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A Review of the Sustainability Crisis and an Appraisal of Sustainable Prosperity

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Abstract

Statistical data taken from the literature is reviewed to revisit and re-examine the impact of global humanity upon the biosphere and to provide a broad bibliography of issues relating to sustainability. The data shows the continuing decline of animal and plant populations and forest area, while at the same time human population, resource usage and pollution continue to increase. Analysis of forest area data shows that with the current human population growth rate and resource consumption, combined with increasing forest fires due to global warming, forests will be eradicated within 85 years. Using the same data, the carrying capacity of the planet is estimated to be 2.5 billion with current resource usage and 8 billion with one third of current resource usage. Plantation to rebuild forests, moderation of consumption, and family size management to reduce and stabilize population, are identified as the main factors required for achieving sustainability. Views of what leads to prosperity is at the root of the sustainability crisis, and this is examined in relation to alternative values and economic models. The ideology of consumerism is discussed as accelerating the decline of natural resources. The teachings of Saint Francis of Assissi, the patron saint of the environment, and the ideals of indigenous cultures are considered as a source of values that can be adopted to transform the modern world into a more sustainable, eco-friendly world in which humans and the biosphere can thrive.

Keywords: sustainability, environment, prosperity, economy, biosphere, population, morality

1. Introduction

Planet Earth, as far as our investigations reveal, is unique in the Universe in that no other known planet is home to biological lifeforms (Chapman, etc. 2023). It is likely that there are many other biological-life-bearing planets, as the Universe is a large place (van den berg 1989; Clark 2021), but as of today we do not know of any (Wilson 2001). Estimates using radiometric dating suggest that Earth is approx. 4.5 billion years old (Alashti 2015), while the fossil record suggests that biological life started in its simplest forms approx. 3.5 billion years ago (Nisbet, etc. 2001). The exact times are still debated (Oro, etc. 1990), but today, an estimated 8.7 million distinct species are living on Earth, of which around 1.2 million are documented (Mora, etc. 2011; Costello, etc. 2013); and one of those species is ours - human beings (Aquinas 1999; von Stuckrad 2022).

Having evolved and thrived for over 4 billion years, the last two hundred years have been particularly difficult for Earth. There has been a marked decline in the health and well-being of the biosphere – the thin surface layer that contains and supports biological life (Meyer 1999; Thomson, etc. 2023). This decline has accelerated rapidly in the last few decades and represents an extremely serious existential crisis for all life on Earth (Ceballos, etc. 2010; IPBES 2019; Richardson, etc. 2023).

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Studies in the 1960s begun to reveal the seriousness of the situation, and directly ascribed it to the presence of human beings: 'The world system is simply not ample enough nor generous enough to accommodate much longer such egocentric and conflictive behaviour by its inhabitants.' (Meadows, etc. 1972). By 1970, the human population had increased tenfold over what it was in 1400, and, combined with widespread human behaviour deficient of accountability and inclined towards aggression and over consumption, the natural world has suffered greatly. Despite constant warnings (Ripple, etc. 2017; UCS 1992), course correction has not been made, human population is increasing exponentially and resource-consuming lifestyles and consumerism are spreading around the globe.

While animal and plant populations thrive and expand in favourable conditions, reproduction and mortality rates within the food chain serve to regulate their numbers. However, the development of tools and more advanced technology has allowed humans to become apex predators expanding in numbers without restraint. Based on current population size and resource consumption, human civilisation is not sustainable, and this is exacerbated by the economic growth of emerging mega-nations such as China and India.

The current study argues that sustainability is a quality of society that is based upon the human moral condition and prevailing views of what constitutes progress and success. Ideologies, values and ways of thinking and behaving are either conducive or not towards the development of sustainable societies. While new and improved technologies might contribute towards sustainability, they need to be coupled with a mindset that takes the wellbeing of the planet into consideration (Berry 2006; Cafaro 2022; Jung 2002; Lovelock 2016).

2. The condition of the biosphere

Figure 1 shows 4 sets of data that illustrate the condition of the biosphere. Figure 1a shows global forest area since 1000 AD (FAO 2020; Richie 2021; Williams 2003). The decline from around 1600 onwards can be attributed to development of railway infrastructures and shipping fleets, the use of wood in the smelting and forging iron (Sieferle 2001) and as fuel for the newly invented steam engine. To illustrate this, in the USA, there are approx. 340,000 miles of railway tracks supported by 800,000,000 wooden crossties, and in 2018 over 15,000,000 new crossties were installed, with approx. 95% made of wood (RTA 2023; Smith 2019; White 1976). This equates to roughly 80 million trees, mostly oak, and 1.5 million trees per year for replacements: approx. 800,000 hectares of forest and 150,000 hectares per year. During the 18th century, the British Royal Navy was using more than 80,000 m^3 of oak per year with a typical ship-of-the-line requiring 4,000 oak trees, and larger battleships 6,000 (Albion 2003; Melby 2012); wooden shipping fleets were maintained by other countries including Holland, Portugal and Spain (Wing 2012).

According to the UN Forestry and Agriculture Organisation (FAO), the world has a total forest area of 4,060 million hectares (Mha), an estimated 10 million of which are lost each year through deforestation (FAO 2020); while of the 2020 global wood production, 1,928 million m^3 was produced for fuel and over 401 million tons for paper (FAO 2021). The largest factor in the decline of forest area is clear cut logging of which a majority is converted to agricultural and grazing land; mining, infrastructure expansion, and urban development are additional contributing factors.

