Chapter 5
The Circular Economy: A Critique of the Concept

Keith R. Skene

5.1 Introduction

The circular economy is an increasingly influential school of sustainable economic thinking, dominating recent five-year plans in Chinese policy while increasingly featuring in the sustainability policies of the European Union. It is a contested concept, with questions surrounding its theoretical and practical feasibility (Korhonen et al., 2018; Skene, 2018; Millar et al., 2019). Furthermore, recent developments in Eastern and Western interpretations and applications differ significantly, which leads to confusion in terms of any global conversation and delivering a sustainable transition that is urgently needed. Furthermore, questions about whether it should be a global development or a myriad of small, local circles are being asked (Prendeville et al., 2017; Real et al., 2020). Currently, the global economy is only 9% circular (with Europe 12% and China 2%), and the linear model is still systemically "baked in" (Circle Economy, 2019).

Over 100 different definitions of the circular economy were identified in a review by Kirchherr et al. (2017). In this chapter, we adopt the definition of Murray et al. (2017), which defines the circular economy as "an economic model wherein planning, resourcing, procurement, production and reprocessing are designed and managed, as both process and output, to maximize ecosystem functioning and human well-being."

We begin by contextualizing the circular economy through its historical development, since the history of a concept often tells us as much about it as does the concept itself. We then compare and contrast the two dominant geopolitical versions of the circular economy, the Chinese and Western models, identifying differences and

K. R. Skene (✉)
Biosphere Research Institute, Letham, Angus, Scotland, UK
e-mail: krskene@biosri.org

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issues in underlying principles. In order to explore the current and future prospects for the circular economy, we explore the Earth system, on which, ultimately, our species relies upon. By teasing apart its functionality, two levels of organization emerge: local and global. The chapter ends with exploring what this means for any concept of sustainable economics and concludes by identifying the essential critical characteristics of such a concept.

5.2 Origins and Context

Desrochers (2002, 2008) pointed out that concepts such as re-use, recycling, and resource and habitat management have played important roles throughout the history of manufacturing. The circular economy was a recognized concept in meaning if not in name two millennia in the past. Back then, rather than environmental damage, resource scarcity drove the pursuit of reducing, re-using, and recycling resources (the 3R concept).

Such approaches also reflected a much more localist approach in terms of short supply chains. Short supply chains bring with them responsibility, accountability, and transparency. If you chop the local apple tree down for wood, there will be no more apples. Thus, Hardin's (1968) tragedy of the commons is rarely, if ever, seen where short supply chains exist and where a functional society operates, which is particularly relevant to First Nations people. For example, the Ogiek people of the Mao forests in Kenya need agreement from the council of elders before cutting down even one tree (Skene, 2019), which has been lost as we externalize our supply chains, which disappear across the horizons to distant lands, where the true impact is not felt by the consumer halfway around the world.

Figure 5.1 lays out the conceptual development of the circular economy in terms of its more recent, post-linear economy evolution. Many of the major schools of sustainable economics share much in common. The circular economy is merely a re-expression of concepts that have been around for many years. What is of more interest is how it is interpreted in different nations and trading blocs. We will take two examples, China and the European Union.

5.3 The Circular Economy in China

Given that the population of China represents around 19% of the global population and given its important position in trade and raw material supply, particularly in terms of the rare earth metal and graphite, the economic practices of China are of vital interest to the rest of the globe.

The history of the adaptation of the circular economy as a central theme in policy in China dates back to 1973, when the first National Environmental Protection Conference formulated environmental protection policies and guidelines (Zhang &

