

Mankind, Ecology & Decentralised Recycling

Local Ecosystems and the Rural Economy

by

Bill Butterworth

Mankind, Ecology & Decentralised Recycling: Local Ecosystems and the Rural Economy

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“It is in the history of the world that, as an empire matures and begins to collapse, and for whatever reason, those left in power in the middle pass more and more regulations, involving more and more public servants, in order (they think) to reverse the collapse. What actually happens is that they stifle innovation and inhibit entrepreneurial activity, so accelerating the rate of decline. That is what is happening in the UK, and most of the EU, here and now.”

Jane Marshall, historian

2009

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Preface

Chapter 4 in this text is a record of the development of a locally based, self-funded, commercial recycling operation which was built some 30 years before this text was written. From zero, in just over a decade, it grew to handle millions of tonnes per annum. It was locally controlled and the Regulator spent very considerable efforts to show environmental damage - and failed.

Chapters 1, 2 and 3 are a discussion of current global issues of climate change and pollution and why we should look again at the structure of that 30-year- old recycling operation.

Chapter 4 is a record of local people, local entrepreneurial activity and local control.

Chapters 5 to 10 look at lessons learned and how the technology and local responsibility developed can help to tackle the global issues of climate change and pollution.

Chapter 11 discusses business and regulation.

and

Chapter 12 raises again if Malthus and Ehrlich were right about population and food security and, although they got the timing wrong, it is now that the clock fingers are within minutes of 12 midnight.

Introduction

Since Malthus first formalised the fear of population growth, and Ehrlich predicted “The Population Bomb” there has been limited worry about the future of the human race. Limited because there have been promises but limited action. There is here a fresh look at that future and possible remedial action to establish a new ecological equilibrium. However, the evidence we have is that the clock is ticking.

The soil of what we commonly call “Land” has always done two things for the human race. One is often talked about, one less often.

Land has produced food and “food security” has always been an issue for half the human race and is moving towards being an issue for most. (Malthus 1798)

The second use of land is that it is part of a wider environment including the seas and atmosphere, which between them take what communities, especially cities, do not want – generally labelled “Waste” which includes personal, municipal and industrial, and even human bodies. In recent decades, pharmaceutical medicine residues and plastics (including nano and micro plastics – or NMPs) have been added dangers. Now, it is arguable that munitions production and battlefield waste is the single largest pollutant globally.

There are, then, two issues. Firstly, the physical issue of human survival. Secondly, one of morality – what we allow and what we do not allow, and how to enforce progress to a better world.

In the UK, and indeed all around western democracies, there has been steadily increasing centralisation. Putting it simply, there is a proliferation of centralised government civil servants sitting in offices in isolation from the real social and economic world, apparently convinced that they can make rules and publish them, and all the problems will be solved. These people are rarely technically trained, they are rarely economists and not trained managers. Even if they were originally, they would quickly be out of date. Worse still, what they do not do, or at best rarely, is to frequently, sometime giving notice, sometimes without any warning, visit the working end of what they try to regulate. Common sense says that they cannot possibly do the job properly. However, they have a financial cost which is significant and potentially crippling.

The result is to stifle entrepreneurial activity and inhibit innovation. This is potentially disastrous when the human race faces significant challenges in global warming and pollution.

It is widely accepted in the science and technology community of the world that there is a problem with global warming. It is increasingly accepted that there is possibly a more pressing problem with pollution, especially with pharmaceutical residues and micro and nano plastics (NMPs). It is certainly true that a progressive reduction in the use of fossilised fuels is necessary, whatever else is done. Similarly, with pollution and, indeed many other problems including population growth.

What is less widely understood, but certainly talked about, is the malaise of Western economies and democracies. Since World War 2, there has been a very significant growth in the bureaucracies of

the West with increases in the cost of government and reduced economic growth. While the growth, both economically and socially, of others, particularly China, has been dramatically greater. There is also another characteristic of western life: the pursuit of money increasingly becomes the driver, rather than morals, honesty, fairness and professionalism.