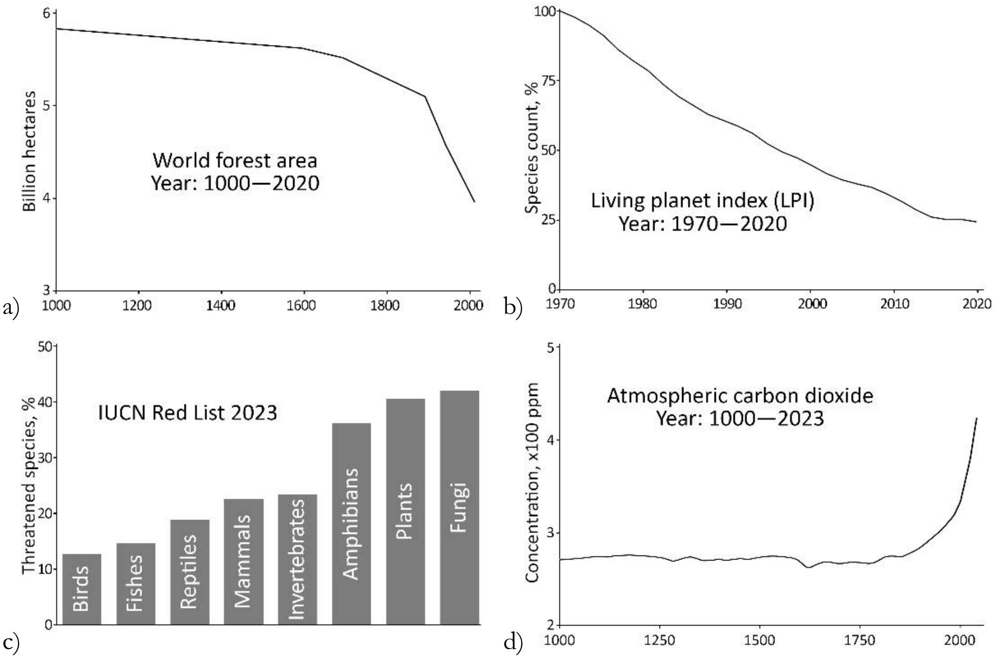

Figure 1. Quantities that indicate the declining condition of the biosphere a) forest area since 1000 AD, b) species count since 1970 based on the Living Planet Index, c) threatened species from the 2023 IUCN Red List, and d) concentration of carbon dioxide in the atmosphere since 1000 AD. (Data sources listed in text)

Figure 1b shows the decline in biodiversity or species count as represented by the Living Planet Index (LPI 2023) (the ± 5% error on data is not shown). Species die-off or loss of biodiversity is mainly a result of loss of habitat caused by deforestation and pollution (Ceballos, etc. 2015; Isbell, etc. 2023; Pimm, etc. 2014; Scholes, etc. 2005). Estimates of forest loss do not capture the full picture of how trees support life, as they fail to account for the vast number of animals, insects, birds, and plants that call individual trees their home. One single tree can provide shelter, food, and breeding grounds for thousands or even millions of these organisms, making it a vital part of the ecosystem. (Mitchel, etc. 2019; Pacala, etc. 1995). The biosphere is a vast and densely integrated bio-structure that integrates also with the other Earth systems (geosphere, hydrosphere and atmosphere) in the production, evolution and maintenance of life (Lovelock 1986; Naess 1973).

Figure 1c presents data from the International Union for Conservation of Nature's Red List of threatened species for 2023 (IUCN 2023). This data is based on the IUCN Table 1b assessments for year 2023 and shows that 12.1 % of birds, 14 % of fishes, 18.0 % of reptiles, 22.3 % of mammals, 22.7 % of invertebrates, 35.9 % of amphibians, 39.5 % of plants and 40.6 % of fungi are currently considered threatened. Recent studies of insect populations have indicated that 40% of the world's insects could become extinct in the next few decades (Sanchez-Bayo, etc. 2019), mainly due to changes in habitat and pollution. Insects are prime consumers in the food chain and higher animals are reliant upon them for food, while plants rely upon insects for pollination; reduction of insect populations below a critical level can quite literally cause the biosystem to collapse. A similar report relates to drastic decline of amphibian populations, also due mainly to pollution and habitat change (Plewnia, etc. 2023). Habitat change in this context means destruction of natural habitat and its replacement by urban, agricultural or grazing developments (Wang, etc. 2023).

Figure 1d shows the variation in the concentration of CO2 in the atmosphere since 1000. Historical data until 1960 is from (Rubino, etc. 2013) based on the CO2 content of air bubbles in deep ice cores from the Antarctic. Data since 1960 is from (NOAA 2023) based on CO2 concentration in air from Mauna Loa observatory in Hawaii. The two sets of data agree at 1960 and are continuous. Since 1800 the CO2 concentration has increased exponentially, and this is associated with deforestation and industrial emissions. Reduction in forest area has a significant impact on carbon dioxide (CO2) levels in the atmosphere (Beyer, etc. 2020; Osman, etc. 2021; West, etc. 2010; Gaur, etc. 2017) as trees are the main absorber of CO2. CO2 is heavier than air and mostly remains at ground level to be used as food by plants and trees. Trees take CO2 from the air in order to grow, converting it to glucose through photosynthesis to feed the growth of the cellulose structure of the tree (Bassham, etc. 2024). Deforestation removes this vital CO2 absorption factor from the environment, while burning trees releases stored CO2 back into the atmosphere.

