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Socio–Ecosystemic Sustainability

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Abstract: In its most recent report, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) announced an unprecedented dangerous decline in biodiversity, one of the planetary limits that are currently being surpassed. The results and trends of socio–ecosystemic problems oblige us to attempt to understand and address the global crisis. Socio–ecosystemic problems are not only ethical and moral challenges but also ones of interest and security, since the financial resources available will be insufficient for people immersed in a sick and dysfunctional society. In this sense, science plays a central role in offering alternatives. This work is a theoretical construction, based on complexity and transdiscipline, that aims to offer these alternatives. It is enriched by several areas of knowledge, with the objective of broadening the interpretation of sustainability and overcoming some of the limitations of existing approaches through the recognition of the objective and subjective relationships between humans and ecosystems. Socio–ecosystemic sustainability is an adaptative process, taking the principles of strong sustainability and autopoiesis as an explanation of living and the processes that maintain and reproduce it. It is argued that goals centered on a vision of economic growth are not coherent with the natural processes of the biosphere—as shown by thermodynamics and complex systems—nor, indeed, with a functional society. The health and life on planet is a compelling reason for seeking dialogue between individuals and coherence in the three dimensions of socio–ecosystem sustainability.

Keywords: sustainability; sustainable development; culture

1. Introduction, the Socio–Ecosystemic Crisis and Planetary Limits

The socio–ecosystemic problem occupied a central position in discussion during the 1960s and 1970s, a period in which the ecological, pacifist, and countercultural movements arose. International public policy highlighted the theme in the United Nations Conference on the Human Environment in Stockholm [1] and, over a decade later, in the report of the World Commission on Environment and Development, entitled "Our Common Future" and more commonly known as the Brundtland Report [2].

The diagnostic of the Brundtland Report was accurate and acknowledged a future threatened by an interconnection of environmental, social, and economic problems. The report also warned that these problems present a tendency to get worse with an increased risk of becoming catastrophic [2]. The proposed solution was sustainable development, with the objective of balancing the three components described above and proposing that the needs of the present can be met without compromising the capacity of future generations to do likewise. It stated that sustainable development implies limits imposed by environmental resources (although, according to the report, these limits are

not absolute), and also that technology and social organization could become ordered and could improve the route to economic growth. The Commission stated that general poverty is an avoidable problem and that sustainable development requires the satisfaction of the basic needs of all, since endemic poverty can lead to ecological or other types of catastrophes [2].

The same report manifested that the satisfaction of essential needs demands (at the time of its publication in 1987) a new era of economic growth for nations in which the poor constitute the majority and that rich countries should facilitate the financial resources for this growth and provide technological support [2].

The Brundtland Report [2] formed the basis for subsequent efforts: The Rio Principles in 1992 [3], Agenda 21 in 1997 [4], Johannesburg in 2002 [5], Rio + 20 in 2012 [6], and the objectives of sustainable development in 2015 of the 2030 agenda [7]. The United Nations Environment Program (UNEP), Man and the Biosphere Program (MAB), International Geoscience and Geoparks Program (IGGP), World Water Assessment Program of United Nations Educational, Scientific and Cultural Organization UNESCO (UNESCO WWAP), the Intergovernmental Panel on Climate Change (IPCC) and, more recently, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) (https://www.ipbes.net/), among others, were created.

Political, commercial, social, and some academic spheres adopted the discourse of sustainable development and continued its use in international and local forums. However, in some academic groups, there is wide debate denouncing the lack of clarity in the concepts surrounding sustainable development, with many critical arguments questioning their coherence [8–13].

The main criticism is related to the economic perspective that demands continuous growth on a finite planet [14–18], as well as the goal of "development" itself, which international public policy has imposed on the people around the world. This was the case even prior to publication of the Brundtland Report, but it has subsequently continued [19–22]. For this reason, it is stated in the academic circle that when the term sustainable development (also known as weak sustainability [23]) is used, it implies the proposal offered by the Brundtland Report [2] that considers economic growth indispensable. When sustainability (or strong sustainability [23]) is used, it refers to a theoretical construction around a critical focus, provided by academia, which is broader. It is applied in this way throughout this study.

