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Review

Sustainable Economics: Systems Thinking and the More-Than-Global Pluriverse

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ABSTRACT: This paper argues that since the Earth system is the organizational framework within which we find our place, and the ultimate arbitrator of ecological, social and economic sustainability and well-being, then any strategy that would deliver a prosperous, functional and flourishing future must circle around the properties of this complex system and be aware of the implications of these characteristics for our own activities and decisions. To do otherwise would be a strategy of doubtful value. The nature of the Earth system is then explored. We examine the global and the local aspects of this system, in terms of many worlds in one world, the pluriverse. The ecological, social, and economic pluriverses are seen to be nested within one another, and are each emergent entities that arise from the Earth system as a whole. The economies of the biosphere are examined across individual, population, community, and ecosystem levels, across a range of biomes, each of which is specialized in accordance with local conditions. In terms of human economic activities, it is suggested that regional strategies and policies are required, rather than global approaches such as the sustainable development goals. These must be designed to maximize ecosystem functioning and human well-being, which are themselves required for successful net economic growth. Furthermore, human economic activity in each region should resonate with the natural economies in that region. Finally, this thinking is applied to the urban setting, drawing on the work of Geddes and Magnaghi, exploring this in terms of the Earth system and its emergent local outcomes, the ecological, social, and economic pluriverse.

Keywords: Complex system; Dùthchas; Earth system; Emergence; Natural economics; Non-linearity; Sub-optimality; Territorialism

1. Introduction

As concerns grow relating to the environmental and social challenges facing humanity, the impacts of our economic activities have increasingly come under the spotlight in terms of their contribution to the causes of and solutions to these problems. The recent history of modern humanity is a brief one, particularly in the Northern Hemisphere, which has seen the most rapid development of separation between humanity and its natural ecology, and of treating the planet merely as a sink and a source for economic gain and power. This period stems back to the end of the Younger Dryas ice age in the late Pleistocene, some 11,600 years ago [1].

What was so dramatic about the Younger Dryas ice age was that Northern Europe went from temperate forest conditions to an ice-covered landmass unfit for human habitation within a few decades [2]. Yet today, many people are largely ignorant of the huge impacts of the immense geological and climatological events of the past, and the power of the Earth system to dramatically alter the conditions that we rely upon for our survival.

Interestingly, many indigenous societies have narratives, passed down through oral traditions, which go back much further in time, informing their understanding of the planet and of societies [3–5] through geomythology. Geomythology is defined as seeking to "find the real geologic event underlying a myth or legend to which it has given rise" ([6], p. 5). MacCormick, who spent years gathering ancient Gaelic tales from the people of the island of Mull, off the west coast of Scotland, came across an intriguing tale about Cailleach, the goddess of creation and destruction, and guardian of nature, referencing her as saying "When forests grew where now the billows play, I was then a winsome maid" ([7], p. 69). Furthermore, MacCormick refers to another legend that cites Cailleach as utilizing the fertile grazing grounds between Torrin Rocks and Dubh Artach Lighthouse off the southeast coast of Mull for her numerous herds of deer. These 'grounds' now all lies beneath the Atlantic Ocean.

This tantalizing quote could reflect on a time when the oceans were in recession, during the ice ages, and trees grew on what is now the sea floor. Recent archaeological work has uncovered a submerged forest off the island of Benbecula, just south of Harris, in the Outer Hebrides, dating to 6600 BCE [8]. Joyce ([9], p. 462) noted that "the Gaelic tales abound in allusions to a beautiful country situated under the [Irish] sea—an enchanted land sunk at some remote time, and still held under spell. In some romantic writings, it is called Tir-fa-tonn, the land beneath the wave".

Thus, much traditional knowledge, in the forms of myths and legends, recognizes the immense power and dynamic nature of our planet. Some also reference how to manage cataclysmic events, such as tsunamis. In Simeulue, Indonesia, traditional knowledge is passed down over generations in many poems, songs, and stories, collectively called 'Smong', that warn of the signs of an impending tsunami and what to do, including information on animal behaviour to watch out for. This led to almost all of the population surviving the 2004 magnitude 9.2 earthquake, whereas neighbouring islands, without such a heritage, had devastating losses [10,11]. Thus, a close association with the planet, as seen in all indigenous cultures, leads to a practical insight into the dangers inherent in this system, ultimately saving lives.