Earlier data (Arrhenius 1896; Pearson, etc 2000) indicates that from 40 to 60 million years ago, atmospheric CO2 was as much as 10 times higher than it is today, and that this higher concentration was associated with the higher global temperatures at that time. However, uncertainty in determining global conditions at that earlier time make it difficult to identify the cause of higher CO2. (Pearson, etc 2000) suggest that 'complex feedbacks initiated by tectonic alteration of the ocean basins' are an additional factor influencing atmospheric CO2 concentrations.

Taken together, these graphs illustrate an alarming rate of ecosystem decline. This is far from sustainable and if left unchecked it is uncertain whether the balance and diversity of life within the biosphere will ever be restored. After the Cretaceous-Palaeogene (K-Pg) mass extinction event, which occurred 66 million years ago most likely a result of an impact from a massive asteroid, it took an estimated twenty million years for species diversification to reach pre-extinction levels (Lowery etc 2019); and after the Permian-Triassic (P-T) extinction event, which took place approximately 250 million years ago, it took an estimated 10 million years for a stable ecosystem to reemerge (Chen etc 2012). Within the limits of these studies, it would therefore be expected to take in excess of 10 million years for the biosphere to restore diversity should humanity be careless and selfish enough to cause a similar mass extinction. However, the nature of biological life would not be expected to resemble current diversity as the generation of novel morphospace would likely produce a new ecosystem with new evolutionary species and variants.

Figure 2 shows the trend in factors harmful to the biosphere, all of which are seen to be increasing; and in the case of plastic waste, exponentially. Figure 2a is a combination of data showing the consumption of non-metallic minerals, fossil fuels, metal ores and biomass from 1970 to 2015 (EEA 2019) and from 2015 projected to 2060 (UNEP 2019).

Resource consumption has been increasing steadily with industrialisation, particularly with the emergence of China and India as economic powers. The upsurge in non-metallic minerals includes the increasing use of gypsum in concrete and plasterboards, of sand and rocks for civil engineering and housing, and phosphate for fertilizer. Fossil fuels still remain the mainstay of industrialisation and include coal, oil and natural gas. Metal ores are rocks from which metals are extracted such as haematite (iron oxide), bauxite (aluminium hydroxide), and dolomite (calcium magnesium carbonate). Biomass is considered a renewable source of mainly crops used for bioenergy, including switchgrass for ethanol and butanol, sugarcane for ethanol, and cereal crops such as corn for biodiesel.

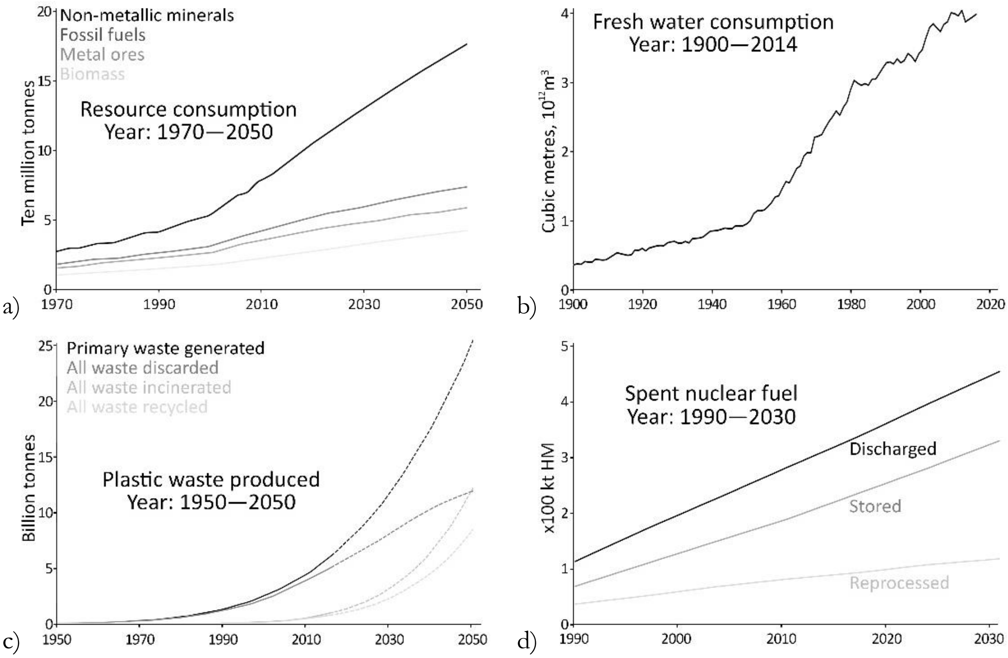

Figure 2. Trends in factors harmful to the biosphere with projections, a) resource consumption, b) freshwater consumption, c) cumulative plastic waste, and d) accumulation of spent nuclear fuel. (Data sources listed in text)

Figure 2b shows the consumption of fresh water from 1900 to 2014 (Ritchie etc. 2018). Global freshwater shortage is steadily becoming an issue, with global warming causing melt-off of glaciers and polar ice, and increased evaporation from reservoirs (Eliasson 2015; Williams, etc. 2012). Additionally, household consumption of fresh water is increasing with population and the development of civil infrastructures in developing countries. Agriculture is the main user of fresh water, accounting for an estimated 70 % by volume, while industry and energy generation are high users of fresh water as well.

Along with increasing extraction of natural resources comes increasing processing, manufacture, distribution, waste and pollution, which further harm the environment (Carson 2003; Hill 2010).