In the last few decades, interdisciplinary scientific fields emerged in response to the challenge for a more sustainable society; these include ecological economy [17,18,24,25], political ecology [26–29], environmental education [30], the integrative science of systems ecology [31,32], human ecology [33], the framework of socio–ecosystems [34], and environmental sociology [35–39]. Likewise, reviews are being made toward ancestral knowledge, not only toward traditional ecological knowledge (TEK). There is also research being done into more equitable, community-based forms of social organization such as Andean, Latin American, and South American environmental thought [40–42], epistemologies of the south [43], eco-feminism [44,45], and liberation ethics [20]. Concepts proposing new forms of human–nature relations ships have also emerged, such as buen vivir [46–51] and panarchy [52].

These scientific communities and social movements have advanced by offering alternatives that recognize the central value of nature and the importance of equity for social functioning. While differences exist among these heterogeneous socio–ecosystemic approaches, each one proposes elements that allow for a greater understanding of life at different scales. However, their proposals have not yet permeated into social structure and function or into decision-making and institutional culture. This knowledge is not reflected in social organization in the way that communication technology and the consumer industry are.

In the last century, human knowledge and understanding of life on the planet has improved substantially [53–58]. There have been conceptual advances in terms of recognition of the complexity within the field of complex systems [56,57,59,60] and complex thought [61], as well as an acceptance of the necessity of addressing sustainability problems through a transdisciplinary approach [62–64].

In that sense, an enriching dialogue of knowledge has been established, creating synergies among academic groups, indigenous peoples, and those responsible for public policy. The United Nations

recognized the need to construct a more holistic vision in harmony with nature [65,66]. Proposals have even emerged from spiritual spheres, such as the encyclical *Laudato sí* of Pope Francis, regarding care for the common home [67] and the contributions of deep ecology [68,69].

The IPBES, the intergovernmental body that works on the creation of bridges between science and public policy formulation [70,71], has made an unprecedented effort in terms of the cross-fertilization of knowledge and contemplation of scientific advances and systems of indigenous and traditional knowledge [72].

The efforts mentioned are just a sample of the groups that have registered the socio–ecosystemic problems and are trying to address them. However, thanks to these efforts, we now have elements that elucidate the current serious situation. The environmental crisis has continued its trend of exacerbation, as shown by the Millennium Ecosystems Assessment (MEA) and IPBES. It is now broadly accepted that climatic change is anthropic in origin [73–76], as was made clear in the joint publication of the Royal Society and the US National Academy of Sciences [77]. While climate change is probably the most studied and discussed ecosystemic problem, it is only one of the many components of a complex network of interrelationships.

For example, the 21st century began with studies that evidenced the water crisis [78–80] and its close relationship to climatic change, which acts to increase the vulnerability of the people who live under conditions of risk [79,81] and threatens food security [82]. In 2006, the United Nations Human Development Report stated that human life and development depends on water, describing the causes of the water crisis as poverty, inequality, and unequal power relationships, while also claiming that weak water management exacerbates its scarcity [80].

The MEA describes the main ecosystemic changes as: (i) The transformation of habitat, particularly through land use conversion of temperate and tropical forests and wetlands; (ii) the overexploitation of terrestrial and marine biomass; (iii) desertification; (iv) an increase of invasive species; (v) the contamination of soils, water, and the atmosphere; (vi) climatic change; (vii) the alteration of biogeochemical cycles, including those of water, nitrogen, carbon, and phosphorus; and (viii) biodiversity loss [83]. The report states that most of these changes are irreversible, at least in the short term, and that they are the result of increased demand for food, water, fibers, and fuels [83].

In 2005, the MEA highlighted the importance of ecosystem services and their relationship with human well-being [83]. The degradation of ecosystems diminishes their capacity to provide services, contributes to the increased disparity between people, and is the main cause of poverty and social conflict [83]. Ecosystemic deterioration and climatic change is also one of the causes of migration [84–87]. Furthermore, there are an increasing number of cases of people being displaced by projects (mining and tourism, among others), and struggles for territories have been documented worldwide (https://ejatlas.org/) [88,89].