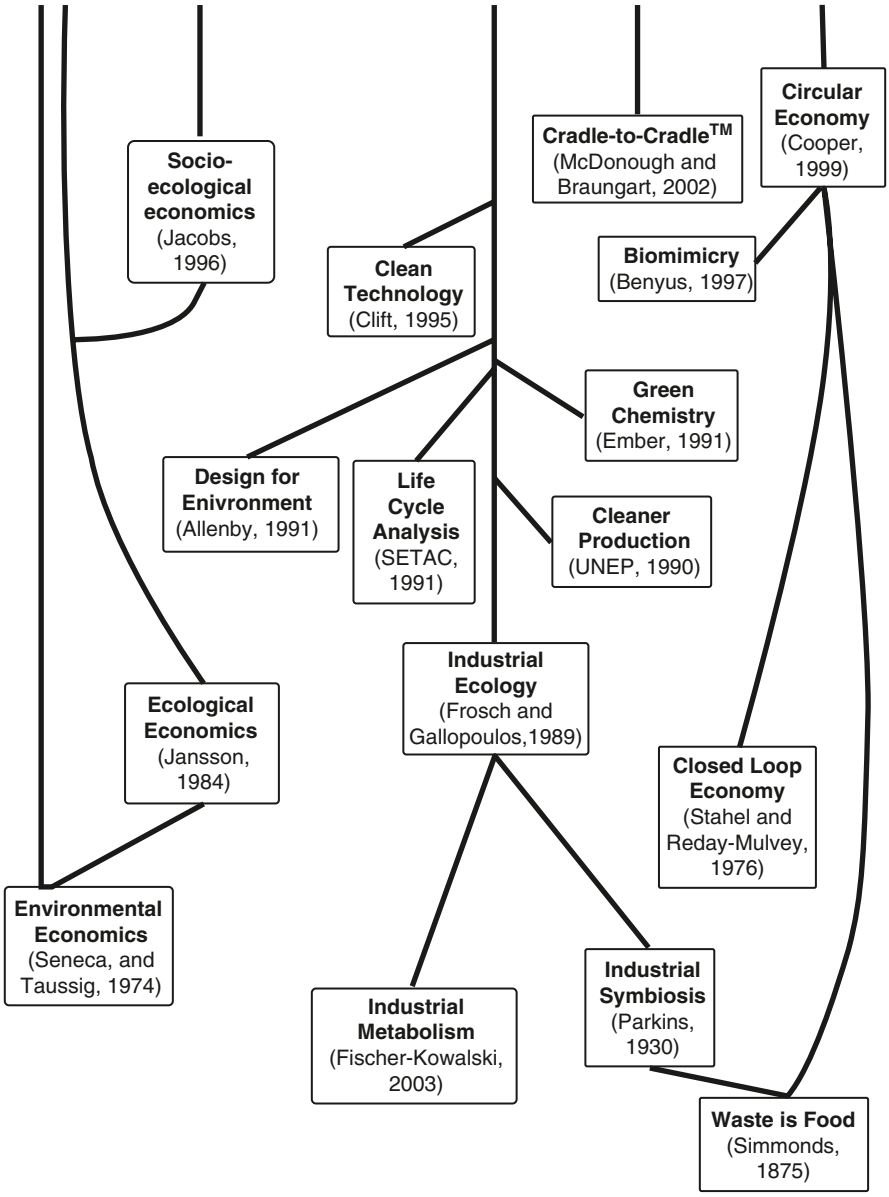

Fig. 5.1 A chronological map of the inter-relatedness of sustainability concepts, tracing the emergence of current schools. The references record the early appearance of each concept. Skene and Murray (2017) developed it

Wen, 2008). In 1983, the second National Environmental Protection Conference was held, making environmental protection a core national policy. In 1989, the Environmental Protection Law of the People's Republic of China was enacted.

In 2002, the 16th National Congress of the Communist Party of China set out an ambitious development plan involving social equality, the recovery and protection of the environment's integrity, and quadrupling of GDP, which was called a circular economy underpinned by a cleaner production strategy. The circular economy is defined in legislation as a generic term for reducing, reusing, and recycling activities conducted in production, circulation, and consumption. Interestingly, these three goals embrace the three pillars of sustainability: economics, society, and the environment. Thus, the Chinese model formally attempted to address all three pillars of sustainability, unlike most other schools of sustainability at the time. Three new laws were introduced to move the agenda forward:

- The Cleaner Production Promotion Law (passed on June 29, 2002, and put into effect on January 1, 2003)
- The Law of the People's Republic of China on Appraising Environmental Impacts (passed on October 28, 2002, and put into effect on September 1, 2003)
- The Law on Pollution Prevention and Control of Solid Waste (April 2005)

Planning for societal development in China targeted realizing a healthy, equitable, and functional society by the year 2020. These laws appear to be the first in the world to make the circular economy a national economic and social development strategy. The Ministry of Environmental Protection initiated eco-industrial parks (EIPs) as early as 2002, releasing an EIP standard. Currently, 50 such parks exist.

