Human Impacts at a Planetary Scale

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Why System Change Is Essential

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Cambridge
Scholars
Publishing

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This book first published 2022

Cambridge Scholars Publishing

Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN (10): 1-5275-8802-5
ISBN (13): 978-1-5275-8802-8

“We cannot solve our problems with the same level of thinking that created them.”
—Albert Einstein

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SYNOPSIS

We have a remarkable capacity to collaborate, building global infrastructure that connects financial, political and social systems. These same systems are directed by a dominant value system that predominantly favours economic growth. The consequence of the scale of these systems is that planetary boundaries have been exceeded in multiple directions. A laser focus on ensuring stability in financial, commercial and political markets has destabilised the life support systems that are provided by the ecosystem and atmosphere of Earth. We now face a task to transition both philosophically and technologically to lifestyles that seek to restore critical functions of natural ecosystems so that we, and other species on the planet, can survive. This is a mammoth challenge that will require changes in the jobs of hundreds of millions of people and a shift in ethics and legislation toward ecological protection and restoration. This book explores the motivations of human society, as well as our global infrastructure and legislation. When appreciated together, it is evident that globalisation and the interdependence of our lives have locked us into financial, political and technological systems that exceed the available planetary resources. The scientific evidence is overwhelming that these systems drive deadly weather events, toxic pollution, and habitat destruction to such an extent that we are witnessing mass extinction events and extraordinary poverty and inequality through exploitation of territories. Much innovation is focused today on reducing emissions and resolving inequalities, but in ways that aim to maintain the status quo lifestyle for financially richer individuals. In this collection of chapters, it becomes clear that, while we will likely need significant technological support, we cannot continue with consumer-driven habits or systems seeking principally profit. Many hopeful and innovative examples exist that could help move us to a human infrastructure that, among other options, favours collaborative networks rather than competitive markets. This leaves us hopeful that we can maintain stable ecosystems and atmospheric conditions to ensure a hospitable planet.

In this book, we aim to highlight various systems and challenges that are contributing to ecosystem and species loss. Some of the many solutions being offered are documented. The interconnectivity of all these things—we are one planet—is evident given the overlapping themes throughout the

various sections and the idea here is to collectively present some of these major challenges and systems. The ideal outcome is twofold; first, to raise awareness of how the choices we make every day contribute to, or can resolve, problems we already face. Second, we seek to encourage communities, political leaders and institutions to debate and advocate for something different; indeed, many already are. Our ultimate *raison d'etre* has to be to nurture, recover and replenish the biodiversity on Earth; in doing so, we will be united and kinder, and have purposeful, stable futures.

ACKNOWLEDGEMENTS

My background is in ecology and quantitative analysis for public health research, so I raise subjects in this book that I have only been reading about more intensely for a couple of years. My aim is to bring a multitude of areas together to try and appreciate the breadth and depth of the challenges we face today, and those to come, and to encourage more of us to question the directions in which we are headed by considering the interconnectivity of our impacts and decisions. I hope the readers of this book freely explore the totality of evidence on the specific aspects raised that I fail to include, and ask further questions that can help us adapt toward a better world for all species on Earth, including ourselves.

First and foremost, I thank my partner Tom for his patience, humility and for keeping me laughing as we explored the most depressing system-based challenges that our planet faces. I had an excellent consultant in Dr Tim Rotheray who provided a perspective from business strategy and expert knowledge particularly on energy and plastic recycling. His support has been invaluable and widened the research base for this contribution. My amazing brother read and provided great critique to help shape this book. His integrity is inspiring, and his belief in the need to communicate what we were finding gave me confidence to pursue the project. I am grateful to our child, nieces and nephews, and all the young people—our next generation—who represent the reason to fight hard for a fairer human society, return to stable ecological systems and support collective effort to value planetary health. I am indebted to Dr Silas Majambere who advised me, after initial discussions, to "just write". I am grateful for this advice, and it initiated this book. Thank you also to Drs Clara Manno and Elisa Bergami who helped educate me on plastics, and shaped my thoughts on the scientific evidence reported. I am grateful to Paul and Dan for your thoughts and conversations on pensions and investment, and the USS team for advice on their pension scheme. Thank you to Samuels Solicitors for legal advice relating to this work. Thank you also to Cambridge Scholars Publishing for taking this book forward and the excellent editorial support provided. I am grateful to the First Nations people of Australia, the Kabi Kabi people, with whom I share a place, for the stories and culture that offers us another way. Thank you also to Jess for starting the Positive Change Makers, and Spencer and his family for their commitment to conservation. You are inspiring. I

am also indebted to a UK Medical Research Council fellowship that allowed me to expand my interests and pursue this project in my spare time, and the MRC Centre for Global Infectious Disease Analysis, School of Public Health, Imperial College London. All thoughts expressed here are my own and may not reflect those of the Centre's acknowledged. Thank you to everyone raising awareness of our need to care more. Any errors are my own.