Fundamental to all of this is the Earth system, the complex, interactive sphere within which all of life exists. It is essential to understand how this arbitrator of our existence functions in order to begin elucidating how we can best contribute to a sustainable world within which we can all achieve our full potential. Complex systems theory underpins the key properties of the Earth system.

Understanding the interactions between the individual, society, and the Earth system as a whole is also important. It has been the focus of philosophy and broader social and environmental studies for as long as records exist, going back thousands of years to the cave paintings of Lascaux and the many indigenous narratives from across the globe. Economic theory itself has been understood as a behavioural science, with Robbins ([12], p. 16) writing that: "Economics is the science which studies human behaviour as a relationship between ends and scarce means which have alternative uses", adding that "humans want what they can't have".

Adam Smith [13] suggested that an invisible hand, preventing excess, emerged from a functional society. He discussed this emergent morality in his first book, The Theory of Moral Sentiments [14], and developed this idea in his later treatise on economics and the free market in his second book, An Inquiry into the Nature and Causes of the Wealth of Nations. In The Theory of Moral Sentiments, ([14], pp. 184–185), he noted: "[The rich] consume little more than the poor, and in spite of their natural selfishness and rapacity... they divide with the poor the produce of all their improvements. They are led by an invisible hand to make nearly the same distribution of the necessaries of life, which would have been made, had the earth been divided into equal portions among all its inhabitants, and thus without intending it, without knowing it, advance the interest of the society, and afford means to the multiplication of the species”. This became known as virtuous self-interest. However, the economic thesis of his second book is built upon a functioning society as described in his first book, which is central to any understanding of Smith’s vision of an equitable, sustainable economy [15].

Humboldt saw the relationship between humans and their ecological context as fundamental to how we live, writing: “In considering the study of physical phenomena, not merely in its bearings on the material wants of life, but in its general influence on the intellectual advancement of mankind; we find its noblest and most important result to be a knowledge of the chain of connection, by which all natural forces are linked together, and made mutually dependent upon each other; and it is the perception of these relations that exalts our views and ennobles our enjoyments” ([16], p. 23).

These ‘chains of connection’ underpinned his concept of ‘Zusammenhang’ (literally, hanging together), wherein what we now refer to as the Earth system acts as a super-organism (sensu Hutton [17]), of which we are a part. Thus, we can conceive of an extended invisible hand, or invisible embrace, wherein the relationships between self, society, and environment inform our decisions and behaviour, including those relating to economics [15].

2. Aims and Objectives

This paper sets out to understand the basis of a sustainable economy in terms of its impact on societal and environmental sustainability. Firstly, the Earth system is understood as the organizational framework within which we find our existence. Its key characteristics are explained. We then explore how the Earth system is an ecological pluriverse, a world of many worlds, with different bio-geophysical contexts across our planet. The paper then explains why these contexts are important in terms of the functionality of the system locally, and for social and economic sustainability.

The natural economics of these different ecosystems vary across the planet, and examples are given. Over our evolution, cultural practices have emerged from within each of these ecological worlds within the global Earth system, at the level of the landscape, place, and people, the social pluriverse, with many different philosophical frameworks in resonance both with the global and the local. Finally, for millennia, humans have practice economics in resonance with the local landscapes, tuned to the functional identity and the natural economy of the ecosystems within which they live: an embedded economy [18–22]. We explore what this means for modern humanity in terms of an economic pluriverse.

In order to understand these relationships, this paper sets out an integrated approach where economics is nested within society and society is nested within the Earth system, each representing a set of worlds within one world: the pluriverse.

In this synthetic review, a literature search was conducted across major academic databases, including Scopus, Web of Science, IEEE Xplore, Google Scholar, ResearchGate, ScienceDirect, and SpringerLink, using multiple search terms including: embedded economics, ecological lag, regional economic policy, pluriverse, more-than-human, complex system, Earth system, emergence, natural economics, non-linearity, sub-optimality, territorialism, glocal, and Dùthchas. Critical reviews were included. Over 1000 papers and chapters were studied across these areas, and where papers overlapped in content, the most cited papers were referenced, provided they made the clearest contribution (a decision made by the author, based on many years of working and teaching in this field). Priority was given to Open Access papers in order to facilitate easy access for readers.