What this book is about is a record of the research and development of linking the available science and technology of these risks of global warming and pollution, to one, field scale, potentially global scale, remedial action using existing available resources in a risk-related timeframe, delivering food security, the rebuilding of the terrestrial Carbon sink, the processing of pollution and a degree of social stability. *It worked because it was locally organised, locally responsible and locally delivering tangible, visible benefits to local people, in a way which was nationally significant. It worked because it developed responsibility and linked that to sustainable economic and ecological benefit.*

What this book is not about is “environmentalism” being the one and only way to face these risks. Instead, it is about *conservation* of a way of responsible human life and government. It is tried, tested and will deliver a significant contribution to the discussion and action in the face of political change, over-population, pollution, ecological constriction and climate change.

A classic approach to a problem is to ask three questions and the text below is organised to do the asking.

- Where are we now?
- Where do we want to be?
- How do we get there?

One other thing: Whether we like it or not, everything we want to do takes resources. Money is a title to resources. To be sustainable, it has to be *both* environmentally *and* financially sustainable. So, whatever we do to achieve the desired objectives, the question of “where is the cash driver” has to be identified, detailed and managed into sustainable action.

One of the common problems with the academic world is the ability of individual researchers to study a relatively restricted area of knowledge and push the limit of knowledge a bit further than what others previously thought. While that is important, indeed vital, there is a potential weakness.

The human race faces a number of complex problems. Climate change is simple enough to identify as “it’s getting hotter” but it is so because of many issues. Pollution has many different causes. Human health is complex. As a matter of a common-sense question: Is it likely that in-depth study of any one of these issues in isolation could solve that problem? The study of any particular problem will certainly give a better understanding of that problem, but there is a wider issue.

“Ecology” is defined as “the relationship of living things to their environment and to each other”. (Cambridge Dictionary 2025) Suppose that were turned round to, “the relationship of the environment to living things (including humans)”? Logically, for its survival, the human race has *necessarily* to look holistically at

not just global warming in isolation, but global warming resulting from the use of fossilised fuels producing Carbon dioxide, *and* the other accelerators, particularly pollution in its many forms.

There is a fundamental issue behind this discussion and that is the continuing growth in human population not only in numbers, but in its desire for “a better life”, which has involved the use of increasing amounts of hydrocarbons to produce energy and plastics. Starting with that as part of the discussion, in one book it is not possible to detail all that is required. However, it is possible to look at the inter-relationship of global warming, pollution and a self-funding, global relationship which would make a significant and positive difference to the progression of many of these issues. It is potentially credible because trials involved over 10 million tonnes of process experience with at least some documentation of evidence. The organisation was originally set up purely as a commercial operation and not, in any way, as an academic study. It is worth remembering that if any proposed solution isn't financially sustainable, it cannot be environmentally sustainable.

So, what is this inter-relationship between key environmental factors and human activity, and how can a new, sustainable balance be set up and implemented fast enough?

One more word: There is a classic way to solve a problem and that is to find a mirror image problem and put the two together in such a way that they cancel each other out and, possibly, produce a synergy giving extra advantage. So, what are the two problems and where is the synergy?

Section 1.

Where we are now?

Chapter 1

What we know about “the now”

1.1 Global warming according to UN and IPCC

The Intergovernmental Panel on Climate Change (IPCC) was established by the UN (United Nations) in 1988 to provide policymakers with regular scientific assessments on the current state of knowledge about climate change. (ISC 2018) Every year since then, the IPCC has warned of an imminent and increasing risk of climate change and its potentially fatal consequences, emphasising the connection with the use of fossilised fuels and the consequential production of Carbon dioxide (CO₂). Indeed, it has escalated its warnings of promises not fulfilled. (IPCC 2022, 2023, et seq) (IISD 2025)

Inevitably amongst the human race of individuals, there are a few dissenters, but almost all trained scientists concur with this view. (Hayhoe et al 2018) (Abbass et al 2022) (Wolf et al 2025) This persistent lack of delivery of real change might have been expected to begin to progress following a landmark advisory opinion from the International Court of Justice which concluded that failing to protect the climate system could violate international law, potentially opening the door for those nations worse affected to sue the most polluting countries. (BBC 2025)