CHAPTER 1

DEPENDENCE ON ECOSYSTEM PROCESSES

With an ebb and a flow, death and her bow ride wild over land and sea
When you look, they don't fear, death drawing near as they know she is our destiny
But the cycle is cut if we burn or deplete what is made to be made and repeat
To take more than we sow is a critical blow to the cycle of life that we seek

The scientific evidence is now overwhelming that the social systems that we live within are causing climate crises across the planet. The most recent International Panel on Climate Change report (April 2022) states in the summary for policy makers, Section 3.3, that:

> "Many natural systems are near the hard limits of their natural adaptation capacity and additional systems will reach limits with increasing global warming (*high confidence*). […] Above 1.5°C global warming level, some Ecosystem-based Adaptation measures will lose their effectiveness in providing benefits to people as these ecosystems will reach hard adaptation limits (*high confidence*)."

Earth is one ecosystem that has many interconnected environments in a unique but transient balance such that the processes that enable life on Earth can be defined as a series of cycles without waste and where the actions of one feed or filter the consequences of another. This beautiful system is our greatest gift, but for too long throughout human history, the planet has been considered as a resource and exploited as such, with humans forgetting to renew or recover what is taken. This is resulting in cracks forming in the natural cycles that buffer us from catastrophic events like major storms, floods, droughts, and the huge forest fires we are beginning to experience more regularly. Within our societies, there is a perspective that human life is worth preserving beyond all other life. This is one of the reasons why corporations and industry push so hard for technological solutions to vast global challenges such as feeding 8 billion people, capturing carbon, or driving disease-transmitting insects to extinction. These are all admirable goals, but, through an understanding of ecological services, it becomes clear

that we are entirely dependent on biodiversity and the ecosystem processes that have evolved across the planet, and it is a deadly mistake to monopolise the planet for the benefit of our species alone.

The composition of atmospheric gases determines surface temperatures and planetary habitability. On Earth, our climate has remained relatively stable for at least 3.5 billion years, at least stable enough to enable life. As solar luminosity (sunlight reaching the planet) has increased, atmospheric carbon dioxide (CO_2) has decreased possibly offsetting the warming from the sun—all driven by a carbonate-silicate geochemical cycle (Kasting 1989). The progression of life on Earth evolved in complement to the conditions defined by these atmospheres. Plants and animals take up carbon as they grow and trap it when they die so that the balance of CO_2 and other gases has been maintained. Water is another fundamental atmospheric gas, but most water is in liquid or solid form on Earth. The water cycle enables all life on the planet. This system sees the evaporation of water from the oceans, lakes and seas—connecting life across the entire planet—and the subsequent precipitation of these waters as rains, hail or snow. Freshwater springs saturate terrestrial habitat and are protected by forests which in turn facilitate precipitation, filter water, and replenish springs. Mountains shape the distribution of these rains and the entire system locks in ocean currents, migration, and seasons by determining ecosystems around the planet. As an example of the necessity of these cycles, the UK, at roughly the same latitude as New York, maintains much higher temperatures because of the Gulf Stream, which circulates warm water from the equator toward the West European coasts. Without this, the climate of Europe and particularly the UK would be dramatically cooler. Over the past 3.8 billion years, water cycles have been driving our ecosystems, and we are reliant on their continuation—on their stability. Critically, altering any one of the ecosystem or atmospheric processes, by definition, alters them all as they are all part of one massive, interconnected system here on Earth.

It is clearly important to understand these systems. They have a key commonality—they are regenerative and, as such, relatively stable. The scientific effort to mathematically capture these complexities is leading to the development of Earth systems models which aim to understand the interacting forces linking atmospheric, terrestrial, oceanic and glacial systems (Bonan and Doney 2018). Earth systems models describe how climate change and atmospheric composition, reactive nitrogen, ozone, land use change, and ocean disturbance alter the interactions of the fundamental systems supporting our shared ecosystem. The models show how human-driven changes result in habitat loss, reduced availability of water, fires, air

pollution and agricultural productivity (Bonan and Doney 2018). In recognising and quantifying the consequences of the linearity in our actions, we have the opportunity to reverse these trends and recover an ecologically diverse and stable Earth. Whilst these models will always fall short of capturing the true complexity of the entire planet, appreciating these inextricable processes is the first step to figuring out how we can live within, and nurture, Earth's environments instead of exploiting them.

The way our species has been living over the most recent centuries and particularly the last 200 years or so, has been distinctly linear and non-renewing. The consequences of this linearity are now witnessed across the planet. Stresses acting on the physical, ecological and economic systems are many and complex. When I was growing up in South Wales, UK, we used to find multiple species of insects pollinating flowers in the garden, while the car windscreen would be covered in insect remains after longer journeys to visit relatives in England. As time has passed, insect numbers in the country have plummeted. More recent trips have resulted in far fewer blind spots on the windscreens. To me, the pattern is unsettling. Insects are essential for pollinating our food plants, feeding other species and enabling ecosystems. The observable loss in their abundance in my lifetime indicates a destabilising of an entire system upon which other species rely. There are many drivers behind this decline, but the buck tends to stop at our doors—intensive agriculture, overuse of pesticides and fertilisers, urbanisation and deforestation of remnant habitats all contribute to reducing biodiversity (Sánchez-Bayo and Wyckhuys 2019). The challenge is that these actions are initiated with the good intention to help improve our lives. Throughout this book we will discuss scale, one of the critical reasons for the adverse impacts our technological infrastructure inadvertently causes. The consequence of a singular focus on improving human lives is ironically introducing instability—a second key focus of the book—to the planetary systems that enable life.