Figure 2c shows the cumulative mass of plastic waste generated, discarded, incinerated and recycled (Geyer, etc. 2017) since 1950 with projection to 2050. Plastic waste has a very long lifetime in the environment and when broken down tends to persist as micro- and nano- particles. Presently less than 10% of plastic waste is recycled; the majority accumulating in landfills and litter. Recent studies (Amesho, etc. 2023) show that rapidly increasing plastic waste, now more than 320,000,000 tonnes per year, is contaminating the environment with micro- and nano-plastics that injure and poison plants and animals at all levels of the food chain (Ghosh, etc. 2023; Talbot, etc. 2022). Development of biodegradable plastics such as polylactic acid (PLA) and methods of recycling and conversion to oil through pyrolysis (Kabeyi 2023) are essential to controlling plastic pollution and cleaning up the environment.

Figure 2d shows the accumulation of radioactive spent nuclear fuel (adapted from Taylor 2022) from nuclear power stations. The use of nuclear technologies for generating electricity is faced with increasing accumulation of radioactive waste, especially spent fuel rods, which is toxic to the biosphere for thousands of years (Deng, etc. 2020). Reprocessing spent fuel generates additional radioactive waste as a by-product, while storage in underground repositories can contaminate deep aquifers. Additionally, nuclear accidents such as Chernobyl and Fukushima and the testing and use of atomic weapons have had a devastating effect on natural ecosystems (ACA 2023; IAEA 2006; Pravalie 2014; Westing 1981).

The issue of pollution is not limited to the above; other forms are also on the rise, including air pollution, sound pollution, light pollution, chemical waste, household garbage, electrical waste from discarded batteries, and a wide range of toxic and non-toxic industrial waste.

These alarming trends reveal a stark reality: the devastating impact of human activities on the global environment is accelerating at an unprecedented pace, precipitating the rapid decline of species and widespread deforestation. As natural resources decline, the scarcity will cause price rises for basic commodities and other consumer items, and resource wars will become more frequent (Klare 2002). If left unchecked this will result in the collapse of civilisation through a lack of available and affordable resources.

3. The human condition

Figure 3 illustrates the human condition through four different sets of data. Figure 3a shows the growth in population since the time of Christ to the present day. Estimates by (Biraben 1980) show that through to approx. 1000 AD there was an estimated 170 million people on Earth and by 1400 AD this increased only to around 350 million (Ehrlich 1972). But from that time onwards population increase accelerated, so that by today it is estimated at 8.1 billion (Goldevick 2005; WPP 2022), over twenty times what it was only 600 years ago. In 2000, world population was 6.16 billion and in 2023 it is 8.05 billion. Fitting an exponential curve with 1.2 % increase per year, population is expected to reach 20 billion by 2100.

Figure 3b shows global gross domestic product (GDP) and genuine progress indicator (GPI) since 1950 (Kubeszewski, etc. 2013). Global GDP measures the total value of goods and services produced by nations worldwide in one year. GPI is related to GDP by the equation GPI = GDP+Adjustments–Subtractions, to include a range of factors relating to the environment, equity and wellbeing. While GDP has increased almost linearly since 1950, GPI has decreased since the late 1970s. This indicates that although productivity is increasing, the economy is not being managed in a way that benefits society as a whole (Chancel, etc. 2022): the environment is declining, economic inequality is increasing (wealth is being concentrated in the hands of fewer and fewer people), social security is being neglected and military expenditure is increasing.

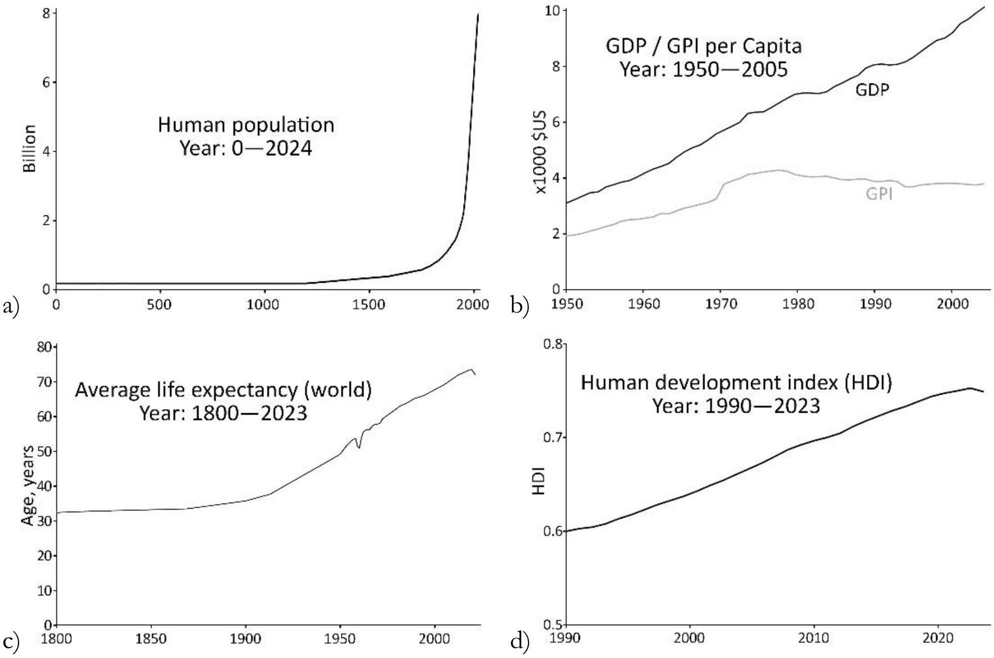

Figure 3. *Global indicators of the human condition a) population growth, b) gross domestic product (GDP) and genuine progress indicator (GPI), c) age expectancy, and d) the human development index (HDI). (Data sources listed in text)*