Guiyang was chosen as the pilot city for implementing a circular economy. In 2004, the Guiyang Circular Economy Development Plan focused on six sectors: coal, phosphorus, aluminum, herbal medicine, tourism, and organic agriculture. The People's Republic of China Law on Renewable Energy was enacted in January 2006, marking an important step in terms of sustainable energy production, which was followed by the Energy Conservation Law of the People's Republic of China, enacted in January 2008.

5.4 Five-Year Plans

The five-year plans, focusing on social and economic development, lie at the heart of policy in China. In 1953, under Mao Zedong, they were inspired by the Soviet economic and industrial development model.

5.4.1 11th Five-Year Plan (2006–2010)

Incorporating a circular economy into the Outline of the 11th Five-Year Plan for National Economic and Social Development meant increased support and focused on sustainability (Wu et al., 2014). The plan was based on the 3-2-1 model (Tan, 2008), which refers to three industrial systems (the eco-industrial system, the

eco-agricultural system, and the eco-service system), two domains (production and consumption), and one industrial chain of renewable resources. The Law for the Promotion of the Circular Economy, which came into effect on January 1, 2009, promoted resource utilization efficiency, natural environment protection, and sustainable development. It operated at three levels: individual firms (focused on eco-design and cleaner production), eco-industrial parks (utilizing the waste-is-food concept), and the eco-city and eco-province level (creating a recycling society).

Key objectives were:

- Close monitoring of energy consumption and pollution emissions in heavy industries by government
- Promotion of recycling, energy efficiency, and waste-reutilization standards by government departments and policy development to diversify capital into environment-friendly industries
- Introduction of water-saving technologies in new buildings and projects
- Switch from oil-fired fuel generators and boilers to alternative green energy fuels in power generation, steel, and iron production plants
- Adoption of renewable technologies, such as solar and geothermal approaches, to be used by enterprises and government departments in new buildings
- Recycling and re-use of coal ash, coal mine waste, and other waste materials
- Recycling straw, livestock waste, and farming by-products to produce methane

As of 2011, tax incentives were expanded, including variable rates of VAT on specific products. Construction materials made from construction waste became VAT-exempt, recycled graphite now could claim a 50% VAT refund, and, more eclectically, wigs made from human hair would now earn an 80% VAT refund (Skene & Murray, 2017).

5.4.2 12th Five-Year Plan (2011–2015)

China's 12th Five-Year Plan dedicated enormous resources (around US$ 470 billion) towards the implementation of a circular economy. In the 12th Five-Year Plan (2011–2015), Chap. 22 is dedicated to the circular economy (Mathews & Tan, 2016). Policy shifted from resource efficiency of heavy industries to remanufacturing and recycling metals and minerals, focusing upon the exchange of materials between companies (Preston, 2012). The development of the internet-of-things to track the resource history of products was implemented, as was research into a green economic growth strategy.

5.4.3 13th Five-Year Plan (2016–2020)

In the 43rd Chapter of the 13th Five-Year Plan (2016–2020), the importance of CE both as a national policy and as a fundamental pillar of the Chinese economy is clearly stated (Central Committee of the Communist Part of China, 2016, p. 219). It was recognized that a market-based approach could encourage Chinese businesses to pursue a more sustainable path, rather than using incentives such as tax rebates, which did not always provide the expected outcomes (Zhang, 2013).

5.4.4 14th Five-Year Plan (2021–2026)

In the most recent Five-Year Plan, the Chinese government has set out its so-called Dual Circulation Strategy (DCS) to boost domestic spending. The main idea behind this strategy is to strengthen China's vast domestic market (domestic circulation) while balancing its foreign trade (external circulation). This significant policy changed from an economy previously focused on export-oriented development since the launch of Deng Xiaoping's reforming policies of 1978.