Our impacts have been considered in terms of planetary boundaries—a framework identifying nine absolute physical boundaries that safeguard and drive Earth's system (Steffen, Broadgate, et al. 2015). Of these, 5 have already been exceeded, including climate change, biogeochemical flows, land system change, biosphere integrity and novel entities which include chemicals and other new types of engineered materials or organisms not previously known to the Earth system as well as naturally occurring elements (for example, heavy metals) mobilized by anthropogenic activities (Persson et al. 2022; Steffen, Broadgate, et al. 2015).

Through the chapters of this book, we will explore some of the drivers behind this exceedance in more detail and collate some of the solutions already used by progressive communities. It doesn't have to be this way and it is a somewhat reversible trend, but only if we take the challenge seriously and address it with urgency and unanimously.

Faith and Spirituality

Human cultures around the world shape societies that have traditionally operated on systems of faith, spirituality, and stories that tie communities to ethics spanning generations. In Aboriginal communities in Australia, perhaps after initial societies had hunted a few prey species to extinction, stories developed to ensure the protection of the natural world. The Great Ancestors are said to have made the rocks, waterholes, trees and boulders of Australia during the great Creation Era. Before leaving Earth, the Great Ancestors taught the Aboriginal people to live in harmony with nature and each other. These instructions became sacred Lore. Roles and responsibilities were shared and kept safe the full meaning of the landscape. Tribes adopted practices to give each person in the community an 'Ngaki'—a totem—when they were born. This totem represents a species to nurture and care for, to protect throughout a person's life. The totem may give signals of danger to the guardian and stay close throughout life. For those still living by the sacred Lore, it is forbidden for the totem's guardian to harm or eat this species. Thus, all species receive some human protection. These stories keep communities strong. The lessons passed from grandparents to children are those that bind all to the sacred ethic: to give, to not see evil, not to steal or trespass, and to share with others. The sacred Lore includes the lesson that the last thing you have you must give. Religious scriptures are similarly instructive in relation to community behaviours, ethics tending to celebrate collective care for all. Many spiritual groups around the world have had similar wisdom educating everyone on living together generously. In Western societies, and increasingly elsewhere, spiritual faith has been somewhat replaced by a commitment to the monetary system, celebrity and status, perhaps leaving us a little spiritually adrift. As we lose the spiritual stories from our past, as we live more distinctly from nature, our decisions become increasingly profit-focused. Disconnected lifestyles tend to be associated with higher emissions, themselves driving the destabilisation of ecological cycles, that increase the frequency and severity of catastrophic events. There is even a (now farcical) advert in the 1955 edition of Life Magazine advocating for the 'throwaway' lifestyle: "avoid chores, use single use plates and utensils".

The evolution of the status-based, hierarchical societies that most of us live within creates a distinctly different ethic, one of individual gain rather than mutualism. We are educated to strive for personal success in terms of grades in exams, or sporting achievement or business acumen. This adherence to a competitive system raises challenges, not least because we lose time to collectively support the communities within which we live.

The monetary system allows people around the world to literally 'buy-in' to a system ultimately based on trust. As trade expanded across the planet, the system could be credited with enabling global cooperation by facilitating worldwide trade, establishing a universal method to assess worth. However, it also establishes a system where Earth and her resources can be considered, in fact are almost defined, as commodities that can be apportioned, bought and sold to the highest bidder. In this way, capitalism and international free trade have led to the exploitation of people and the land upon which they would otherwise live in the pursuit of financial gain for individuals or companies living in complete geographical isolation from the site of destruction. Thus, the emotional attachment a person would have had for the project were it local is all but eliminated. The dominant value system of Western cultures has historically provided a standard of living for those within the benefiting communities, but ignored the ecological damage inflicted on people and territories elsewhere to facilitate such lifestyles. As examples, mining for rare minerals along the East African coast, drilling for oil in Nigeria, or levelling forest for cattle in Brazil are all constructs to enable lifestyles elsewhere, but crush local ecosystems and their people.

Free Trade, International Markets and Hierarchical Society

An argument for free trade and international markets is that these platforms connect people everywhere so that we can all access the same market and enjoy the economic benefits from this system. The well-intended ideal is that an international market levels wealth between countries and brings people out of poverty. However, generally, the data are not showing this. It is an established reality that capitalism tends to expand inequalities between the rich and poor of society (Hodgson 2015; Bowles and Gintis 2002; Shorrocks, Davies, and Lluberas 2019), though there are various strategies to address this (Ackerman and Alstott 1999) and this trend is not unique to capitalism. The World in Data demonstrates that the trends in the proportion of wealth are increasing within the top 1% whilst decreasing in the lower 50% (https://wir2018.wid.world/executive-summary.html). Estimates today

indicate that the US contributes about 24% of the global 'gross domestic product' GDP—a metric to measure economic growth—and the ten most wealthy Americans account for roughly (and this is an ever-growing estimate) USD 1.12 trillion, which supersedes the wealth of entire countries (Shorrocks, Davies, and Lluberas 2019). America has extreme inequality in household wealth as measured by the Gini coefficient; a metric that ranges from 0 to 1. A value of 0 indicates that wealth is evenly shared between all households, whereas a value of 1 would indicate all wealth to be owned by the top 1% whilst everyone else has nothing. Credit Swisse estimated the Gini coefficient of the US at 0.85 for 2019 (with a global mean of 0.73, only the Netherlands, Russia and Sweden rank higher, (Shorrocks, Davies, and Lluberas 2019)); the same data source reports that the top 1% of the wealthiest people in the US have equivalent wealth to the sum total of all those within the bottom 93%.