Systemic global and local inequality has also been documented [90–92]; the gap between the rich and poor grows, not only in those countries considered "underdeveloped," but also in "developed" countries [93]. The concentration of the urban population is rising [94]; despite the fact that living conditions in large cities are not always adequate for the disadvantaged, people in search of better opportunities continue to leave the rural areas.

The socio–ecosystemic crisis does not show improvement, despite the genuine efforts of different groups and warnings. In 1992, the document *World Scientist's Warning to Humanity*, signed by 1700 scientists, was a call directed to the scientific community, the leaders of industry and commerce, religious leaders, and the people of the entire world. It expressed concern in terms of human activities, population increase, inequality in consumption, and the impact on the integrity of the Earth system. The second such warning was published in 2017, this time signed by 15,364 scientists of 184 countries [95].

The identified planetary limits are: (1) Climatic change; (2) the alteration of biogeochemical cycles (particularly those of nitrogen and phosphorus); (3) the loss of ecological integrity, characterized by the accelerated loss species rate; (4) the acidification of the oceans and expansion of oceanic "dead

zones;" (5) global fresh water use; (6) the change in land use or cover; (7) the depletion of stratospheric ozone; (8) chemical pollution, this refers to the emitted quantity or concentration of persistent organic pollutants, pesticides, herbicides, plastics, endocrine disruptors, heavy metals, and nuclear wastes in the environment, or the effects of these on the ecosystem and functioning of the system of planet Earth [96]; and (9) the atmospheric aerosol load. It is estimated that the limits of climatic change, alteration of biogeochemical cycles, and loss of ecological integrity have already been passed, while the authors explain that they have not determined how to measure the two final concepts [96,97]. The problem is that exceeding one or more planetary limits increases the risk of crossing thresholds that can unleash non-linear and abrupt ecosystemic change within the system at a global scale [96,97]. It is important to note the concordance between these results and those obtained by the MEA and IPBES.

Paul Crutzen proposed the term Anthropocene considering the degree of the anthropogenic alteration of the natural cycles of the planet, and he suggested the consideration of the Anthropocene as a new geological epoch [98–101]. The International Union of Geological Sciences (IUGS) has discussed the formal declaration of the epoch as a succession of the Holocene. At present, the Anthropocene is not properly defined, but is under active research by the Anthropocene Working Group (AWG) (http://quaternary.stratigraphy.org/working-groups/anthropocene/). However, though the data being brought to this proposal are not under discussion, an accelerated anthropic impact is documented and indubitable.

The most recent IPBES report on biodiversity and ecosystem services announced an unprecedented dangerous decline in biodiversity and acceleration of species extinction rates, and it affirmed that: (A) Nature and its vital contributions to human wellbeing, which together embody biodiversity and ecosystem functions and services, are deteriorating worldwide; (B) direct and indirect drivers of change have accelerated over the past 50 years; (C) the goals for conserving and sustainably using nature and achieving sustainability cannot be met by current trajectories, while those for 2030 and beyond may only be achieved through transformative changes in economic, social, political, and technological factors; and (D) nature can be conserved, restored, and used sustainably while simultaneously meeting other global societal goals through urgent and concerted efforts fostering transformative change [102].

The socio–ecosystemic crisis proves the importance of rethinking the efforts being undertaken to address it and challenges us to find new forms of relationships with the biosphere [103] and to recognize that the impacts are not generated at the same scale for every form of human life, but rather are related to the industrialization of agriculture and fishery, urban concentration, use of fossil fuels, and increased consumption in global markets, among other activities that intensify the use of nature and compromise the capacity of the planet to sustain human life. This form of relationship with the planet has been in existence for approximately 200 years and has intensified from the second half of the 20th century onwards.

In this context, it is necessary to recognize the efforts of different actors, academics, ecologist and humanist social movements, and national and international policy makers, among others, who have highlighted the importance of socio–ecosystemic problems and are working to address them. Thanks to these efforts, there is now information available with which to monitor the global crisis, realize its gravity, and contribute to the objective of moving towards true sustainability.