The DCS represents a new development pattern where domestic and foreign markets can boost each other, with the domestic market as the mainstay. Supply chain issues now take the central stage in terms of sources and sinks. By localizing, there is less uncertainty and less externalization. The "dual-circulation" strategy avoids asynchrony between cycles and feedback loops and government policies by applying flexible, adaptive, institutional, and structural approaches.

China's 14th Five-Year Plan sets technological autonomy as one of the country's top priorities and signals a shift from pure economic growth to social and climate-friendly development. It is hoped that a new urbanization strategy, more equal distribution of public goods, and increased investment in environmental technologies will deliver new sources for sustainable growth by improving economic efficiency and by increasing domestic demand (Yang, 2020). It is also envisioned that an increasingly inward, domestic focus of the DCS will protect China in extreme scenarios (such as global pandemics) while reducing China's vulnerability in trade war scenarios (such as with the Trump administration). It is not only the market that is shifting internally. Made in China 2025 (MIC25) aims to achieve independence from foreign suppliers (Liu, 2016), essential in domestic cycling and supply chain integrity.

China has developed a system of indicators to provide feedback on progress in the circular economy, based around resource output, resource consumption, integrated resource utilization, and waste disposal/pollution emission (Geng et al., 2012). Macro-level indicators are used to analyze progress at the national and regional levels, guiding development and planning, while meso-level indicators operate at the eco-industrial park level. Eco-city indicators cover such aspects as

local ecosystem value, greening land rate, and biodiversity. Finally, CO_2 indicators provide feedback on climate mitigation policies.

5.5 Issues with the Dual Circulation Strategy

Some issues arise from the DCS. The re-orientation of the economy towards a domestic market creates many challenges. For Chinese consumption to be equivalent to that of other developing economies, ordinary households would need to recover at least 10–15 percentage points of GDP at the expense of businesses, the wealthy, or the government (Pettis, 2020), which would require a massive shift of wealth and power to ordinary people. The success of China's international circulation has been built on low material and labor costs. An interesting point to note here is that with advancing robotic manufacturing, the cost of production, in terms of labor, will soon decrease as a consequence of the loss of the human workforce, which is seen to impact the manufacturing geography, making it cheaper to bring manufacturing back to Europe and the USA as transport costs would now dominate over labor costs (Skene, 2019). Thus, a decreased reliance on international markets may well become a necessity anyhow.

The aim of zero net carbon by 2060 becomes more problematic when viewed alongside the DCS, as domestic economic growth will pose considerable challenges in terms of the green growth strategy as initially outlined in the 12th Five-Year Plan. Furthermore, fundamental issues related to the core nature of manufacturing in China revolve around a coal-based energy sector, a heavy chemical industry-centered industrial structure, and a heavily road-based transportation structure. Li et al. (2020) point to the challenges of urban-rural development, whereby the desire is to move more of the population into cities, raising energy intensity and green agriculture issues.

Economic growth coinciding with absolute reductions in resource use and emissions is called "absolute decoupling," while economic growth increasing less than resource use and emissions is referred to as "relative decoupling" (Skene & Murray, 2017). Whether green growth is possible through either absolute or relative decoupling is highly questionable (Albert, 2020; Hickel & Kallis, 2020). Haberl et al. (2020), having assessed over 800 studies, reported that few delivered absolute decoupling. Ward et al. (2016) report that there is little evidence that GDP growth can be decoupled in the long term.

5.6 The European Approach

While China has led the way in adopting a circular economy, Europe had been initially world leaders, with eco-industrial parks such as Kalundborg in Denmark established in the early 1970s and Germany's recycling laws providing essential

inspiration in China. However, more recently, the EU has fallen behind in terms of national policy, which is understandable, as the EU comprises 27 nations, with qualified majority voting, but, for several key issues, unanimity is required. These nations pursue quite different political and economic agendas while often coming from very different historical contexts. There are significant differences between individual nations within the EU, both in industrial profile and pollution production. Some nations are fundamentally agrarian, others industrial, while yet others are firmly in the Information Age. Poverty levels vary widely. Previous heterogeneity is a big challenge for the EU, as exemplified by the difficulties in approving the EU budget for 2021–2027 and the membership of North Macedonia.