There are innate explanations for inequalities; inheritance of wealth leads to differences in education, economic—and legislative—power, and ultimately continuously unequal incomes (Ackerman and Alstott 1999; Atkinson 2015). However, these systems of inherited wealth are historic patterns somewhat pre-dating modern capitalism. A more direct reason for the trend may be due to the different influence that sellers or buyers can instil upon market prices. Once over a threshold, a stakeholder has more influence to strategically drive market behaviours. For example, Amazon as a delivery platform has essentially monopolised the (among others) e-books market (though its monopoly status is disputed: https://theweek.com/articles/443007/amazon-monopoly), enabling the business to effectively undercut competitors and buy up the rights to multiple products, sell these at low cost, and emerge as one of the richest global organisations. Part of the route to this wealth is the philosophies of the taxation systems of various countries. That is, taxation is a way to generate revenue for a government but also to stimulate economic activity across a country. In the US as an example, large companies can receive tax credits for the generation of jobs and innovation. These 'loopholes' within Internal Revenue enable reduced tax for businesses. The tax deductions, credits and incentives available given job creation and innovation, increase with the size of the organisation as it can offer more economic activity as it grows. Amazon gains tax credits for investing heavily in Research and Development (2017 estimates were USD 22.6 billion investment), and property and equipment (USD 60 billion in 2018) (https://www.forbes.com/sites/stephaniedenning/2019/02/22/why-amazon-pays-no-corporate-taxes/?sh=166ad19154d5). Tax deductions increase with stock increases, so Amazon benefits from offering employees stock-based compensation. Therefore, as Amazon grows, it reinvests within

itself, and, by doing so, negates its responsibility to pay corporate tax, but it is only able to do this through its strategies to undercut others competing within the same market. This is increasingly possible as it grows. From the perspective of government, it is difficult to rewrite these tax breaks as it would disincentivise companies from reinvesting in the local economies, effectively leading to job cuts. These tax loopholes also explain why there is a rising trend in private capital whilst public capital somewhat collapsed across the higher-income countries from 1970 to 2016 (https://wir2018.wid.world/executive-summary.html). However, perhaps we have an opportunity here, while trade laws impede governments from subsidising local communities and local markets (which we will explore later in Chapters 3 and 7), companies could do so instead. Indeed, they are almost encouraged toward this investment by loopholes in taxation strategies. Therefore, the commercial world can massively facilitate the transition from large emission costs associated with transportation and construction through supporting local community and local business. Having the integrity, or legislation, to then refrain from scaling to damaging levels is also needed.

In Europe, and particularly the UK, the system has been historically hierarchical; financially elite classes tend to become multigenerational as wealthy families are able to send children to attend private schools and afford tutorship for their children that are inaccessible to most of the population. These same advantages shape individuals to be successful within the cultural and business system of the country, itself disproportionately designed by those in beneficiary positions. The gap between income in the UK's wealthiest people and everyone else has increased across the past 10 years up to 2020 (Office of National Statistics: https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/incomeandwealth/bulletins/householdincomeinequalityfinancial/financialyearending2020). Metrics other than the Gini coefficient support the observed increase in inequality; the ratio of the income received by the wealthiest 20% relative to the poorest 20% is the highest that it has been since 2008. Now at 6.2, the ratio of incomes of people at the 10th and 90th percentiles of the income scale indicates a similar increase in inequality (ONS data, UK). Of course, some opportunities remain to transcend across societal classes, but the wider trend for maintenance of power in these few elite classes is stark. In fact, 2 of the recent Prime Ministers in the UK are pictured in the same school and university photographs. The Conservative Party in government for the past 10 years also has a tight hold on the media, giving it potential opportunity to mislead the people as to the reasons for inequality and injustice. This has critical impact on the lives of those with less, who are underrepresented in parliament, leading to the entirely