To achieve global temperature stabilization goals, such as those set out in the Paris Agreement, current projections suggest that between 7 and 16 gigatons of CO₂ removal annually could be

required by the second half of the century. (Hickey et al 2025) Relative to what is required, there are currently significant shortages, particularly for geological storage options. There certainly are risks of releasing CO₂ back into the atmosphere from industrialised processes of CCS - Carbon Capture and Storage. Natural climate solutions like forestry face reversal risks from wildfires, droughts, and land-use changes, while technologically focused projects such as direct air capture with geological storage offer greater permanence but face delivery risks around scalability, cost, and technological maturity. Additionally, costs vary by orders of magnitude between forestry offsets and engineered removal technologies. (Hickey et al 2025)

There is one more potential difficulty that must be faced. As global population expands, so does food consumption need to rise accordingly. However, agriculture is a major contributor to the rise in Carbon dioxide concentration in the atmosphere. (See below Para 3.1) So, does more food production mean more CO₂?

Despite these negative statements, there is evidence (UNCC 2025) of increased positive: “climate action is accelerating across key systems, from energy and transport to food and health, from industry and finance, to land, ocean, and education, with clear benefits to people and nature”. However, climate change is not the only impending crisis.

1.2 Pollution

1.2.1 Urban sewage

Sewage has been put to land and used to fertilise crops ever since humans began to farm the land. There have been social objections

and some justification of objection to the risk of transfer of disease. During the industrial revolution, there were certainly problems with pollution by heavy metals. Despite recognition of the problem, the reality is that this is progressing, not regressing. (Han et al 2025) (Femina et al 2022) (Vaardham et al 2019) (Zubowicz et al, 2023) There is one further, potentially very serious and developing threat in sewage products and this micro and nano plastic content. (Casella 2023)

However strong and negative that evidence, the problem does not start with the companies managing sewage. Reducing plastic in rivers (much of which is carried in sewage), and ultimately emissions into the ocean, depends primarily on managing land-based plastic availability and human behaviour, rather than the capacity of rivers to transport such pollutants. (Roebroek et al 2026). Logically, this will apply to all pollutants distributed by rivers, or indeed, any other distribution mechanism.

1.2.2 Industrial

Over the last 200 years, two developments have made a difference to industrial pollution: complexity and volume. Output of heavy metals has certainly continued and, despite regulation, increased in volume. The complexity has dramatically increased with a multitude of Carbon-based molecules. (Leogrande et al 2019) (Isaeva et al 2021) (Hazrat 2019)

There is also a range of what are commonly called “forever chemicals” and more favourably labelled PFASs – polyfluoroalkyl substances. Probably over 10,000 different ones are produced by industry for use in industry and, many of them progress to

domestic use in such applications as the lining in “non-stick” frying pans. Where they end up involves the risk of being inside humans. Some of these have been linked (BMJ 2025) to various health concerns including harming the development of unborn children in the womb, changing liver enzymes, disrupting thyroid function, increasing cholesterol concentrations in the blood and lowering response to vaccines.

1.2.3 Agricultural

Global agriculture has a confusing mixture of plusses and minuses. Farming world-wide produces an estimated 24% of Carbon dioxide emissions. (IPCC 2023) Animal excreta are globally widely used as organic fertiliser. They are widely underused. (Devault et al 2025) Despite that positive, pollution with excreta has, ever since humans domesticated and/or constrained other species been an issue. (Moya et al 2019)

The industrial production of fertilisers has been an enormous plus in feeding the global population, but the cost is significant. (Rodríguez et al 2024) This process relies on using fuels (usually hydrocarbon fuels) which creates significant carbon emissions. Overall, fertiliser manufacturing contributes around 1-2% of global CO₂ emissions. (Menegat 2022) That is around 400 million tonnes per year.

However, volume and sophistication of food produced have dramatically increased in the last century or so.