The origins of a circular economy strategy in Europe can be traced back to 1972. With global environmental awareness growing, the European Commission chairperson, Sicco Mansholt, stated that new economic thinking was needed to prevent resource waste, increase product lifetimes, and reduce resource use per capita (Vonkeman, 1996). As early as 1975, a European Communities Council directive emphasized taking "appropriate steps to encourage the prevention, recycling and processing of waste, the extraction of raw materials and possibly energy from that place and any other process for the re-use of waste" (European Communities, 1975, p. 40). Since the 1970s, the approach of the EU has been criticized as resembling an incremental policy layering of closed-loop thinking rather than some form of paradigm-shifting transformative thinking (Fitch-Roy et al., 2020).

Finally, on December 17, 2012, the EU released the following statement: "In a world with growing pressures on resources and the environment, the EU has no choice but to go for the transition to a resource-efficient and ultimately regenerative circular economy" (EU, 2012).

They identified six action points (EU, 2012):

1. Encouraging innovation and accelerating public and private investment in resource-efficient technologies, systems, and skills, also in SMEs, through a dynamic and predictable political, economic and regulatory framework, a supportive financial system and sustainable growth-enhancing resource-efficient priorities in public expenditure and procurement.
2. Implementing, using, and adopting intelligent regulations, standards, and codes of conduct that (a) create a level playing field, (b) reward front-runners, (c) accelerate the transition, and (d) consider the social and international implications of our actions.
3. Abolishing environmentally harmful subsidies and tax breaks that waste public money on ancient practices. Also, taking care to address affordability for people whose incomes are hardest-pressed—shifting the tax burden away from jobs to encourage resource-efficiency and using taxes and charges to stimulate innovation and development of a job-rich, socially cohesive, resource-efficient climate-resilient economy.
4. Creating better market conditions for products and services that have lower impacts across their life cycles and are durable, repairable, and recyclable. Also, progressively taking the worst-performing products off the market; inspiring

sustainable lifestyles by informing and incentivizing consumers, using the latest insights into behavioral economics and information technology, and encouraging sustainable sourcing, new business models, and the use of waste as raw materials.
5. Integrating current and future resource scarcities and vulnerabilities more coherently into broader policy areas, at national, European, and global levels, such as in the fields of transport, food, water, and construction.
6. Providing clear signals to all economic actors by adopting policy goals to achieve a resource-efficient economy and society by 2020, setting targets that give a clear direction and indicators to measure progress relating to the use of land, material, water, and greenhouse gas emissions, as well as biodiversity. Such indicators must go beyond conventional economic activity measures, help guide all actors' decisions, and assist public authorities in timely action. All organizations above a meaningful size and impact must be held accountable to measure and report critical non-financial progress indicators on a comparable basis.

By 2015, the circular economy had become a foundational concept in Europe, exemplified by the report "Closing the Loop – an EU Action Plan for the Circular Economy" (European Commission, 2015), and is now recognized by the European Union (EU) as an "irreversible, global megatrend" (COM, 2019a, p10). It is a critical component of the European Green Deal and the Von der Leyen Commission (2019–present) (European Commission, 2020). Hill (2015) provides an excellent review of the emergence of circular economic concepts within the European Union.

The EU views the circular economy as an economic tool, primarily. The idea of green growth and the decoupling of economic growth from environmental degradation pervade, which is quite a reversal from the environmental Kuznets curve that underpins much of sustainable development thinking and espouses that economic growth will deliver environmental sustainability and economic equity over time (see Stern, 2004). However, in terms of economic growth delivering social justice, the Kuznets curve is acknowledged when the Council of members writes, "member states will work towards ensuring inclusive and sustainable growth in the EU, a necessary condition to reduce inequality" (COM, 2019b, p.96). Thus, there is a tension here. As Friant et al. (2021) observe: "By focusing on growth and competitiveness rather than human well-being and ecosystem health, the EU might be creating new business opportunities from some while doing little towards addressing the core socio-ecological challenges of the 21st century."