understandable pursuit of financial wealth as a key life goal for many. Most of us are, after all, reliant on the state to provide, among other things, food or safety, through housing and medical care, to which we have improved access through greater financial status. (This is a trend becoming increasingly evident in the UK as public services and crucially the National Health Service are systematically privatised.) The disconnect between politicians and their people is a dangerous one in which a lack of empathy leaves people unprotected and disadvantaged. This trend is not exclusive to the UK; dynasties emerge elsewhere, where the pursuit and maintenance of wealth and power are at the core. Again, this makes some sense, and the hope is that those achieving greater influence endeavour to provide justice and beneficial solutions for the rest of us. Yet when you think about which pursuits will be most beneficial financially, it is those that are scalable. In other words, if you can make a product that people become reliant on, and need to replace regularly, or one that serves many people, then you can gain wealth fast. It follows that items such as iPhones, platforms such as Netflix, even rapid diagnostic tests for infections, and delivery operations like Amazon, generate superb wealth for their executive management teams. But it is also true that those critical jobs that protect the community and nature such as nursing, social care, teaching and conservation, rely on the kindness and integrity of those with humanitarian perspectives. These are far less scalable, and generally poorly paid. Similarly, there is little support for ecological pursuits. The absence of support for these roles is problematic: in the UK, we are witnessing complete mismanagement of nature with raw sewage deposition and overuse of agricultural land—given a lack of representation of ecological or climate knowledge in the decision-making process—leaving waterways poisoned across the country. If we were all to pursue profit, all to focus on individual benefit, the system would rapidly collapse, stressing the cruciality of collaborative community roles.

Giving Habitat Value

Maximising profit (scaling our enterprise) is a key endgame in the dominant value system within which most of us live. However, this drives the negative cascades we are witnessing: extreme heat, droughts, wildfires, flooding, mass extinctions. How can we renegotiate the value of life on Earth and the ecosystems that enable it? Whatever social system evolves, it seems clear to me that we must place planetary health at the pinnacle of any hierarchy of values.

Across the past 40 years or more, ecosystem and climate researchers have attempted to put a monetary value on ecosystems, their services, and various environments to engage a capitalist system and global industrialisation in valuing and protecting that which enables life (Logsdon and Chaubey 2013). To some extent, this is working as we see increased forest cover in Europe and the USA in the past 20 years relative to 1990 levels. Increasingly, those investing in these conservation and restoration efforts are recognising the value of different habitats. Metrics are designed that can evaluate the service provided by various ecosystems that benefit human communities and quantify this to assign some monetary value. There are many services to choose from: ecosystems provide us with fresh air, freshwater, food, and fuel, regulate against erosion, and insulate against fires and flooding. Each of these services is enabled given healthy climate, water and nutrient cycling, soil formation and retention, groundwater storage, infiltration and evapotranspiration, and can be measured using feasible outputs such as water or air quality metrics (including the level of nitrate, ammonia, carbon dioxide, nitrogen or phosphorous in the environment), biomass and yield estimates, or streamflow metrics. Estimates suggest that as ecosystems decline the cost to the global economy is beyond USD 5 trillion (Kurth et al. 2021), making a strong case for environmental protection to financial investors. A recent study from China estimated that urban sprawl from 1985 to 2015 had negative consequences for ecosystem services (including sustained food production, maintenance of fresh water, forest resources and air quality, climate regulation and regulation of pests and diseases) at a value of more than USD 110 billion, advocating strongly to try to reduce the decline in ecosystem services in the future (Yuan et al. 2019).

The ecological value of land can be restored with environmentally sensitive management. The Loess Peninsula in China had degraded soils and contamination of waterways leading to poor productivity on farmland. However, since 1999, an area the size of France has been recovered and restored and is now an outstanding, productive, and fertile habitat. In 1999, the Chinese government recognised the importance of vegetation regeneration to control soil erosion and improve the ecological environment, and so funded an ecological restoration program: “Grain to Green” (Sun et al. 2015). The original project aimed to protect steep slopes from erosion by planting trees and grasses on former cropland, and, over the first few years (1999-2001), a total of 12,000 km^2 was transitioned into forest and grassland. Progress continued in 2003 with approximately 70,000 km^2 of cropland, and a further 50,000 km^2 of bare land converted to forest. This effort resulted in 27.2% of the total region having been artificially planted

or seeded by 2008 (Zhou, Van Rompaey, and Wang 2009; Sun et al. 2015). The effects have been ecologically and economically positive for local farmers. There are estimated consequential increased rainfall and levelling temperatures in the region following the increasing canopy cover (Sun et al. 2015). The project's implementation is estimated to have increased soil organic matter by more than 0.315% on average, alleviating the soil degradation (Shi and Wang 2011). Farm households reported a 2- to 9-times increase in their net income assessing people in 1998 and again in 2009, and this increase was far in advance of any expected inflation (Shi and Wang 2011). Interestingly, after the implementation of the Grain to Green project, issues arose given the rate of reduction in overall cropland, leading teams to focus on improving productivity of the agricultural system (Xiuhong Wang, Shen, and Zhang 2014). Local farming communities commonly pursued increased use of agrochemicals (fertiliser and pesticide) and agricultural energy to enhance yields, but the ensuing greenhouse gas emissions, soil and water pollution consequently increased, which negatively affected the land quality, ground and surface waters and productivity. Promoting the intensification of agriculture, whilst neglecting development and use of low-carbon agriculture, and agriculture that can be sustained in the absence of agrochemicals or with their minimal use, hinders the potential success of sustainability projects (Xiuhong Wang, Shen, and Zhang 2014). This raises an important technical challenge: how can we, at a global scale, transform high-carbon agriculture that relies on non-renewable resources—the large machinery, the fertilisers that are by-products of fossil fuels, and the worldwide shipment of products between continents—into low-carbon, renewable-resource, systems? These are those with low transportation costs, low input of agrochemicals, and those that use renewable energy to power the agricultural community. We return to this topic in Chapter 4.