The debt-based economy which is prevalent in the modern world has been widely criticized for its significant contribution to environmental degradation. This economic model, driven by the need to perpetuate growth to pay off debt, often prioritizes short-term profits over long-term sustainability. As a result, individuals and businesses tend to exploit natural resources to generate revenue, leading to unsustainable practices that harm the environment (Gonzalez-Reding 2019). Other economic models do exist, some of which are more sustainable than others. The gift economy, for example, is based on the exchange of goods and services through gifting rather than through buying and selling (Thygesen 2019). The current amount of debt in the world is so staggering that many economists argue that a debt jubilee is the only viable solution to prevent economic collapse (Hudson 2018). Cancellation of debt and its associated obligations would allow for a fresh start and provide an opportunity to rebuild the economy on more sustainable foundations.

Figure 3c shows the average life expectancy (Riley 2005; WPP 2022), which has been steadily increasing so that a person born in 1950 would expect to live twice as long as a person born in 1850. The dip in the middle of the last century was a result of civil upheaval and famine in China, while the dip from 2021 is due to the Covid19 pandemic. In the short-term, this is an obviously positive trend, but the corresponding increase in consumption, usage of natural resources, waste production, and land conversion for housing and infrastructure developments reduce the sustainability of the population and the life expectancy of humans on Earth in the longer term.

Figure 3d shows the human development index (HDI) as a world average, which measures development through life expectancy at birth, years of schooling, and monetary income. HDI has increased steadily since its inception in 1990 (UN DP 2023), which is considered to be a positive trend. Although increased life expectancy and income can increase the impact upon the environment by increasing resource consumption, improved education can have a positive effect on sustainability by increasing environmental awareness and increasing the investment in sustainable development and innovation towards sustainable solutions.

Figure 4 illustrates the development of technology over several millennia. Figure 4a shows the exponential increase in the number of decimal places of π that have been calculated (Pi 2024), which represents the power and speed of computers that are at the heart of modern technology. Figure 4b shows the exponential trend in the power of conveyances from domestication of the horse around 4000 BC to present day internal combustion and electric engines (data sourced from various automotive websites). Similar trends can be found for the speed and distance of communication, the speed of felling and processing trees, the amount of food production per hour, the mass of material that can be transported, light generation, magnification and so on. Technology has progressed at such a rapid rate that what was fast or powerful 500 years ago is unimaginably slow and weak by comparison with what is commonplace today.

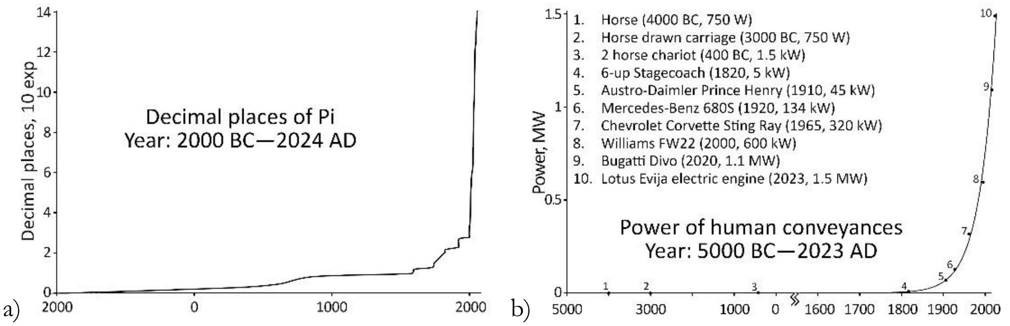

Figure 4. Indicators of technological development a) number of decimal places for π from 2000 BC and b) power output of human conveyance systems from 4000 BC. (Data sources listed in text)

It is generally recognised that these advances have been a result of developments in science and technology since the 14th century, new ways of thinking as a result of the protestant reformation in the 16th century (Weber 2023), and the industrial and agricultural revolutions of the 18th and 19th centuries (Deane 1980). These led to improvements in medicine, hygiene, living conditions, work environment, farming and civil infrastructure and resulted in people living longer and sustaining larger families. Today, countless millions have a comfortable bed to sleep in, fresh water to drink and clean warm water for bathing, and fewer people are in poverty.

Technology has enabled human beings to travel further afield, to open up and exploit more remote areas of the globe and to set up networks of resource extraction and trade. Access to the vast natural resources of Africa and Asia, combined with the increasing ability to harness these resources and convert them into power and to focus them into productive endeavours (Parthasarathi 2002), fuelled the rapid civilisational acceleration known as "The Great Divergence" that made the Western world the most powerful civilisation the world has ever known.

The impact of these technological developments has been so significant on a global scale that a new geological age is recognised – the Anthropocene or 'the age of man' (Turner 2022; The Anthropocene Project 2023) – where human activities have become a dominant force in shaping the course of Earth's evolution.

Although the decline of the biosphere is coincident with the rise of mankind and the development of technology, technology itself is not the reason for the decline; it is *how the technology is used* that is the problem. While ships, trucks and mega machines might be seen as the culprits for overexploitation of natural ecosystems and destruction of wildlife habitats, it is the system behind them that drives their use. Company directors, lending banks, shareholders, managers and labourers all want to make as much profit as possible, which means that machines are used to their maximum capacity to exploit. Rather than making work easier, machines are being used to make people richer at the expense of the biosphere. In 1900 for example it took as much as one day to cut down and process an averaged size pine tree, today it can be done in a few minutes.