The EU has also set out a straightforward program for auditing pollution costs, a key externality related to market failure, as identified early in the twentieth century by Pigou (1920). To do this, they set up ExternE, which concentrates on damage from energy and transport sectors upon the environment. Such audits are essential if a circular economy is to be assessed and implemented in Europe and based on material flow accounting (MFA) (Bringezu, 2001). The European Environment Agency's reports include assessments of policy progress and analysis of crucial material flow trends.

In 2013, the European Union (EU) Environment Commissioner, Janez Potocnik, set out a parallel path with China, undoubtedly with the hope of encouraging trading relations with China through a shared sustainability approach: "When I look to China's 12th five-year plan and compare it with the EU's political documents, I see many similarities ... It is an excellent basis for cooperation" (Potocnik, 2013); however, apparent differences exist between the approaches in Europe and China. While China set out its principles to guide government and in order to communicate the rationale and implementation of their program to its citizens as ipsum factum, setting up new EIP projects continuously and funding from central funds, Europe relies much more on the private sector, which they must convince of the merit of such a thing.

The private sector is predominately profit-driven. Hence, the emphasis on the financial benefits of the circular economy lies at the heart of European approaches. Western governments are also elected, and so attractive political references relating to jobs, living standards, and the environment playing well on national and European stages. Europe also faces the difficulty of significant differences between its member states. One joint facet between Europe and China is the dependency on external sources for much of their material and energy needs. However, China's new DCS points to a separation of pathways here also.

5.7 Indigenous Economics

While the Western economic model, founded on neo-liberalism, globalization, and a production/service dichotomy (where developing nations produce goods while developed nations buy and service these products), dominates global trade, a very different approach also exists, modeled on localism, post-development, and indigenous thinking. Here, many of the circular economy principles have been practiced for millennia, explaining why such approaches have underpinned the long-term survival of ancient people in even the harshest of landscapes. Indeed, many indigenous civilizations today are primarily limited to the regions of the planet that are not inhabited by industrialized populations, such as tundra, semi-arid plains, and high-altitude environments. The Ogiek people of the Mau forests in Kenya have, for centuries, embraced most of the principles of the sustainable development goals, with the exceptions of goals 8 (Economic Growth), 9 (Industry, Innovation, and Infrastructure), and 11 (Sustainable cities) (Njeru, 2018; Skene, 2020).

However, the foundations of these essential practices have not emerged from economic theory, nor is the emphasis on green growth and development targets. Instead, these principles emerge from a holistic approach, wherein humans are bound within their social and environmental contexts. The 'more-than-human relational self' lies at the heart of this (Gould et al., 2019), wherein society recognizes the Earth system as the unit of sustainability, with all players as components of that system, contributing to its resilience and functionality.

Many argue that unless we recognize the Earth system as the alpha and omega of our existence, within which we find our evolutionary, ecological, social, economic, and individual context and meaning, we cannot possibly hope for a sustainable future. While the Earth system will continue with or without us until the Sun eventually expands and consumes it, we, as all species before us, face extinction at some point or another. How we interact with the Earth system is critical. Economics governs the intensiveness of our exploitation of the Earth's resources, the flow of energy through ecosystems (due to fertilizer application), and the sink issues in terms of waste. Therefore, contextualizing our economic activity within the Earth system in such a way as to reduce our footprint to an appropriate size must surely be the priority.

In many ways, the Chinese policy of DCS can be seen to embrace the benefits of this localized indigenous approach. By developing the domestic economy, China hopes to be less impacted by issues elsewhere on the planet, whether political or pandemic. Ironically, the Trump administration also emphasized a version of this, in terms of nationalism first, internationalism second, creating one of the issues that encouraged the development of the DCS in China, where self-sufficiency and domestic production and consumption can shield from shocks while raising living standards within the nation through increased employment.

However, problems arise in terms of how to implement the profound changes needed. In a low-wage structure such as China, increased spending power requiring increased wages, increased wages requiring increased business profitability, and increased profitability requiring increased consumer spending all lead to a very different form of circular economics. Meanwhile, production at home costs much more in any given Western nation than production in a developing nation, requiring a sharp increase in prices and further wage increases simultaneously, thus driving up inflation. You can make your cake and eat it, but you have to pay a lot more for it. Fundamentally, globalized economics still dominates, and our supply chains are deeply embedded within this approach. Thus, any attempt to change direction brings with it enormous challenges. However, more significant challenges exist regarding the environmental crisis, impacting such necessities as food production, water supplies, climate, and health. The planetary card trumps any economic card, and therefore, we must shape our economies to support the Earth system if we are to continue as a species.