As stated above, sustainability is a concept that has been the subject of academic discussion for more than three decades, but the diversity of interpretations offered has not reached a consensus [8–11,13], while in concrete fields, such as public policy, business, and daily life, the operativity of sustainable development is diffuse as a result of some contradictions regarding the biological and ecosystemic principles of life.

In the practical sphere of globalized society, the economy has a protagonist role, with a focus on the market and individual and collective decisions based only on monetary cost–benefit [104,105], which determines almost all actions of the social actors with aspirations of consumption and financial accumulation. It is important to analyze the monetization of variables for decision-making;

when everything becomes monetary units, it is possible to completely lose the qualitative aspects involved in that decision.

While monetization is useful in certain circumstances, it acts to impede analysis when dealing with people's quality of life and ecosystem health. An illustrative example is the integral activity carried out by housewives in the functioning of a family; from the administration of economic resources, care for the children, elderly, and sick, hygiene and health, food, moral and material support, education in values, and other actions that create cohesion among the members of the family, these activities are not adequately highly regarded. Homework and care not remunerated are excluded from the calculations of the Gross Domestic Product (GDP) and the analysis of the economy and public policy, so their value is simply ignored. Women were integrated into the labor market, some in search of professional development and others because of the loss of purchasing power of the salary of the couple or the member providing the family. The vast majority obtain a minimum wage for their working time, which does not compensate for the benefits received by the family and society as a whole. Part of the social decomposition can be explained by the absence of both parents at home and the lack of those elements that women's work brings. Women's work refers to the activity of care and work of the home that has traditionally been done by women; it is questionable since it can be done by any member of the family that assumes the responsibility. The theme becomes a complex gender issue that is addressed from ecofeminism with interesting proposals [44,45,106].

Another example is the care and management of the ecosystems carried out by campesinos and indigenous people: Having no tangible monetary income is not considered valuable and indeed runs the risk of loss and dislocation of the cultural elements that link individuals with nature. The components and activities that arise from the economic formula lose estimative value. The economic patterns generate a pressure on the individuals and on the biosphere that puts the balance and health of the socio–ecosystemic system at risk.

The results and trends of socio–ecosystemic problems oblige us to question the elements on which collective efforts are based. The socio–ecosystemic crisis currently faced by society was generated by the economic goals of growth and consumption and cannot be resolved by following the same logic. In its aspiration for sustainability, society must generate a process of ontological change. Ontological is an adjective that indicates that something is relative to the branch of philosophy that studies the nature of being and seeks to determine the fundamental categories of existence and reality, as well as the manner in which these are interrelated, i.e., it refers to being and how this is itself defined. This change most to be based on ethical values and knowledge in order to adapt its culture to the structure and functioning of life on planet Earth, on which it interacts and of which it forms part [107].

The globalized society of the 20th century established its goals within an economic framework rather than in terms of maintaining the integrity of the biosphere or coupling to the natural cycles of the ecosystems. At present, human activity is strongly influenced by the logic of markets and economic growth, which is the discourse encrusted into society. This logic is rarely questioned in business or politics spheres; it is simply assumed, and goals are established as a function of objectives that are mainly related to economic growth [108].

The goals centered on a vision of economic growth are not coherent with the natural processes of the biosphere, as explained by thermodynamics and complex systems and warned by Gaorgescu-Roegen [15], Meadows and collaborators [60], and Schumacher [16], among others. It is still being analyzed by some of the socio–ecosystemic approaches.

The theme that has the greatest impact on ecosystems is consumption. If the goal to which 7706 million people (https://www.worldometers.info/world-population/) aspire is to consume in a lavish manner, the planetary limits make this unaffordable. Inequality in resource use cannot be solved by increasing the material consumption of the entire population beyond its basic needs, particularly if this consumption is of products that are unnecessary for well-being. The error of seeking to attain this goal implies acceleration towards the planetary limits.

The goal of equality must therefore contemplate the reduction and limitation of costly and excessive consumption. A social structure in which few people have the capacity to purchase makes businesses reduce the life span of products and generates a series of unnecessary products in order to maintain demand. The duration of the products is key in the use of the material necessary for their production, since this exercises pressure on the source ecosystems.