If we accept that man is right in developing and using technology, and that cleaner and more efficient technologies can contribute towards a sustainable society, then along with that technology comes the responsibility for using it in a moral and environmentally sound manner (Ayres 2021). This is more urgent now than ever because machines are so powerful and can cause such great damage if used improperly or without the proper respect and consideration. When greed drives the tractor, the land really has little hope. Traditionally, hunters and fishermen used to catch only for themselves or their village, but now the market is global and much greater financial profit can be earned and it is more difficult to restrain greed, and aggressive competition.

The way we perceive and understand natural ecosystems is crucial in shaping our relationship with them. If we view them solely as a resource and a way to accumulate wealth, we are more likely to exploit them without consideration for the long-term consequences. However, when we see ecosystems as vibrant, interconnected living systems that are home to diverse life and beauty, we are more likely to adopt a holistic approach, treating them with respect, protection, and sustainable management. Along with the use of media and education to develop environmental consciousness and eco-friendly ethics, global policies are needed to regulate industrial access to natural ecosystems. In this way we can build on our successes while learning to share the biosphere with other species without harming or depleting its resources (Jayne 2020).

4. Estimation of the human carrying capacity of Earth

The planet can sustain a human population so long as the resource consumption of the population does not exceed the planet's capability to renew that resource within the same period of time. This is illustrated in Figure 5a where the maximum population size that the planet can sustain, called the 'carrying capacity', increases with decreasing resource consumption per person and decreases with increasing resource consumption per person.

Currently natural forests, especially tropical rainforests are being decimated for wood and to clear space for grazing and agriculture. If all the trees in the world were to be cleared, the consequences for the biosphere and for human civilisation would be catastrophic. Global warming, degeneration of air quality through lack of oxygen, carbon dioxide increase, loss of biodiversity, soil degradation, flooding and landslides, and much more would devastate life on Earth. Based on the critical importance of trees and forests, the quantity of forest area is used in the following calculations for estimating the carrying capacity.

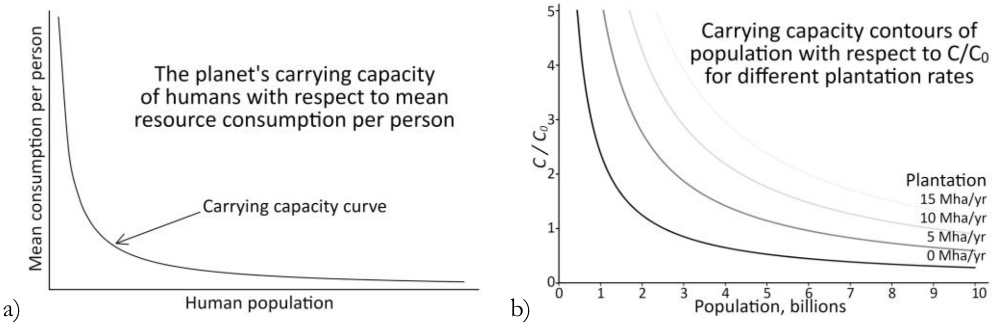

Figure 5. Graphs showing a) the relationship between the carrying capacity of Earth and the mean resource consumption per person, and b) carrying capacity curves with respect to relative mean consumption C/C_0, where C_0 is the current mean consumption, for four different rates of plantation. (Data sources listed in text).

Each year global forest area increases a small amount by natural expansive growth and by plantation, but decreases by clearing and forest fires. This is shown in Equation 1 where A is the area of forest remaining after time T from an initial area A_0 as a result of these four factors.

$$A = A_0 - A_{cleared} - A_{burned} + A_{growth} + A_{planted} \quad \text{Eq. 1}$$

According to recent studies (Potapov 2022; Tyukavina 2023), between 2000 and 2020 forest was cleared at an average rate of 11.2 Mha per year, growth and planting combined made up 6.5 Mha per year, with 4.0 Mha growth (0.1 % of total forest area) and 2.5 Mha plantation. This gives the recognised global forest loss of 4.7 Mha per year. Forest fires are adding 9.3 Mha per year to forest loss, and this is increasing by 0.32 Mha each year due to global warming (MacCarthy, etc. 2023).

Using this data, a computer program was written to calculate the yearly change in global forest area and the time remaining before forest area reaches zero. To facilitate this calculation a *mean resource consumption rate* C per person was defined as forest area cleared per year divided by population. Based on the average 2000—2020 population of 7 billion, $C = 1.6\text{x}10^{-3}$ ha/year, and this particular value of *C* was referred to as C_0. An exponential population growth rate of 1.2 % was used, and a 0.5% increase in *C* each year reflected mean consumption growth based on calorie consumption increase per year (UN FAO 2023). Based on this data, *global forests are eradicated within 85 years*.