3. The Nature of the Earth System

Bianconi et al. [23] define a complex system as “a distributed set of entities with many interconnections (usually networked), where each entity self-operates locally with its neighbouring entities, and exhibiting globally emergent behavior". The International Geosphere-Biosphere Programme [24] defined the term 'Earth System' as the suite of interlinked physical, chemical, biological, and human processes that cycle (transport and transform) materials and energy in complex dynamic ways within the system.

The Earth system is the arbitrator of our future prospects and has always been so. Mass extinction events were a natural outcome of the Earth system's response to perturbations. While Crutzen and Stoermer [25] have suggested the term 'Anthropocene' to describe the geological era in which human activity has been the dominant influence upon the natural world, in reality, it is the Earth system that has always held this role, determining the biogeophysical conditions and the envelope of life (the biosphere) [26].

Complex systems have a number of key characteristics that should enlighten all sustainability policy and practice, since our futures are predicated upon 'hanging together' (sensu Humboldt [16]) within the Earth system.

Firstly, they self-assemble and self-organize, properties that are observed throughout the cosmos, from flocking birds to galaxies [27–29]. Mass extinctions throughout the history of the Earth system have led to re-assembly and re-organization of life on earth [30]. What is interesting is that the new assemblies, while functionally similar (with detritivores, herbivores, and carnivores), are structurally very different. For example, following the K/T mass extinction event 65 million years ago, the dinosaurs were replaced by mammals and, to a lesser extent, birds, as the dominant herbivores, omnivores, and carnivores.

Thompson [31] referred to the importance of this organizational drive when he wrote, "We rise from the conception of form to an understanding of the forces which gave rise to it… forces that have sufficed to convert the one form into the other". Thus, transformation, while evidenced by structural change, can best be understood as an emergent outcome of the greater system, which is 'hanging together' as a dynamic, interactive whole, wherein feedback across the system acts as the invisible embrace across the entirety.

Secondly, these systems demonstrate emergence, in which the system's properties belong to the system itself rather than to any given component [32]. Lewes ([33], p. 413) noted that "the emergent is unlike its components in so far as these are incommensurable, and it cannot be reduced to their sum or their difference". This is an important point, highlighting the fact that reductionist thinking is irrelevant here. Resilience is an emergent property and cannot be built [34]. A loss of resilience occurs before catastrophic population collapse and thus is symptomatic of further emergent outcomes, the causes of which are still unknown [35].

Only by careful monitoring can we pick up on signals of dramatic shifts in system functionality, and, thus, real time feedback is essential. The communication channels between the components of the Earth system, both biological and physical, include ions and other chemicals, as well as mass and energy, acting as key sources of information [36]. There are some 30 billion smart devices on the planet, and thus we have the power, through the internet of things, to monitor these channels across the Earth system, providing some knowledge of how the system is responding to our inputs and giving us the opportunity to respond [37–40].

Non-linearity is another important characteristic of complex systems. Strogatz ([41], p. 182) observed that "every major unsolved problem in science—from consciousness to cancer to the collective craziness of the economy, is non-linear". Non-linearity can be understood as the existence of multiple unstable states between which the system can shift, often leading to regime shifts and tipping points that are difficult to predict. Many examples have been observed across economic, ecological, and social arenas, and, more often, simultaneously across all three [42–48]. Given the complexity of the interactions leading up to dramatic change, feedback across a wide range of indicators is essential.

Trade-offs are extremely important in complex systems. Because there are so many demands across the system, no single demand can be resolved optimally without jeopardizing the solution space of all other demands; otherwise, the system will fail [49,50]. For example, if we optimize DNA correction, there will be no genetic variation, meaning that there will be insufficient options to meet changing conditions [51]. By optimizing for agricultural productivity, humanity has created eutrophication, due to runoff of fertilizers

[52], impacting freshwater and coastal shores and creating dead zones. Soil compaction has increased due to increasingly heavy, complexed machinery [53]. Soil salinity has increased due to increased irrigation [54]. Herbicide resistance has increased with the widespread use of herbicides (much like antibiotic resistance) [55]. And so, our attempts to optimize crop productivity have sown the seeds of agricultural collapse. We see sub-optimality across the Earth system, and it is a sign of a working system [56–59].