This is a sensitive theme because the economic system privileges certain sectors with high levels of consumption. The gap between the advantaged and the disadvantaged increases with time, and social problems are intensified. The economically privileged sectors seek to maintain their prerogatives while the disadvantaged sectors attempt to gain access to them. Squandering becomes a symbol of social status, with consequent high ecosystemic costs.

The currently expanding global information flows allow people to clearly see inequalities in income and real or perceived well-being. Observing their position in the income pyramid (local and global) generates discomfort and social conflicts. Some try to improve their situation by migrating to other territories [109]. Much of the growing violence and great mobilizations that have worried the countries and cities that receive huge amounts of people are justified in this way. It is also important to work on understanding the social structures that generate asymmetric power relations and visualize them in a critical manner.

Concerns about poverty are, according to Paul Collier, a matter of morality and compassion for the billions of people who have no hope, but they are also of intelligent personal interest, since the financial inheritance will not be enough for people immersed in a violent and dysfunctional society, which could turn into a nightmare [110]. This illustrates the importance of the present study in terms of its objective of broadening the interpretation of sustainability from the recognition of ethical values in the relationship between humans and the ecosystems that sustain their life. Faced with the global crisis, academia plays a central role in offering alternatives, and socio–ecosystemic sustainability is a proposal that aims to offer such alternatives.

Errors in decision-making in relation to natural laws have serious consequences for the health and well-being of people. They will be judged by citizens, voters, and consumers, and they will undoubtedly also be evident in the economy. Worse, ethics is a matter of life and death; it is not a question of ideology but one of overwhelming reality.

2. Backgrounds, Strong and Weak Sustainability

Figure 1 presents the comparison between weak sustainability (sustainable development) and strong sustainability; the diagram on the left assigns the same weight to the three themes: Economy, environment, and society, conceiving the possibility of an economy or a society outside the environmental framework, i.e., it does not recognize that society depends entirely on the biosphere and that the economy is a social subsystem, so it is totally incoherent with the laws of thermodynamics [15]. Efforts of sustainable development are inspired by the belief that economic growth and technological development would solve social and environmental problems. In this sense, the proposal of the Brundtland Report of a "new era of economic growth" was deeply flawed; human society around the world established goals and focused its determination on attaining these economic aspirations, and the lack of improvement in the socio–ecosystemic problems of the last four decades are not surprising.