There is a potentially more serious threat to air, soil, ground water, and the food we eat, from residues of crop protection chemicals. (Chengkai et al 2019) (Sabzevari and Hofman 2022) Organo-

chlorine pesticides (OCPs) were used extensively in agriculture and pest control in the latter half of the 20th century. Some OCPs are identified as endocrine-disrupting chemicals due to their ability to disrupt hormonal homeostasis, interfere with the endocrine system, and consequently cause detrimental effects to humans and non-target organisms.

The presence of pesticides, even in low concentrations, disrupts soil microbial communities, impacts key nitrogen cycle processes, and can reduce soil fertility by killing beneficial microbes. (Zhou et al 2025)

1.2.4 Pharmaceutical residues

There is no doubt that the human race would, on many counts, be worse off without the pharmaceutical industry. It is also true that there is an increasing risk to human well-being and, indeed, life itself, from residues of pharmaceutical drugs getting into all parts of the environment in terms of both complexity and concentration. (Brown et al 2014) (Richmond et al 2018) (Sharma et al 2022) (Lunghi et al 2025)

A multitude of biologically active pharmaceuticals contaminate surface waters globally, yet their presence in aquatic food webs remain largely unknown. (Richmond 2018) Richmond's team showed that over 60 pharmaceutical compounds can be detected in aquatic invertebrates and riparian spiders in six streams near Melbourne, Australia. Similar concentrations in aquatic invertebrate larvae and riparian predators suggest direct trophic transfer via emerging adult insects to riparian predators that consume them. As representative vertebrate predators feeding on aquatic

invertebrates, platypus and brown trout could consume some drug classes such as antidepressants at as much as one-half of a recommended therapeutic dose for humans.

These residues cannot, at least, be a good thing and it may be that these residues are a more urgent threat to human health than climate change. (Butterworth 2025)

1.2.5 Plastics

According to Houssini et al (Houssini et al 2025) for the year 2022, global figures of, 436.66 million tonnes (Mt) of plastics were traded in 2022, with final products alone accounting for 111 Mt. The research study findings “suggest that plastics are subject to geographical concentration, with feedstocks concentrated in oil-resource rich countries and processing in countries with large manufacturing capacity. Furthermore, there is a significant shift in waste disposal: incineration is emerging as a prominent waste disposal method (34%), landfill is decreasing substantially (40%), while the global recycling rate remained stagnant (9%)”.

The figure of 34% incineration necessarily involves production of Carbon dioxide and a number of other pollutants. The figure of 9% recycling, and *stagnant*, is a shameful reflection on the industry, municipal authorities, research institutions and the human race in general. *Not* recycling plastics, because of the energy use in manufacture, and the scope to produce nano and micro plastics (NMPs – see Para 1.2.6 below), is a significant threat to human survival.

1.2.6 MNPs – Micro and Nano plastics

Small particles have been in the Earth environment since the planet was first formed. What is different now is that “plastics” are a fairly recent arrival and small particles of these plastics have either developed from the weathering of discarded plastic or been deliberately manufactured as a product – such as a polish or “blast media” (as is referred to in “sand blasting”).

The global growth in microplastic release into the environment is certainly substantial and not sustainable. Despite that sweeping and alarming statement, there is also an increasing concern that, in at least some cases of research, the wearing of plastic gloves by researchers, and/or the use of laboratory containers and instruments, did at least complicate the issue in that at least some of the NMPs identified came from the gloves, not the material being tested for pollution by NMPs. (Michigan 2026) Nevertheless, there does appear to be sufficient evidence to be concerned, even if a significant danger is in plastic gloves.

One disturbing study concluded that the microplastics in the marine environments were estimated to have half-lives of 3.4 and 58 years. (Wei et al 2021). Another study (Liu et al 2026) pointed to the contribution of NMPs in the atmosphere to global warming. More than 8900 papers were identified as being relevant studies on microplastics in the environment and, in summary, there is little doubt in the scientific literature, and growing so in the public mind, of the potential threat to human and environmental life. (Ghosh et al 2023) (Lamichhane et al 2023) (Ziani et al 2023) (Butterworth 2025)

The threat to human health by NMPs is gradually emerging. Human in vivo evidence confirms that MNPs accumulate in multiple organ systems and are associated with inflammation and functional impairment (Tran et al 2026) and endocrine disruption. (Ullah 2022) Research by staff at Cambridge University (Tien-Smith et al 2026) cited increasing evidence of NMPs related to Parkinson’s Disease.

