily be small-scale; the students are novice researchers; the projects are individual; and on graduation, the students must earn a living, which almost inevitably requires shelving these potentially useful projects. Nonetheless, these and other comparable projects demonstrate the scope for development of more extensive and thorough research and design projects in these areas, as well as indicating students' inherent interest in such issues.

Conclusion

This paper has indicated likely conditions in which design education in South Africa may have to function in future. The main climatic changes are predicted to be increased temperatures and probability of extreme weather events; the main societal ones increased food and water insecurity and disease incidence. Social instability is likely to increase, inciting populism and authoritarian politics. The parallels and differences between South Africa and the Syrian disaster were used for illustration. However, the literature confirms that these consequences are not inevitable and can still be avoided. The paper suggests that responses to the climate crisis will be most effective if owned by the population, rather than enforced from above. The examples of BTech graphic design projects at a South African university of technology demonstrate students' independent interest in engaging with these issues.

References

Alcamo, J & Leonard, SA (eds.) 2012, *21 Issues for the twenty-first century: result of the UNEP foresight process on emerging environmental issues,* Nairobi, Kenya, United Nations Environment Programme (UNEP).

Bastin, J, Finegold, Y, Garcia, C, Mollicone, D, Rezende, M, Routh, D, Zohner, C, Crowther, T 2019, 'The global tree restoration potential', *Science*, vol. 365, no. 6448, pp. 76-79, viewed 4 July 2019, <doi: 101126/sciences.aax0848>.

Britton, B 2018, 'Religious hate crime surges by 40% in England and Wales', viewed 2 July 2019, <https://edition.cnn.com/2018/10/16/uk/hate-crime-religious-england-wales-intl/index.html>.

de Lille, P 2017, 'Day zero: when is it, what is it, and how can we avoid it?' Cape Town: City of Cape Town, viewed 1 July 2019, <http://www. politicsweb.co.za/documents/day-zero-when-is-it-what-is-it-and-how-can-we-avoid-it>.

Diamond, J 2004, *Collapse: how societies choose to fail or succeed, New York,* Viking.

Geyer, R, Jambeck, J & Law, K 2017, 'Production, use and fate of all plastics ever made', *Science Advances*, vol. 3, no. 7, e1700782, <doi: 10,1126/sciadv.1700782, viewed 17 June 2019)

Grooten, M & Almond, R (eds.) 2018, 'Living Planet Report– 2018: aiming higher', WWF, Gland, Switzerland, viewed 18 October 2018, <https://www.worldwildlife.org/pages/living-planet-report-2018>.

Institute for Policy Studies 2017, 'Report: billionaire bonanza 2017. The Forbes 400 and the rest of us', viewed 1 July 2019, <https://ips-dc.org/report-billionaire-bonanza-2017>.

International Centre for Integrated Mountain Development (ICIMOD) 2019, 'Landmark Study: two degree temperature rise could melt half of glaciers in HKH region, destabilising Asia's rivers', viewed 7 July 2019, <www.icimod.org/?q=33860>.

International Panel on Climate Change (IPCC) 2018, 'Summary for policymakers', in *Global Warming of 1.5˚C. An IPCC report on the impacts of global warming of 1.5˚C above pre-industrial levels, and related greenhouse gas emissions pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*, Geneva, World Meteorological Organization, viewed 2 July 2019, <https://www.ipcc.ch/sr15/chapter/summary-for-policy-makers>.

International Panel on Climate Change (IPCC) 2014, 'Climate change 2014: impacts, adaptation and vulnerability. Summary for policymakers', Geneva, Switzerland, IPCC, viewed 1 July 2019, <https://www.ipcc.ch/report/ar5/wg2/>.

Kelley, C., Mohtadi, S, Cane, M, Seager, R & Kushnir, Y 2015, 'Climate change in the Fertile Crescent and implications of the recent Syrian drought', *Proceedings of the National Academy of Sciences*, vol. 112, no. 11, viewed 28 June 2019, <doi:10.1073/pnas.1421533112>.

Kemp, L. *Are We on the Road to Civilization Collapse?* London, BBC, viewed 19 February 2019, <http://www. bbc.com/future/story/20190218-are-we-on-the-road-to-civilisation-collapse>.