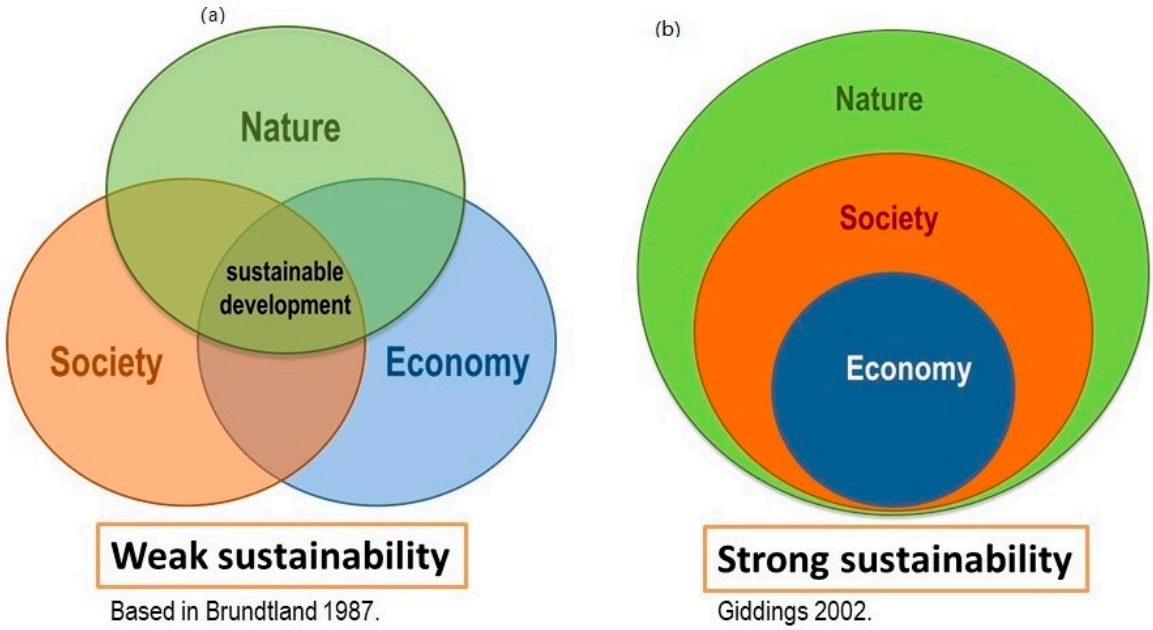

Figure 1. Graphic representations of weak and strong sustainability: (**a**) Weak sustainability, or sustainable development, presents the environmental, social, and economic themes with equal weighting and seeks to balance them. This image was developed based on the Brundtland Report and was widely disseminated. (**b**) Strong sustainability, with a focus on systems, presents the three themes as nested and confers different sizes and weightings to them. This model was presented by Giddings in 2002.

Liberal policies stimulated the markets, facilitated the flow of merchandise, and promoted consumption with credit and marketing that increased the production of all types of products. The middle and upper classes of almost all countries increased their levels of consumption, but the consequences were disastrous for the socio–ecosystemic sphere. The mechanism by which to accumulate wealth stimulates depreciation in the value of work and resources taken from nature, increasing inequality and degrading ecosystems. In other words, the concrete measurable results do not support the belief in the "need" for economic growth. While a small and privileged sector of the population advances in the economic race, social and ecosystem health deteriorates.

In the diagram on the right, Giddings presented the three components nested, recognizing the importance of each [8], which is coherent with the idea of Vernadski in which humans can develop nothing outside of the biosphere [111], as well as the systems theory of Bertalanffy [56].

Strong sustainability has an eco-centric perspective, and the proposal of socio–ecosystemic sustainability is based on its central ideas:

- The warning that a finite planet cannot sustain human life with an economy that intends unlimited growth [14–16,18,25,60].
- Excessive production and consumption causes serious ecosystemic deterioration [15,31,60,83,95,96]. In addition, this excessive consumption does not generate well-being in the long term, but it does affect the ecosystems that sustain life and mental health of individuals [16,112,113].
- There are sufficient solid arguments and evidence to consider that economic growth based on excessive and wasteful production and consumption is a socio–ecosystemic failure [8,14,16,31,60,97,102,114].
- The global problem cannot be tackled with small isolated actions—its complexity must be understood and addressed through profound change [15,16,18,60,69,102,112,115], i.e., from an understanding of the complex system and coupling of human society as a subsystem.

- Human activity must be centered on ethics—on the relationship with nature and their fellow beings. Life and people's well-being are the most important factors. The economy must protect and serve people, not vice versa [15,16,69,116].

The magnitude and trend of the global crisis urges a rethink of human activities, above all with a recognition that it cannot be resolved with the same order of ideas that created it. For this, the complexity of the components that interact in this conflict must be accepted, with a reconsideration of the economic criteria, planetary limits, and growth limits that have been ignored for many years, encouraging the excessive and costly economic growth that represents the main cause of the current socio–ecosystemic situation.

3. Ontological and Cultural Change

A reorientation of the adaptive capacity of human society is necessary, utilizing knowledge and values in order to generate notable changes. This will be possible only with modifications to the current objectives, which are focused on consumption. It will therefore be necessary to make the distinction between basic and functional material needs, discourage consumption, and propose other values that can offer well-being to people [108].

In contrast to the economies of a market absorbed in aspirations of consumption and accumulation, campesino and indigenous experiences exist around the world that are focused on subsistence, with different economic structures, as documented in sociological studies by Shanin [117]. However, it is important to highlight that these economies are part of cultural systems that are more closely linked to the Earth.

Human beings developed their cultures according to their relationship with nature and the resources necessary for their subsistence -water, food, and refuge- of many diverse forms, and these even changed with the passing of time. There is a vision of some indigenous people and philosophical groups around the world, e.g., Buddhism, that confers a sacred status upon nature, recognizes the elements -water, air, earth, and fire- as having a power over the different manifestations of life. Today, we know the value of biodiversity and its importance for all forms of life; the composition and quality of the water, air, and soil; the sun for photosynthesis and as an alternative for the creation of clean energy, a central theme for human life; thanks to satellite technology, we can monitor oceanic and atmospheric flows and currents as planetary processes.