An exciting project following on from the 'Grain to Green' initiative is the transformation of the Sahara Desert into forest using renewable solutions (https://inhabitat.com/sahara-forest-project/). This is transformative and perhaps one of the most hopeful solutions being attempted so far to restore ecosystem processes on Earth. The project brings saltwater inland to generate electricity from solar power more efficiently. The solar power units operate energy—and saltwater—efficient greenhouses to grow high value crops. The saltwater is then used to produce freshwater for drinking and irrigating crops. The resultant brine produced is efficiently managed. This enables regeneration of an ecosystem in the absence of competition, as the need for space for activities such as growing food crops is eliminated allowing the revegetation of deserts (that were once forest). An additional advantage is job creation for communities. The beauty of the project is the

cycling of each element to continually improve and expand the forest. It also demonstrates immense human creativity to innovate and combine the technological and nature-based solutions that have potential to restore and recover the planet. The global climate benefits from a project such as this could be huge, enhancing carbon sequestration and, eventually and potentially, the recovered ecosystem will alter rainfall in the region enough to benefit farmers previously, and currently, distressed by drought.

A Desire to Change

Somewhat reassuringly, social perception of worth also drives the market, giving communities acting collectively some power in shaping how the system evolves. Shareholder action can alter the investment direction of business and by 2020 represented one of the top three most commonly deployed sustainable investment strategies globally (DCFS analysis team 2020).

A major ethical challenge today asks how can we transition our economic system, at a pace fast enough to prevent catastrophic and irreversible change to Earth's systems, to support protective, sustainable and generous objectives?

A leading idea to refocus productivity is the circular, or doughnut, economy. Wealthier individuals are most ecologically expensive. So, a particular challenge is to convince these people that it is financially beneficial to protect ecological processes. The ideas of a circular economy are not new; they mimic what physical and natural systems have always done. But to return human activity to circular lifestyles requires us to minimise systematic wastefulness. In 2013, the Ellen MacArthur Foundation published "Towards the Circular Economy", a series of three publications focused on designing a system within which our collective impacts are minimal. The ideas included the recycling and reuse of materials, the extension of user-life length, and the recovery of constituent parts for the subsequent manufacture of goods. An equal focus was placed on regeneration of the biosphere, the use of natural systems to the benefit of agriculture and a plug for biofuels for electricity and transport. In 2015, the European Commission was introduced to the Circular Economy Package by Potocnik. The concept of a circular economy seeks to replace exploitative practices with the pursuit of restorative ones; for example, it looks to eliminate the use of fossil fuels, toxic chemicals, waste production, and replace these with renewable energy, ecological recovery and continual recycling. More recent work has brought in micro-, meso-, and macro-scales

to the definition. Here, cleaner production was advocated for at the micro-level, networks and industrial symbiosis at the meso-level and an aim of collaborative consumption and eco-cities at the macro level. Ekins et al. (2019) lay out the steps for the EU to set up environmentally sustainable economies, particularly noting the conflict between sustainable development or growth and environmental care. A critical point that Ekins et al. make is that moving to a circular economy will likely mean some economic loss along the way through the necessary investments to refine circular material flow. Capital investment now however could provide massive cost savings over the longer-term in addition to the much-needed ecological gains. As such, our valuation process must place ecological care highly, so that financial loss is not considered as a negative during transition. The environmental benefits—the extreme of which is to maintain survivable conditions on Earth—are clear and fundamental to ensure collective commitment to transition from linear to circular economies. The most important aims of a circular economy are to slow or to eliminate the depletion of natural resources, to prevent or to reduce environmental damage driven by extraction, and to reduce or to eliminate pollution emitted during manufacture, transportation, or product disposal. Within the circular economy framework, the main ideas focus on an increased efficiency to reuse or repurpose or extend product use-life lengths and, in this way reduce disposal and the need for waste management. An obvious accompaniment is minimalism. We have grown societies that expect excess, and it is luxurious lifestyles that cost Earth the most. A philosophical transition to minimalism, paralleling the move to circular economies, is critical to any recovery plan. Haas et al. demonstrated that, even with the EU's advanced recycling efforts, the region can cover only about 41% of total end-of-life waste. As a result, the authors conclude that we must downscale our overall social metabolism, with particular emphasis on industrial countries and lifestyles with excessive actions (Haas et al. 2015).

Amsterdam, the Netherlands, has pioneered the city-level ideas of a circular economy, focusing on value creation, jobs, reductions in Domestic Material Consumption and reductions in CO_2 (European Academies' Science Advisory Council 2016). The town of Peterborough, UK, has a set of 8 indicators to measure how economic, social, energy and waste sectors are transitioning (Morley, Looi, and Zhao 2018). China has established eco-industrial parks with an evaluation system to determine the environmental performance of manufacturing (Huang et al. 2019). Ekins et al. (2019), however, point out some of the challenges with developing frameworks to monitor the performance of circular economies; the first issue is that the definition of a circular economy varies, particularly between the EU and

China. A second challenge raised is the risk of moving to reusable items. These are commodities such as insect-based protein that may be picked up by people who may otherwise not have had the commodity. This is particularly problematic when equivalent, original items like beef or lamb continue to be purchased. The result is simply more produce.