What is important is the level of sub-optimality that best serves the system. However, because the Earth system is a dynamic non-equilibrium system, the trade-offs necessary will change over time. Here, again, feedback is essential, as is the inclusion of dynamic sub-optimality in any design process. Much as carrying capacities do not remain constant for a given landscape [60,61], in similar ways, appropriate trade-offs will increase or decrease over time.

Thus, the Earth system has a number of characteristics that pose challenges in terms of sustainable outcomes. Table 1 summarizes these and explores important approaches to responding to these challenges in business and more generally.

Table 1. Summary of key challenges posed by Earth system characteristics, and possible approaches to meeting these challenges.

Characteristics	Challenges	Approaches
Self-organization	Implications for our own organizational plans; occurs at every level of organization with unexpected consequences	Emphasise process-based planning rather than structure-based planning; develop multi-level appraisal of development, not merely single component level
Emergence	Difficult to predict and impossible to control; barriers to recognizing the system as the centre of control	Increase ecological intelligence and technological feedback to monitor impacts of actions at every level of organization
Non-linearity	Difficult to design adaptation, given potential regime shifts; difficulties in forecasting and planning	Study and monitor changes in resilience, which often occur prior to regime shifts; prioritize research into other warning signs of imminent transformation
Real-time feedback	Decline in socio-ecological knowledge due to dualism; ignorance of systems theory due to reductionism	Actively increase formal and informal education programmes for system awareness for all ages; increased training in Earth system economics; major adoption of 30 billion smart devices, citizen science and the internet-of-things to restore feedback links
Sub-optimality	Drive for efficiency and optimization; silo thinking leads to denial of the necessity of trade-offs at every level of organization and of embeddedness of all components	Increased awareness of the importance of trade-offs in design; eradication of silos; system-level planning, research into appropriate sub-optimality operons for process design; trade-offs as part of policy; system-level assessment of impact

4. The Global and the Local: 'Ways of Being' within the Earth System

The Earth is not a singular, uniform entity. Due to its spherical shape (resulting in higher levels of incident radiation at the equator than at the poles), its axial tilt, the location of its land masses, tectonic plate movement, global oceanic and atmospheric circulatory systems and changing atmospheric gas content, very different conditions occur across the planet, both in temporal (seasonal and across geological time) and spatial (altitude and latitude) terms. Climatic differences impact on the biodiversity, both structurally and functionally.

While the characteristics of the Earth system operate globally, they are expressed differently depending on the local biogeographical conditions. This is fundamentally due to the energetic context, which drives everything else, from natural economics (*i.e.*, the economics observed within natural ecosystems in terms of growth, resource allocation, marketing (e.g., for pollinators), and storage), through to meteorological conditions (where energy drives atmospheric/oceanic circulation patterns and the hydrological cycles).

Table 2 explores the economic activities of a particular organism and how they compare to business economics. Two points are important here. Firstly, Earth system economics operates at every level of organization and across these levels, because all levels are integrated and dependent on one another, from individuals to populations, communities, and ecosystems. Secondly, because of temporal and spatial heterogeneity, these natural economies are structured with very different emphases and financial strategies, depending on the conditions prevailing at that particular place and time.

The natural economies of the different ecosystems across the globe vary radically. For example, a tropical rainforest behaves very differently than a savanna or a tundra ecosystem (see Table 3). Indigenous populations located in these ecosystems also differ significantly.

Table 2. Economic terminology in nature and their parallels in business.

Natural Property	Example	Business Equivalent
Gross productivity	Total energy income	Gross income
Net productivity	Production minus costs	Cash flow
Ecological disturbance and competition	Increasing costs in acquiring resources	Inflation
Free energy	Available energy for work	Capital
Stored resources	Tubers/corms/bulbs/starch	Assets
Resource allocations	Root to shoot ratio	Asset allocation
Respiration	Maintenance and growth	Liabilities
Nutrient turnover	Asset realization	Liquidity

Table 3. Differences between three major biomes across the planet.