There is, then, emerging evidence of complex and increasingly negative, effects of NMPs on human life and throughout the wider environment.

However, there are two things that are potentially positive. The first is that there are initial reports of a possible therapy to remove microplastics from the human body. (Coffee 2026) While this is hopeful, this is far from a recognised total cure and was concentrated on microplastics in general and specifically not nanoplastics. What this report does do is point to researchers looking for answers and, no doubt, at least partial treatments will emerge eventually. In the meantime, there is a need to concentrate on not producing them and, where they do exist, to limit distribution. The second hopeful is what this book is about, i.e. to collect what might otherwise be seen as “waste” or potentially dangerous, and treat it in a way that allows beneficial use.

Discussion on pollution

The danger of pollution is such that humans at all levels, from Heads of State to the man in the street, choose to ignore the enormity and urgency of the threat. The evidence we have is that it is progressing.

1.3 Food insecurity

The interesting thing about discussions concerning food security is that it isn't. (Malthus 1798) Ever since 1859 when Charles Darwin first formalised competition and survival in "The origin of species", there has been at least some academic understanding that food supply will, at some point, be limiting. However, that has always been a factor in survival of any and all species.

So, what is different now for humans and why?

The FSA (Food Standards Agency, an agency of the UK government) "has been tracking consumer experiences of food access and affordability for some years. Our data tells us that increasing numbers of consumers are being forced to make difficult choices when it comes to food". (FSA 2026) No doubt many other governments might report the same way from time to time depending on local circumstances. Indeed, the UN's WHO (World Health Organisation of the United Nations) reports in the same year of 2025 that food price is a global issue and that global hunger declines generally but rises in Africa and western Asia. (WHO 2025)

What is different for humans is that they appear to think that they exercise more influence than other species over the control and use of resources and, therefore, they have a choice – especially over the resources used for food production or something else – including military action. (Or is that really any different from any other species?)

Whatever the discussion, that same report from the WHO estimated 8.2 percent of the global population, or about 673 million

people, experience significant hunger, enough to damage health and life expectancy.

There is another aspect of food security – or at least a further risk to that provision. The manufacture of nitrogen fertiliser takes very significant energy. One tonne of nitrogen fertiliser nutrient (equivalent to 3 tonnes of ammonium nitrate fertiliser) made in a modern and efficient USA factory, takes 21,000kWh of electricity to make and deliver. (Gellings and Parmenter 2004). Many factories around the world are significantly less efficient. When used excessively, more than 50% of these N inputs are not used by the crop but lost to the environment, causing severe air and water pollution, soil acidification, ozone depletion, biodiversity loss, and climate change (Waqas et al 2023)

Even though what is discussed here is certainly complex in itself, the fact is that food security is more so. (Santeramo 2024) Nevertheless, this text is a contribution to the jigsaw puzzle.

1.4 Global Financial system sustainability

The worldwide financial crisis of 2007–09 has shown the importance of cross-sectional dependencies of assets, credit exposures and volatility, which can threaten domestic and global financial stability through cascades in financial networks. (Duygun 2020) However 5 years later, the FSA (Financial Services Authority of the UK) concluded that “Against the heightened volatility of asset prices, (the report) assesses that global financial stability risks have increased significantly.” (FSA 2026)

It might be argued that the objectives of those people who influence or control the use of money and resource, generally have

little more than verbal sympathy for those with knowledge of the matters raised in this Chapter of this book. That raises a serious question and difficulty. There appears to be a significant disconnect between the problems outlined here and the global control of money which might be used to control the resources necessary to manage these risks.

1.5 The need for a degree of independence to get global action at speed

Delivery of anything certainly demands teamwork. Individuals necessarily depend on others. Teamwork may well support discussion, but it is individuals who create that spark of ingenuity, that crazy idea, that innovative thinking which allows the vital crack in a problem which progresses solutions. Therefore, nurturing respect for individual thinking is a necessary part of managing progress. It also follows that regulation not only demands control of the negative, it also needs enabling of change. There is here a danger: How to manage encouragement of creativity in individuals without failure to control risk.