Alongside shifts to circular economies we have changing investment markets. What was once considered a niche, adoption of Environmental, Social and Governance (ESG) investment strategy—the explicit inclusion of these factors into financial analyses by investment managers—is growing to such an extent that, by 2024, this type of investment is projected to account for about half of all professionally managed assets globally, and much of this shift is due to client demand (DCFS analysis team 2020). Even for non-ESG funds, there is a requirement to disclose any sustainability risks. In Europe, recent changes to the European Union Sustainable Finance Disclosure Regulation have made it an expected practice for investment managers to include sustainability risks in all investments. This means that all financial products in EU territories must conduct negative/exclusionary screening (the exclusion of companies with ties to weapons, tobacco, animal testing, human rights violations or corruption for example), ESG integration and norms-based screening (the practice of screening investment options against minimum standards of business practice on international activities such as those issued by the United Nations or Non-Governmental Organisations, for example).

Recent developments in perception of norms are impacting financial investment. The Paris Agreement became legally binding in 2016 and advocates for a goal of limiting global warming to below 2°C, ideally 1.5°C, in comparison to pre-industrial levels. Increasingly, investors and asset managers are aiming to align their portfolios with these goals, even though current commitments from states ratifying the Paris Agreement are falling short (COP26. Advance unedited version 2021). Companies looking for investment are following suit. The United Nations (UN) has set 17 Sustainable Development Goals (SDGs) to be achieved by 2030 that would ensure planetary health, and these were adopted by all member states of the UN in 2015. Investors are currently adopting the framework and business-based guidance is in development. However, scientists have recently questioned the progress of these SDGs (Bendell, Sutherland, and Little 2017; Bendell 2022; Issever Grochová and Litzman 2021), observing that:

> "The popularity of the term Sustainable Development in both national and international policy making over the past 30 years has conveyed [implications

> about worldviews, probabilities, and priorities]. Whatever the many definitions of the term offered over passing years, the ones that predominate in policy have communicated a worldview where material and technological progress is both good and inevitable; where humanity will balance social, economic and environmental issues to progress materially, and; that it is a priority to foreground corporate economic interests. […] Recent data in support of the view that the ideology of Sustainable Development is empirically contradicted by the failure to progress towards the internationally agreed goals based upon it. [Instead, the] economic system of global capitalism - esteemed and promoted by the concept of Sustainable Development - has been driving the increasing damage to the biophysical foundations of contemporary societies. […] In an era of increasing disruption, decline, crisis and disasters, it is time to split an eco-social contract from the counter-productive ideologies implicit in Sustainable Development" (Bendell 2022).

Like Ekins *et al*. (Ekins et al. 2019), these researchers consider that it is not possible to compromise on environmental efforts for economic successes in many contexts if we are to avoid existential crises. Instead, they advocate for:

> "a separation of both environmental and social objectives from economic growth" (Bendell 2022).

In parallel, the Taskforce on Climate-related Financial Disclosures' (TCFD) recommendations announced in 2017 aid companies to provide more transparency around climate-related risks and opportunities (DCFS analysis team 2020) but still remain focused on an economic pathway. Other global instruments exist that support these same goals and all are slowly redirecting financial investment toward sustainable action, though, as we will see in later chapters, this is an imperfect process and companies can game the system in various ways.

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In summary, we live on a planet that was once defined by regenerative processes ensuring relative stability in the conditions that we experience. However, we have created an economic system that is principally linear, locking us in financially, technologically, and politically to actions that exceed the safe operating systems of Earth, lifestyles that mean the wealthiest 10% of people alone are using more resources than the planet can afford. The challenge is to recognise how the major structures we have created are driving planetary damage and reconstruct our world so that these systems instead help to restore a healthy Earth. This necessitates reforming

hundreds of millions of jobs across thousands of enterprises. Persuading those enjoying disproportionate resources to transition will likely require shaping economics so that they can continue to enjoy some luxury whilst the actions taken regenerate ecosystem health. This is a giant task, and possibly one that cannot be achieved without some degrowth. As Simard's work on the cooperation between tree species has uncovered, life can go far further through empathetic collaboration than through competition (Simard 2021). In the following chapters, we will visit some of the many solutions that are already aiming to support these goals. First, Chapter 2 explores how we as a species have enjoyed different social structures and where we are currently positioned for the ecological restorative revolution that must come.

CHAPTER 2

FROM NOMADS TO SETTLED COMMUNITIES TO DIGITALISED LIFE

Study of the social transitions in human evolution may help uncover how we transition from consumer-driven to impact-neutral societies. One leading theory argues that major expansions in *Homo* species are associated with tool technologies—for example, sharp-edged utensils—because these allowed access to high quality habitat given improved capacity to defend territories from predatory species (R. Foley and Gamble 2009). The ability to control fire is considered an important development influencing 'family structures' which contributed to definable male-female roles leading to stronger partnerships. After this, the capacity to live at vastly greater densities became possible with the shrinking of glacial sheets which revealed rich ecologies, in turn offering opportunity to harvest seeds and develop cereal agriculture (Lowe et al. 2008; R. Foley and Gamble 2009). The capacity to grow, harvest, and store enough edible food crops throughout the year enabled communities to settle at larger numbers in fixed locations.