Characteristic	Tundra	Tropical Rainforest	Savanna
Annual precipitation (mm) [62]	200–1000	2000–4600	400–1500
Mean temperature (°C) [62]	−15 to −5	20 to 30	18 to 30
Carbon turnover time (years) [63]	65	16	14
Root to shoot ratio [64]	6.6	0.19–0.34	0.7
Roots in top 30 cm of soil (%) [64]	93	69	57
Incoming radiation (watts·m^{-2}) [65]	180	260	250
Net radiation (watts·m^{-2}) [65]	−125	75	50
Seasonality [65]	Extreme	Moderate	Moderate
Fire risk [66]	Moderate	High	Very high
Economy [67]	Store/spend	Spend	Spend

This paper suggests that our economic activities should also align with the natural economy to reduce our impact. We will explore this through the lens of the pluriverse concept.

5. Pluriverse Thinking

The concept of a pluriverse was defined by James ([68], p. 125) who described it as: "Things are with one another in many ways, but nothing includes everything or dominates over everything". More recently, pluriversal thinking has been limited to the domains of post-globalization and post-development philosophy, insisting that different ontological approaches produce different materialities and realities, and that these approaches can and should exist concurrently [69–71]. Thus, it is argued, there are many ways of being in the world and being of the world, rather than a universalist, globalist approach based on a single, reductionist, individualist, and dualistic (where humans and nature are separated) mode of being [72,73].

The concept of a pluriverse has been critically received [74]. Pluriversal thinking can appear as a set of alternative economies reflecting a very different cosmovision than that of the globalized one-world world (OWW) of Western economics: a biverse rather than a pluriverse. This alternative vision is often an emergent outcome of indigenous political, social, natural, and religious-spiritual theory [70,75]. Such an approach can appear very challenging for a more rectilinear, empirical school of thought, as in OWW philosophy, meaning there can be little consensus between these two positions [76,77].

Hence, there is a risk that the concept of the pluriverse could represent a politico-social divide, preventing integration of the many indigenous and post-development philosophies with Enlightenment philosophies within one world of many worlds [70]. Furthermore, potential issues arise at the economic level. How can a global and a local economy function alongside each other? Localized differences in ethical philosophy, culture, and legislation could impact governance and supply chain accountability [39,78]. What does this ‘world within which many worlds fit’ actually represent? Can it function, and what evidence exists for this? In this paper, it is argued that a fully functioning pluriverse does exist: the ecological pluriverse. Over many thousands of years, indigenous traditional communities have formed embedded, cohesive societies within this ecological pluriverse: the social pluriverse. In turn, the economic activities of these communities have formed an economic pluriverse.

In this paper, the pluriverse will be considered at these three levels: the ecological pluriverse, the sociological pluriverse, and the economic pluriverse. These are viewed as nested within each other, in which society emerges from the ecology, while economics emerges from a nested society. Thus, as mentioned above, we have the concept of an invisible embrace [15], which drives appropriate behaviour within the Earth system, wherein our economics is both sustainable and healing for our social and environmental relationships.

At the heart of this lies real-time feedback (Table 1). Only when our economic activities are embedded within our environmental and social contexts can we contribute to a sustainable future [18–22]. It is not enough to reduce our negative impact; rather, we must positively contribute to the Earth system to increase resilience and reduce the risk of non-linear regime shifts. Murray et al. [79] stress that what is needed is: “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”. Human well-being is dependent on ecosystem functioning [80]. This is the Zusammenhang of Humboldt, as encountered earlier. The British economist, Dasgupta ([81], p. 497), emphasises the interplay between communities, nature and well-being, observing that: “If contact with the natural world is a means to furthering personal well-being, connectedness with Nature is an aspect of well-being itself”.

6. The Ecological Pluriverse

While many argue that the pluriverse is an abstract concept, the Earth system acts as a fully functioning example. As we have noted, the biosphere is spread across a number of biomes, each with very different properties. The global, complex Earth system, with its core characteristics, as noted earlier, is realized in different ways depending on the biogeographical context of its location. Here, place is everything, and complex systems theory operates through the local conditions (Table 3).

Each world within the pluriverse of worlds has a unique economy, which is energetically fitted to the conditions, with an appropriate fiscal strategy. The economy is not the property of one single individual or species, but is a highly integrated whole, operating within local and global contexts. Thus, it is an emergent outcome, non-linear and sub-optimal at any given component level [18,82], with the system expressing itself locally, within the greater whole. Indeed, sustainability within this context can be seen to require local, regional policies and approaches [83], rather than applying a global bauplan and global policies across the pluriverse [84]. Strategies and policies designed for a tropical rainforest are unlikely to achieve success in the tundra, for example (Table 3).