5.8 The Earth System

In terms of the local/global balance, we can learn much from the Earth system. Firstly, the business of the planet is partitioned into biomes, determined by temperature and precipitation. The main biomes, moving from the equator towards either pole, are tropical rain forest, tropical dry forest, tropical savanna, desert, temperate grassland, temperate woodland and shrubland, temperate forest, boreal forest, and tundra. Each has evolved, with species adapted to the conditions and natural

economies matched to these conditions. These biomes, differing in soils, topography, and climate, have shaped the ecology and evolution of life within them. A tropical rainforest functions entirely differently from an area of tundra, and a desert consists of very different organisms than a temperate rainforest. For millennia, human cultures have also differed across these landscapes, adapting to the local conditions and resonating with the functioning of these landscapes.

5.9 Local and Global Realities

Indigenous people living in these biomes, whether the Ogiek in the tropical dry forests, the Sami in the boreal and tundra, or the Masai in the savanna, each have economies and cultures adapted to their ecological environment settings. While trade between tribes from different biomes does occur (e.g., honey and milk traded between the Ogiek and Masai (Njeru, 2018)), for the most part, these tribes have localized economies. Supply chains are short and immediate, while accountability is high. Cutting down a fruit tree for fuel is a strategy of doubtful value and would immediately affect the local community.

Thus, the idea of local solutions for local communities is an ancient and emergent concept within the Earth system. Furthermore, a rainforest does not strive to convert a desert or a savanna into a rainforest. Each biome functions in the most appropriate way relative to the biogeochemical context within which it finds itself. In other words, the concept of development is not found within the Earth system. However, global issues exist in atmospheric gas levels, ocean and air circulation (such as El Niño and El Niña), and long-term glacial (Milankovitch) cycles, driven by changes in the Earth's tilt and orbit around the Sun. These impact upon most if not all parts of the planet. Indigenous human populations have both globalized and local identities. Thus, we would suggest that a sustainable future requires some balance, but to identify this, we need to reflect on the origins of global issues within the Earth system.

In ecology, localism is easily accounted for, reflecting the tight relationship between any given organism and the biome level differences in climate, biogeochemistry, and topography. However, global issues, such as the albedo effect, ocean, and atmospheric circulation, tectonic plate movements, atmospheric chemistry, and long-term cycles in solar radiation (leading to intermittent ice ages), impact the planet. Anthropogenic impacts can affect both local and global ecology. Global patterns, particularly across human cultures, are emergent yet shared across the world, be it the Inuit and Sami of the Arctic, the Pila Nguru of the deserts of Western Australia, or the Pumé people of the Venezuelan savanna. Common themes include equitable societies based on indigenous communalism and the gift economy, where resources are shared. Furthermore, activity (economics) is firmly rooted within societal and environmental contexts. The tragedy of the commons (Hardin, 1968) is not an issue here because accountability is a survival skill, not an option.

It has been proposed that the study of local, place-based socio-ecological research allows an insight into the interplay between global and local scales (Norström et al., 2017). Transformations towards sustainability are often triggered at the local scale. It has been suggested that regions may form a helpful go-between, connecting the local with the global (Paasi, 2003; Jonas, 2012). Resilience stems from local biocultural diversity, where indigenous knowledge plays a vital role in resonance with landscape (Ruiz-Mallén & Corbera, 2013). Resilience is a system-level property that cannot be built or constructed but emerges in a functioning ecosystem. However, with 7.5 billion people currently on the planet, dematerializing and localizing the supply chains, reducing waste to appropriate levels, economic degrowth, and environmental revitalization pose untrivial challenges. Fundamental to all of this is accountability, wherein our decision-making is well informed in terms of its environmental and social consequences. By thinking global and acting local, we do not merely focus on our spatial localities but instead consider all of the planet as our locality while preventing environmental and social damage wherever our supply chains lead.