Human history documents nomadic communities, and tribes where women were equal or often the leaders (because they can give birth), living (almost) in harmony with the land. There was little evidence of war (with no land or women to dominate), and social tribes were more successful because they picked up skills from others. Technological advances in weaponry and agriculture led to males having capacity to protect livestock. Theory suggests that, while female reproduction relies on resources, male reproduction relies on females, so as males became able to control resources, the socio-environmental loop was closed, creating social structures that become more familiar to what many of us experience today (R. Foley and Gamble 2009). Abundant resources in specific locations were the subjects of key battles to determine those who would claim ownership, and subsequently power, over others reliant on these claimed resources. At this point, it is easy to see how some communities are then exploited by those who seek power through the control of a resource—an observation that

resonates with the hold of the fossil fuel industry on governments and societal energy requirements over recent history. Humans naturally organise into hierarchies (as do many animal species) and one probable driver for this is that control of resources dictates societal direction. However, rising to power simply by exploiting others and their environments is highly unstable. Many wars have been fought for the ownership of land and the more recent wars have sought ownership of commodities such as oil. When exploited communities establish movements to push back against this, those in power give just enough to prevent violent civil action, but never accede resources, and so equality remains out of reach. So, where do we now go as resources become increasingly scarce and the planetary systems become increasingly unstable? How do we proportion resources to avoid further conflict for critical commodities including food and water and how do we prevent the most powerful from claiming well-managed resources from smaller communities or those looking to nurture balance rather than take too much?

From the earliest human settlements, we have been felling trees for housing and fuel and to expose fertile land to farm. Yet it is worth remembering that the longest lasting human communities on Earth are arguably those that cause least damage to their local ecosystem, or periodically enabled damaged habitat to regenerate, those with a deep connection to, and understanding of, ecology. Aboriginal communities in Australia survived in a set of linked environments for 60,000 years through delicate knowledge and management of their habitat, the species' present, and the cycles of life. This highly empathetic, stable existence may well be the secret to the communities' longevity and was only disrupted by the arrival of European settlers. Such communities and their absorption into—and compassion for—the natural systems led to ways of life that prioritised balance, protecting and respecting resources for future generations. There is a philosophy in Aboriginal communities (that the English language translates as 'dreaming') where a community member can lie still, perhaps similarly to meditation, and communicate with Elders from generations past or those to come, sharing knowledge. As hunters and gatherers, the original communities of people in Australia had deep respect for Earth and developed strict rules of behaviours to ensure food supplies were not diminished across seasons, and that all group members had adequate resources. These rules are still fundamental to Aboriginal communities today. It is believed that violation of a totem animal will be punished by severe illness or death. Both greed and selfishness are serious crimes and severely reprimanded. There is a legend told of *The Cannibal Woman* who used to offer food and drink to messengers passing by her home. Once they

were asleep, she would set her two ferocious dogs upon them. The reason for this was her cannibalism. The people wanted to investigate the disappearance of messengers. Two men were sent along the path. They too were welcomed by the old woman and encouraged to camp at her home. They set large logs in place to look like sleeping men. Then, when the woman set her dogs upon them, the two men jumped out from hiding and speared the dogs; sure of their facts, they then speared her too [Retold from *Australia Dreaming: 40,000 years of Aboriginal History*. 1980. Editor: S Wagner. Designer: R James. Lansdowne Press, Sydney].

The wandering habits of the Aboriginal people protected ecosystems, allowing habitats to recover when left alone, while also preventing people from contracting transmissible disease; if infections were to emerge, only small family groups were likely to be affected as opportunity for transmission was minimal. The compassion for the habitat and responsibility taken for the health of non-human species may explain the longevity of Aboriginal communities. This sort of altruistic nurture is evident in forest systems too. Susan Simard uncovered that dying trees pump their nutrients into the surrounding woodland in a final act of generosity (Simard 2021). The ultimate solution to longevity may be generosity; the awareness to create stable conditions for life to come enables systems to survive for hundreds of thousands of years. Our capacity to collaborate as humans is remarkable and evidenced by the international infrastructure we enjoy today. However, the good intentions driving the establishment of these interconnected financial, political and cultural connections have also locked us into high carbon, consumer-focused, convenience lifestyles that are, inadvertently, highly destabilising to the planet. Imagine the amount of waste one creates should we throw a single bag of waste to landfill each week: an 80-year-old would have contributed 4,160 bags alone, while a planet of 7.8 billion people would produce 32.4 trillion bags in 80 years. We explore the challenges of waste in Chapter 5. How can we engage the millions of organisations involved in these human-constructed systems to simultaneously transition to alternative paths that align to minimise damaging emissions? This must happen.

Human societies have tended to compartmentalise habitats into cities, farmland, and more recently industrial zones, business centres or shopping malls. The establishment of settlements and the organisation of jobs into those resourcing provisions for the community, and those engaged in other roles, has somewhat decoupled our connectivity to the essential support provided by our ecosystems. As the proportion of people active in roles that are disassociated with resource provision or nurture increases, society may