7. The Social Pluriverse

The social pluriverse is seen as emerging from the ecological pluriverse, in which early human societies were obligated to embed within the landscape and ecology to survive [85–87]. As a result, socio-ecological cultures emerged [88,89], and ecological ethics developed [90]. Linkages were strengthened through myths and legends, and through art and the oral tradition [91–93].

Here, the social pluriverse is seen as emergent from the ecological pluriverse, in resonance with the global Earth system and the local biogeography. Change through time is also fundamental, as the Earth system is a dynamic, far-from-equilibrium entity. By developing ways of being that are tuned to the boundaries and patterns that define the ecological space available, a sustainable paradigm arises. This avoids the tragedy of the commons (sensu Hardin [94]), wherein humans drive themselves to destroy the ecology that provides for their survival.

Thus, the Earth system represents a global integrity and a local plurality, which represents a form of 'glocalism', combining the global and the local [95–98]. Mihr ([99], p. 15) defines glocalism as "a process of norm diffusion from the local to the global and from the global to the local". Interestingly, the term is thought to have been inspired by the Japanese concept of 'dochakuka', referring to the adaptation of farming techniques to local contexts. In many ways, the glocal represents a functional pluriverse, where common values and local emphases operate together.

8. The Economic Pluriverse

The natural economic pluriverse exists throughout the Earth system and is itself an emergent form of the ecological pluriverse. Each organism, population, community and ecosystem practice economics that are relevant to and resonant with the temporal and spatial conditions specific to their landscape and climate (see Table 3). Fiscal planning is finely tuned to the energetic, nutrient and hydrological context, but sub-optimal for systems theory reasons and because of ecological lag [22,100]. Ecological lag means that the system takes time to catch up in terms of any significant changes that have occurred in the past. For example, Trinidad was once connected to mainland South America, only becoming separated a few thousand years ago [101]. As a consequence, species diversity has been decreasing since this time due to the species richness-area relationship (*i.e.*, the smaller the area, the lower the species richness). Hence, any study of decreasing species richness in Trinidad must take into account changes due to a lag in adjustment to dramatic events millennia ago. Ecological feedback can act over huge timescales. Another example of lag is isostatic lift, where landmasses previously covered in ice can be rising relative to sea level, thus masking sea level rise [102].

Seasonality, incident radiation, fire ecology, nutrient turnover rates, competition, and opportunity all provide input to natural economic decision-making. This is because survival depends on an embedded economy, responsive to the state of the commons and the dynamics of the system as a whole [69]. Real-time feedback is an essential component, and drastic economic collapse can occur through non-linearity if tipping points are crossed [103]. As Bloom ([104], p. 98) observed: "A pattern of resource acquisition and allocation that is efficient in one climate may prove disastrous in another". Thus, it seems clear that human economics should follow a similar path for a sustainable future.

This paper suggests that rather than a global, one-world world (OWW) economy, a set of alternative economies, rooted in localism, place, and ecology, while emergent from the ecological and social pluriverse, would be more likely to lead to sustainable, resilient outcomes, within the human, ecological, and economic arenas, since these arenas are tightly interdependent. This also requires a policy pluriverse, where, rather than global sustainable development goals, for example, we have regional, relevant sets of policies that are resonant with the local conditions [83,84,105,106]. For example, turnover rates vary hugely across the ecological pluriverse (Table 3), and what might appear as a renewable resource in a region with fast turnover rates may not be renewable in a region with slow turnover rates. Also, disturbance events will take much longer to naturally ameliorate in areas with slow turnover rates. Furthermore, resilience varies across regions, depending on functional redundancy and disturbance regimes [107–109].

In terms of policy, it is fundamentally important to assess economic growth as net economic growth (*i.e.*, man-made capital) with social costs (such as increased healthcare expenditure) and environmental costs (such as sea level rise, red tide events, soil salinity and air pollution) subtracted, and gains, both (such as reductions in healthcare costs relating to asthma and healthcare costs related to extreme temperatures) and environmental (such as reduction in agricultural failure relating to climate destabilization, and insurance payouts related to flooding, for example) added, rather than gross growth [18]. Governance processes that can more fully recognize complex system outcomes such as tipping points and emergence, should be implemented [110]. Furthermore, priority should be given to information governance in the shape of policies around disclosure, while shifting governance approaches from merely reporting to delivering action [106]. Only by doing this can a true understanding of productivity be calculated. Policies should also recognize heterogeneity across the ecological and social pluriverse, with relevant measures reflecting the characteristics of the landscape and ecology. An analytical framework is presented in Figure 1.