Using Equation 1 to examine the long-term carrying capacity, growth plus planted must equal or exceed cleared, while forest loss due to fire can be ignored because over a longer time forest regrows, if not appropriated for some other use. As the area cleared is already defined as the mean consumption factor C multiplied by population, the sustainable threshold that defines the carrying capacity can be expressed as:

$$C \cdot Pop = A_{growth} + A_{planted} \qquad \text{Eq. 2}$$

Figure 5b illustrates this relationship for $A_{growth} = 4\ Mha/year$. C/C_0 is the relative mean consumption of individuals within the population, with C_0 being the current value. The four curves represent the carrying capacity corresponding to 0, 5, 10 and 15 Mha plantation per year. This shows that with our current mean consumption per person $(C/C_0 = 1)$, the planet can only sustain a population of 2.5 billion, which was the population size of 1950. For our current population size to be sustainable, our mean consumption per person must be reduced to one third of its present value. If, however, we invest in plantation, we assist the planet to sustain us, then the population size and/or mean consumption can be higher. By planting 10 Mha of new forest per year (four times the current amount) our current population and consumption level would be sustainable.

This rudimentary calculation strongly urges a significant increase in the plantation of new trees, while resource consumption for individuals and industry must be addressed, and family size management is recommended to stabilize population size.

5. A sustainable way of thinking

Sustainability is a quality of a society, and as such is rooted in the moral development of the people that make up the society, but it is also a quality of mind and a way of thinking. The last century was dominated by consumerism (Curtis 2000), which is based on the notion that "increasing the consumption of goods and services purchased in the market is always a desirable goal, and that a person's well-being and happiness depend fundamentally on obtaining consumer goods and material possessions" (Hayes 2022). Western economies grew large on the manufacture and sale of consumer goods, and many businesses were built and many individuals became extremely wealthy by exploiting the trend. However, as all consumer items are derived from natural eco-systems, the catalogues and department stores have accelerated, perhaps more than any other factor, the decimation of the biosphere.

In a consumer society, trees and animals are worth more dead than they are alive. For example, one fur coat, selling in a price range from €500 to as much as $50,000, requires the slaughter of 50-60 minks, 200-250 squirrels or 30-40 foxes, 1 kg of caviar obtained by gutting a sturgeon costs approx. €3,400, one freshly killed tuna fish can sell for over a €1,000,000, and a 5 kg lobster for around €400, while 1 kg of ebony can cost as much as €100 making ebony the million-dollar tree.

Consumerism was enabled by colonialism, which opened up lands for exploitation, but as our world becomes more multi-polar, the colonial mindset is fading out and a new global mindset based on equality, fairness, respect, friendship, international cooperation, and sharing seems to be appearing. Within this transformation of global humanity, it is imperative that a new mindfulness towards the planet also forms up. The fragility of the biosphere and the interconnectivity of all living things needs to be appreciated and understood, and our relationship with the planet needs to change from unrestrained exploitation to responsible stewardship and a win-win deal in which mankind can thrive along with other species and not at their expense.

Civilisation has separated mankind from the natural ecosystems, and a way of thinking has formed up that perceives the biosphere as a resource to sustain civilisation. But the planet is not a resource, it is a living being. While indigenous cultures have retained the sense of this spiritual reality, and it is the basis of traditional practices of Shinto and Shamanism, modern science is finding its own way to appreciate the subtle interconnected nature of the fabric of life.

Recent studies of electrical and chemical activities and signals in the biosphere (Thomkins 1996, Vani 2017) reveal how animals and plants are connected into a web or continuum of awareness, communication and even consciousness (Lovelock 2016, Malley 1993). As these fields of study grow and we learn more about the processes of life, we will hopefully develop a different kind of attitude towards the biosphere, more inclusive and respectful, and we will be much less inclined to clear the forests and pollute the rivers and seas when we understand and appreciate that they are sacred.

Building on our successes in science and technology and through innovation, we can continue to upgrade societal infrastructures with new cleaner low CO2e alternatives (e.g. Salonen, etc. 2011, Whitmore 2023). But the most direct way to reduce our impact on the biosphere is through moderation, in all things but particularly food consumption, family size, consumer goods and travel.

Over the last few hundred years we have taken a lot out of the planet, and now we see the consequences of it in deforestation, resource depletion and ecosystem destruction. It is time to give back to the planet to help rebuild the ecosystems. When we start to think of living with the planet and contributing our own unique humanness to the world rather than living off of the planet like a parasite, we can build a symbiotic win-win relationship with the biosphere that can sustain generations to come.

6. Discussion

Sustainability is arguably the most critical issue facing humanity today. While in earlier times a village or community that had outgrown or depleted local resources could move on to new and fertile lands, today, faced with exhaustion of natural resources globally, there is nowhere else for us to go. Either we change our ways or our civilisation and way of life will collapse. As this existential crisis looms, it is prompting us to re-examine our values, our relationship with the planet, and confront the imperative of accountability that demands our collective response.

One possible solution to this crisis is moderation, but implementation of it requires consensus and transformation of values and systems on an international scale. National economies have grown large on exploitation of the environment, everything from cheap meat to expensive furniture is obtained from natural ecosystems. However, while economic growth is important to bring nations out of poverty and to develop essential infrastructures, continual growth beyond a certain point is counterproductive in that it overtaxes the environment. Added to this is the debt-based nature of most of the world's economies, which necessitates economic growth to pay off debt, and that tends to benefit the larger financial institutions who earn interest on the debt.

The comparison of GDP and GPI in Figure 3b also suggests that the economy is being exploited by individuals and businesses to acquire extreme wealth while neglecting the majority of people and the wellbeing of the environment. This is consistent with the 2022 Global Wealth Report (CSRI 2022), which states that the world has over 62 million millionaires, while over 140,000 individuals in the US and over 32,000 in China have a net (financial) worth of over 50 million dollars.