Kendon, E, Stratton, R, Tucker, S, Marsham, J, Berthou, S, Rowell, D, & Senior, C 2019, 'Enhanced future changes in wet and dry extremes over Africa at convection-permitting scale', *Nature Communications* (2019), vol. 10, pp. 1794, viewed 18 June 2019, <https://doi.org/10.1038/s41467-019-09776-9>.

Motasharrei S, Rivas, J, Kalnay, E , Asrar, G, Busalacchi, A , Cahalan, R, Cane, M, Colwell, R, Feng, K, Franklin, R, Hubacek, K, Miralles-Wilhelm, F, Miyoshi, T, Ruth, M, Sagdeev, R , Shirmohammadi, A, Shukla, J, Srebric, J, Yakovenko, V & Zeng, N 2016, 'Modelling sustainability: population, inequality, consumption, and bidirectional coupling of the earth and human systems', *Natural Science Review, vol.* 3, pp. 470-494, viewed 2 July 2019, <http://doi: 10.1093/nsr/nww081Z>.

Motasharrei, S, Rivas, J & Kalnay, E 2014, 'Human and nature dynamics modeling inequality and use of resources in the sustainability or collapse of societies', *Ecological Economics,* vol. 101, no. 2014, pp. 90-102, viewed 19 February 2019 <http://dx.doi.org/10.1016/j.ecolecon 2014.02.014>.

Nuwer, R 2017, *How western civilization could collapse, London,* BBC, viewed 22 February 2019, <http://www.bbc.com/future/story/20170418-how-western-civilization-could collapse>.

O'Connell, M 2019, 'The uninhabitable earth by David Wallace-Wells review - our terrifying future', viewed May/June/July 2019, <https://www.theguardian. com/books/2019/feb/27/the-uninhabitable-earth-review-david,>.

Powell, A 2019, 'Xenophobic attacks surge in South Africa ahead of elections', viewed 7 July 2019 <http://www.voanews.com/africa/xenophobic-attacks-surge-south-africa-ahead-elections>.

Randers, J 2012, 2052, 'A global forecast for the next forty years', Cambridge, University of Cambridge Programme for Sustainability Leadership, viewed 2 July 2019, <https://www.cisl.cam.ac.uk/resources/publication-pdfs/jorgen-randers-2052-a-global-forecast-for-the-next.pdf>.

Sherwood, H 2019, 'Getting back to nature: how forest bathing can make us feel better', viewed 8 June 2019, <http://www.theguardian.com/environment/2019/jun/08/forest-bathing-japanese-practice>.

Shinrin-yoku 2019, 'The medicine of being in a forest', viewed 8 June 2019, <www.shinrin-yoku.org>.

South Africa, Department of the Environment 2019, 'National Climate Change Adaptation Strategy (Draft 2019)', Pretoria, Department of the Environment, viewed 2 July 2019, <https://www.environment.gov.za/sites/default/files/gazetted_notices/draftnational_climatechange_adaptationstrategy_g42446gon644.pdf>.

Spratt, D, & Dunlop, I 2019, 'Existential climate-related security risk: a scenario approach', Melbourne, Australia: Breakthrough - National Centre for Climate Restoration, viewed 18 June 2019, < breakthroughonline.org.au/papers>.

Stiglitz, J 2019, 'Capitalism and its discontents', London, Times Literary Supplement, viewed 18 June 2019, <www.the-tls.co.uk/articles/public/capitalism-ethical-economics-joseph-stiglitz>.

Tamir, C & Budiman, A 2019, in 'South Africa racial divisions and pessimism about democracy loom over elections', Washington, DC: Pew Research Center, viewed 5 July 2019, <www.pewresearch.org/fact-tank/2019/05/03/in-south-africa-racial-divisions-and pessimism-about-democracy-loom-over-elections>.

'Total population of the world by decade', 1950-2050, viewed 5 July 2019, <https://www.infoplease. com/world/population-statistics/total-population-world

World Bank Group, 'South Africa Overview', viewed 5 July 2019, <http://www. worldbank.org/en/country/southafrica/overview>.

World Health Organization (WHO) 2019, 'Ebola virus disease', viewed 10 July 2019, <www.who.int/ebola/en>.