Shortening supply chains bring transparency, accountability, and awareness. It also brings resilience, resistance, and security against the winds that blow elsewhere. Circularity is much easier if you can see the perimeter of the circle. Global supply chains disappear into the mist and are anything but transparent. An example would be the horrific child labor in the mines of the Democratic Republic of the Congo (DRC), with children as young as 6 years of age forced to work at gunpoint or drugged, underpinning the supply of 50% of the world's cobalt, which plays a crucial role in electric vehicle batteries (ILO, 2017; Cheruga et al., 2020).

Indeed a consumer in Europe who is considering buying a car with cobalt from DRC must be given the information that allows them to decide if they wish to contribute to the maltreatment of these children. Because whether they know it or not, their consumer decision contributes to this cruel form of slave labor. Consumer awareness will prevent us from facilitating such cruelty.

Artificial intelligence and the internet-of-things can provide feedback and information on our supply chains and the impacts on human and ecological communities across the globe and allow us to act for the global good while in our localities (Skene, 2019). The indigenous people who live within these biomes have cultures, economies, and behavior tightly tied to their specific habitats and share familiar global narratives, even though they may never have met. We may have lost much of the ecological intelligence of indigenous people, but our decision-making can still be informed, allowing us to make the decisions that can provide the basis for a sustainable future, one informed decision at a time. Given the advanced technologies now available to us, where remote sensing satellites such as Copernicus can monitor the heartbeat of the Earth system from space, collecting data on every facet of the functioning biosphere, we have unequaled access to the health of our planet and the consequences of our actions.

5.10 Conclusions

China and Europe have pursued the circular economy principles as mainstays of policy for much of the twenty-first century. However, significant differences exist, both in terms of the political contexts and more recent policy agendas. The DCS has been announced as the subsequent significant development in economic thinking in China. In terms of supply chains, production, and consumption, the domestic economy will be promoted, thus building resilience, mainly through a decreasing dependence on international markets, which pose increasing risks. The Trump administration has recently promoted a similar, nation-centric approach in the USA. Both of these strategies pose significant problems and require significant economic growth. How this fits in with a sustainable transition is less than clear. While these approaches and the policies of Agenda 30 for sustainable development all embrace economic growth, it is unclear how the planet can heal and where any form of circular economy can persist, given the elephant of complex supply chains tied up and gagged out of site in the cupboard across the corridor and the discordant harmony of economic growth, environmental damage, and social inequality.

Recent upheavals, including the interruption of international trade caused by COVID-19 and the rise of populist politics with concomitant nationalism, are likely to drive nations further towards domestic and regional production and consumption, further undermining a globalized economy that offers opportunities as well as challenges, in terms of a more localized approach to sustainability and economics. So, what type of sustainable economic strategy should we practice to fulfill our objective of continuing to exist, where existence must be within the Earth system, which provides our sustenance, fresh air, water, and context? We would suggest that the following characteristics should define any systems-based pathway:

(a) Complementarity, wherein our activities contribute to the functioning of the Earth system, allowing it to repair itself and self-organize.
(b) Resonance, wherein our activities' temporal and spatial patterns are in tune with the Earth system, material and waste cycling, renewable resource use, and appropriate, landscape-sensitive care of the commons. Resonance also informs decision-making.
(c) Feedback, where we are monitoring our impact in real time and adjusting it where necessary, thus being alive to the emergent and nonlinear nature of the Earth system while understanding our impact upon it.
(d) Sub-optimality, where we optimize for the Earth system while sacrificing our excesses, and where trade-offs are central to planning, design, and lifestyles, rather than problems that need to be overcome.

These key characteristics describe social and environmental interactions. Then the path to sustainable economics will reveal itself, most likely at a local level but governed by global, Earth-system thinking. Almost all of our time on Earth as a species has been governed by the socio-ecological relationship rather than the socio-economic relationship. Economics emerges from the former relationship at a

fundamentally local level. Universal to this approach is systems theory, wherein the individual is embedded within a social construct, and the social construct is embedded within its broader ecology, embracing ecological ethics. Here the context is everything, and all elements within a given landscape are, in a sense, "globalized," circular, resonant, and accountable.

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