It may be said that it might well be true that for something to be environmentally sustainable, it has to be financially sustainable. Similarly, for financial sustainability, environmental sustainability is also necessary. These are not alternatives; they are fundamentally mutually inter-connected.

Conclusions

- There are significant threats to human survival.

- The question must then be raised as to the options, the opportunities and how to use knowledge to deliver a new balance and survival.
- That new balance has, from the start, to be both financially and environmentally sustainable.
- Action is urgent.
- How can risks be balanced?

Questions

1. Which of these risks have already limited human survival? In what way?
2. Which of these risks might be considered to be most potentially lethal to the rest of the human race?
3. Which of these risks might be considered to be most urgent in time?
4. Have any of these risks passed their catastrophic tipping point?
5. How can this be known?
6. When can it be known?
7. Is it really worth doing anything now?
8. If so, what can be done and by whom?
9. How can that action be triggered?
10. Who will finance progress?

Section 2.

Where do we want to be?

*Answers are relatively easy, especially if you have enough resources.
The difficulty is: what is the question?*

Harold M Butterworth

Chapter 2

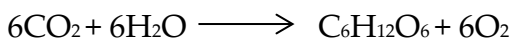
The global Carbon-Oxygen relationship

2.1 The Carboniferous Era – reversal has been done before

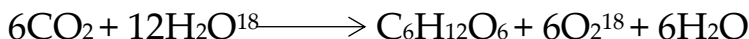
For the purposes of this text, it suffices to observe that atmospheric Carbon dioxide, sometime before the Carboniferous Era, might well have been between 4000 and 7000 ppm, (Hönisch 2009) (Rothman 2002) and during the Carboniferous Era, it came down to 400 or even 200, and has fluctuated ever since around the 180 to 400 ppm with a reasonably well-established figure of around 200ppm pre-industrial revolution. For nearly a million years, atmospheric CO₂ has not been above 300 ppm. (Lüthi 2008) Since then, it has doubled to just over 400 ppm. (Costantini, 2024) Global warming is keeping in step.

2.2 Photosynthesis

The statement above in 2.1, “Reversal has been done before” is certainly partially true, but not quite as might be possible today. The fundamental equation from the Carboniferous Era does still apply today.



While that equation is not wrong, it does not show an interesting source of the CO₂. A bit more of the way the system works can be seen by the rewritten equation with some added H₂O.



Plants, algae and cyanobacteria are oxygenic photosynthesisers that use light energy to generate organic molecules (e.g. glucose ($\text{C}_6\text{H}_{12}\text{O}_6$), sugars, starch) from carbon dioxide (CO_2) and water (H_2O) and release molecular oxygen (O_2) into the atmosphere. Note that the above global equation of photosynthesis emphasizes that the oxygen molecules released into the atmosphere originate from water oxidation, not from carbon dioxide, as established by Samuel Ruben in 1941 using ^{18}O -labelled water. (Rumberg et al 1962) (Muller and Witt 1963) This being the case raises another question which will be discussed in Chapter 3, para 3.3.

The basic efficiency of the photosynthesis process has, however, changed. When green plant chlorophyll first carried out this process back in the Carboniferous Era, the proportion of Oxygen in the atmosphere was less than it is now. For maybe 10,000 years up to around 1750 the figure was fairly stable at around 289 ppm. However, the industrial revolution began to burn coal and we have escalated the burning of all fossilised fuels ever since and Carbon dioxide in the atmosphere rose to around 340 ppm by 1989, and to 405 ppm by 2018. It is still rising. That rise puts a very significant risk on the survival of human civilisation as we know it.

That figure of 4000 ppm or more (as raised in 2.1 above) 500 million years ago has a very interesting consequence. Plants which evolved then did so under the conditions at that time and the process of photosynthesis, which used energy from sunlight to take Carbon dioxide out of the atmosphere to make sugars and