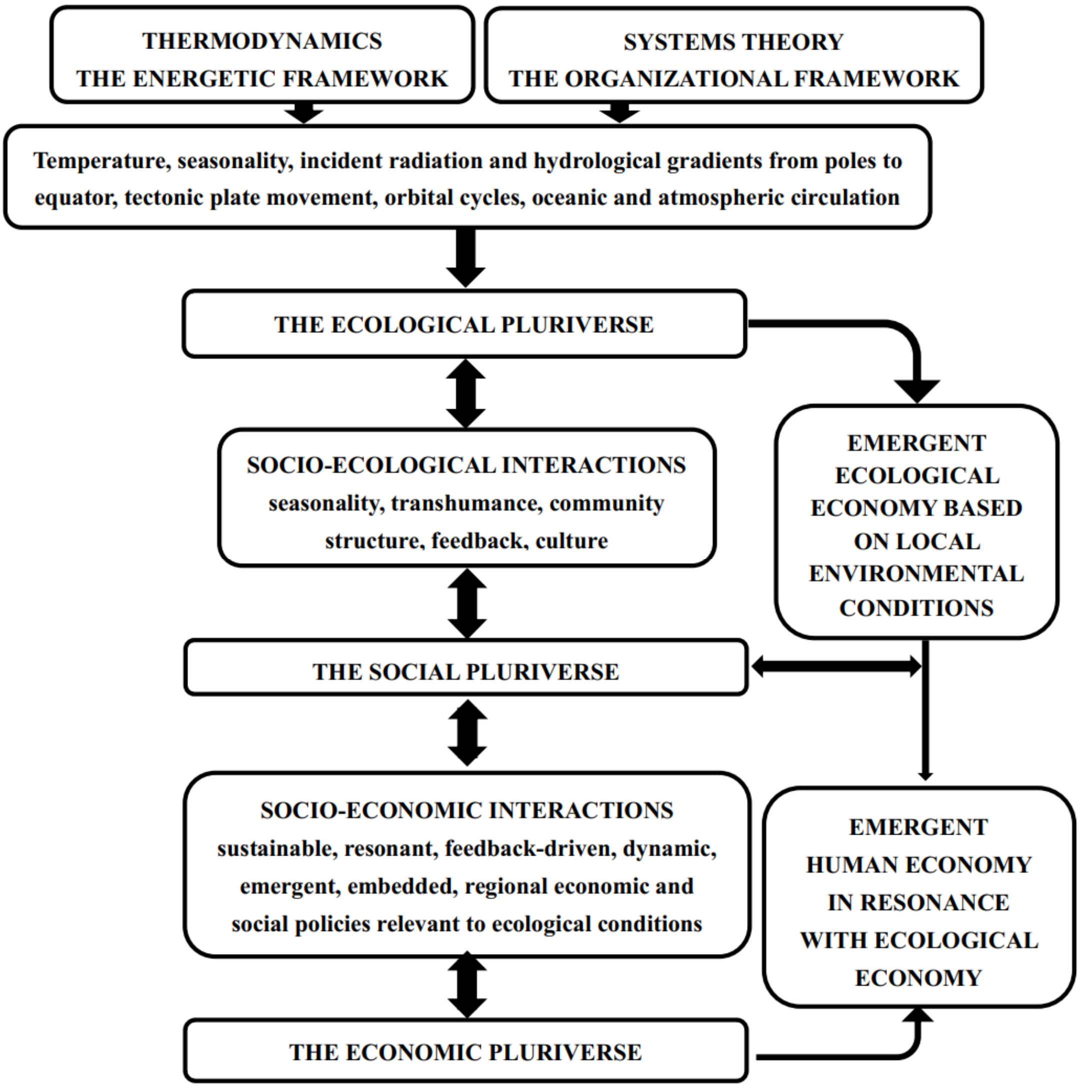

Figure 1. An overview of the ecological, social, and economic pluriverse.