Overexploitation of the environment and the sustainability crisis are therefore based upon the ideal, perception or illusion that material wealth is the source of prosperity, a sign of progress and success, and is worth striving for. Prosperity means to succeed or to thrive in any good thing; it does not necessarily mean material wealth. The truth is that there are other views and other ways of life that also bring prosperity and that are not so demanding upon the planet. Native people find prosperity and fulfilment in connection to the land and the natural worlds, through community and social connection, spiritual practices, family, traditions, storytelling and oral tradition, traditional dance and music, land management and stewardship, and personal growth and development.

Native peoples of the world are living sustainable lives; they are not the problem. The problem is the modern way of life in which people want big houses and gardens, multiple cars, countless plastic labour-saving appliances, steak every day, air conditioning, luxury fashions, exotic vacations and so on. This wanting too much is what is causing the sustainability crisis. Have we confounded human development with technological development?

What better way to seek guidance and inspiration for a sustainable way of life than through the example and teachings of Saint Francis of Assissi (1181-1226), the patron saint of the environment. Saint Francis was an Italian Catholic friar, poet and itinerant preacher who lived in the Middle Ages. He is known for his devotion to poverty, simplicity, and the natural world, and is often considered the patron saint of animals, the environment, and Italy. He was the founder of the Franciscan monastic order.

His teachings emphasize the importance of respecting nature, caring for and protecting natural ecosystems as well as individual animals and plants, of living simply without the need for material possessions and wealth, having humility and gratitude, being peaceful and non-violent, of living and working together with a strong sense of community spirit and solidarity, and of practicing prayer and contemplation as a way to deepen and grow spiritually.

Saint Francis believed that true happiness and fulfilment come from living a life of faith, hope, and charity, rather than from accumulating wealth or possessions. He understood true prosperity to be inner peace, spiritual growth, joy and gratitude, love and compassion, contentment with what is, freedom from anxiety and a sense of connection to the greater spiritual nature of life. There an estimated 650,000 people in over 100 countries who are members of the Franciscan Order today.

Saint Francis' radical simplicity was a testament to sustainable living and demonstrated that human beings can prosper and thrive without material wealth. Between the excesses of materialism and the austerity of asceticism, there are many middle paths. Sustainability is about finding a way between these two extremes.

Since very earlier in the history of mankind, greed has been considered a vice: both Aristotle and Plato wrote about greed as a cause of conflict and inequality in the world, and in Christianity greed is considered as a sickness of the soul. The study of vice and virtue in the Middle Ages found that greed can be countered by either moderation or the development of generosity, and the idea that by giving one receives has become an important part of the Christian way of life and understanding of prosperity.

Cross-cultural exchange of ideas is extremely important in leading the world to more sustainable societies. The view shared by many indigenous people around the world is that a person is measured not by their material possessions but by the content of their character, with qualities such as honesty, integrity, kindness, knowledge and wisdom being held in high regard. Such a view is only partly upheld in the modern world where material wealth and social status play a large part in the thinking of most people. Although living in mud huts is not a particularly attractive prospect to most modern people, it does indicate that other sustainable ways of life are possible and that the views of native people should be included in the larger forum of ideas.

7. Conclusion

Review of the literature has illustrated the continued decline of the biosphere and its connection to the presence and activities of human beings. The current sustainability crisis is a legacy of the unsustainable practices of previous generations, who extracted resources and exploited the planet's capacity without considering the long-term environmental and social consequences. Although progress was made, much has been at the expense of the natural eco-systems of the planet. If humanity today perpetuates the problem, then there is little more than two generations left before civilisation no longer has the resources to function.

Analysis of data has shown how forests will be eliminated within 85 years unless action is taken to stabilise the population size, reduce consumption and plant more trees. Eradication of forests would be so catastrophic to the global condition that no semblance of civilisation could be expected to continue. The calculation of carrying capacity curves based on forest area data from the literature show that either reduced consumption or reduced population size are necessary for sustainability. Thus, individual responsibility, family size management and moderation of consumption are necessary in this time if we are to resolve the sustainability crisis.

The pursuit of prosperity through the acquisition of material wealth is at the root of the sustainability crisis. Across cultures and throughout history, human experience has consistently demonstrated that prosperity is a state of being that transcends material wealth, and can be achieved through a wide range of means. Firstly, it is paramount to appreciate the interconnectedness of things, in which individual human prosperity depends upon that of society and the prosperity of society depends upon that of the planet.

Then gratitude, community spirit, the value of simplicity, and appreciating the beauty and abundance of the natural world are all factors that contribute to the wellness of life that form the basis of a true and more sustainable prosperity that is not derived from exploitation of the environment. Beyond this is an appreciation of the spiritual context of life in which spiritual growth and the development of qualities such as wisdom, charity, kindness and humanity, all bring a sense of meaning and purpose to life.

A debt jubilee could reset the economy, providing an opportunity to transition to more sustainable alternative economic models, such as those based on gifting and sharing, which prioritize social and environmental well-being over profit.

The calculation of carrying capacity made in this study is rudimentary and can be developed into a larger more inclusive simulation with a wider range of variables. For example, how culture, customs and world view of different ethnic groups relates to carrying capacity. A study of the psychology of greed in the context of sustainability would also help in understanding why it is that some people are driven to acquire very much more than they actually need.

Greater value needs to be given to the views of the indigenous peoples of the world, and those who have maintained some idea of the native way of life. Being very close to ideal sustainable societies, these have much to offer the endeavours of modern man to build a sustainable society. Forums of discussion should include people with a native heritage so the cross fertilisation of ideas can benefit the common good, and their views should be reported more consistently in the scientific literature.

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