9. Urban Contexts of the Ecological, Social, and Economic Pluriverse

The ecological pluriverse is easily appreciated in rural settings, where the landscape is evident. However, 55% of humans live in urban settings, and this is predicted to rise to 68% by 2050 [111]. Thus, if the ecological pluriverse is to be a foundational principle upon which to base sociological and economic sustainability, then how can an urban setting be relevant to the surrounding rural landscapes? In fact, much research has been carried out on this, beginning with the theoretical and practical work of the city planner, Patrick Geddes. Geddes understood the city as being situated within the cultural and ecological contexts of its surroundings, knitting together landscape ecology and green urban city space. He brought together people, their social structures, and the environment [112], approaching town planning as a holistic endeavour.

Geddes [113] explored the importance of the local landscape and ecology in terms of regional planning. He rejuvenated urban slums by referencing cultural history and the ecology of the territory in which the city was located, bringing a multi-dimensionality to urban renovation. This thinking stemmed from his 'valley section' concept [114], which saw the city as expressing the region, and vice versa. Geddes ([115], p. 106) wrote: "As the river carries down contributions from its whole course, so each complex community, as we descend, is modified by its predecessors".

Cosgrove [116] noted that the valley section defines our modern concept of community as emerging from the environmental context and the social history. Economic activity is reflected in both ecology and sociology, as Geddes referred to it, in his trinity of folk, work, and place. The region and the city are seen as integrated and embedded within each other, forming true regionality. Thus, urban planning should be informed by this nature/culture context.

Magnaghi, the founder of the Italian school of Territorialism, discussed the emergence of a consciousness of place, challenging the contemporary economic logic that dislocates the relationship between environment, work, and living. The rebalancing of this relationship implies a reappropriation of economic processes by local populations. Magnaghi [117] envisaged the territory as a living being, with an identity stemming from its geophysical configuration and from reciprocal adaptations between ecology and society over time. By understanding these relationships, regional planning can further embed economics, ecology, and sociology within each other.

Magnaghi discussed Olivetti's work on territorial justice, reflecting that Olivetti set out "a practice of community self-government of territories which advocates for a general reform of the institutional hierarchy. Such progress, founded on a 'holistic' conception of territory as a historical-social subject pre-existent to production relationships, and resulting in an apolitical project in which the primary decision-making level resides in local territories" ([118], p. 57).

All of this relies on a connectivity between community and place, and we see this explored in a number of ways. The Gaelic philosophy of sustainability, Dùthchas (in Scottish Gaelic) or Dùchas (in Irish Gaelic), from the Gaelic word 'dùth/dù', meaning earth or land, is relevant here. Starmore [119] described it as: "a feeling of belonging, of where everything is linked, completely linked. Where you belong to the land, and the land belongs to you—there is no distinction". Ó Tuama ([120], p. 28) notes that in this philosophy, "there is a sense in which place finally becomes co-extensive in the mind, not only with personal and ancestral memories, but with the whole living community culture. Community becomes place, place community". Newton ([121], p. 453) writes that these ideas "encode, transmit, and reinforce particular ways of thinking about the relationship between people and nature". These ideas are prevalent in much traditional thinking, such as the sub-saharan African concept of ubuntu, and the South American sumak kawsay and buen vivir, where reciprocity, connection, and relationality are core characteristics [122,123].

10. Conclusions

Sustainable economics must be practiced within the Earth system, embedding itself within the multitude of feedback loops that form the lifeblood of the system itself and of the many components within it. At a local level, the ecological, social, and economic pluriverse can be seen as emergent entities, and by having regional policies and practices, relevant to the local ecology, we give ourselves a much better opportunity for a sustainable future. Technology can be important, both in terms of feedback through the vast array of smart devices and the internet-of-things, and in implementing appropriate sub-optimality operons that manage trade-offs across the social, ecological, and economic arenas, rather than optimizing for efficiency and economic growth. Indeed, the depreciation of natural capital will overwhelm any gross profit unless addressed, and so a system-based, pluriversal economic programme is the only profitable direction. An analytical framework and roadmap for implementing the ideas set out in this paper are detailed elsewhere [124]. A re-evaluation of our activities in light of complex systems theory and pluriversal thinking can be seen to not only provide a positive way forward, but also represents an essential step, given the fact that the Earth system acts as the arbitrator of our future prospects, both socially and economically.

Ethics Statement

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Informed Consent Statement

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