Life that is manifested from the level of the cell and its historical transformation of autopoietic coupling in all of the classified kingdoms [118]— interrelated in one whole; the Earth. Consistent with the Gaia Hypothesis [58], broadened and supported by Bateson, Margulis, Atlan, Maturana, Varela Thompson, Henderson, and Todd [53]. Mother Nature, Mother Earth or Pachamama (the Inca deity, from the indigenous peoples of the Andes), of which human beings form part and share with the other species in a brotherhood.

There are still cultural systems that are closely related to their ecosystem and have an empirical knowledge that is inherited from several previous generations, constituting a coupling with their particular territory: for them, it is not the same to live in one place or another. For these groups, migration due to ecosystemic deterioration or because large projects displace their populations is a real tragedy which upsets the deep roots of cultural identities and the empirical knowledge of the functioning of their specific ecosystems.

The model of industrial development, competitive and standardized, based on consumption, devalued life in rural areas, intensified industrial agricultural production with the use of agrochemicals, caused the abandonment of the land work, and with it, the loss of productive activities of self-consumption. Mass consumption systems and urban lifestyles, now overestimated, led to the disarticulation of collective relations with the territory, ignoring the components of human health and well-being and their relationship with nature. This is how the global crisis was generated in the natural and social spaces of the people of the north, south, center, and periphery.

As analyzed by Philippe Descola, there are various forms of relationship between humans and non-humans; some cultures confer non-human beings (individual animals and plants) with the quality of a person, capable of establishing interpersonal relationships [119,120].

This explanation of reality provides human beings with an orientation of respect towards the different species and composition of nature. People interpret their being in a broad context, with an acknowledgement of and praise for life in all its manifestations. Harmony with both the surroundings and the other confers a profound sense of life in a creative, loving, and aesthetic imaginary, a rationality of being blessed by life that relates to the spirituality and redefines the relationship between human and non-human beings.

It seemed an advance when, in 2001, UNESCO published the declaration on cultural diversity [121]; however, in the Johannesburg declaration on sustainable development in 2002, culture is hardly mentioned and is not given an important role in the face of the socio–ecosystemic challenge [5].

In the Hangzhou declaration in 2013, culture was proposed outside the center of the discussion on sustainable development [122]. A resolution approved in the General Assembly of the United Nations on the 20th of December 2013, Harmony With Nature [66], recognizes the contribution of the indigenous peoples to a broader vision of life. It is a significant advance, which has taken 40 years, in the order of ideas expressed; indeed, perhaps we should say 500 years—since the expansion of the European empires. The indigenous groups were neither understood nor recognized as human beings with an advanced culture; instead, they were enslaved, exterminated, and, at best, ignored. However, they were treated as savages that must be educated, seeking to renounce their culture and way of life. It is worth remembering that, in Europe, the question of whether the Earth was flat or not was discussed for centuries, as was the question if it moved or was at the center of the universe. This discussion would cost lives. At the same time, the Maya culture could already predict eclipses with surprising accuracy.

However, in articulating these ideas, the work around culture concentrates once again on obtaining a monetary value and the commercialization of cultural products in global markets [123,124]. In these terms, sustainable development represents a limited interpretation of the biosphere, socio–ecosystems, and culture [107,108]. However, there are alternatives in the form of useful scientific, epistemic, and ontological tools with which society can redefine its relationship—objective and subjective—with nature, with the ethics and aesthetics of life as a central theme.

4. Socio–Ecosystemic Sustainability

In order to widen the notion of sustainability, which is the objective of this study, based on complexity and transdisciplinary knowledge, some important perspectives and arguments were selected from various disciplines and integrated into an analysis and synthesis in the light of transversal concepts such as life, ethics, and culture. A broader description of the theoretical framework of this study is presented in an article by the same authors published in 2018 [108].

To recognize the central value of life in any determination of sustainability, it is necessary to answer the question: What is the living being? It is likely that a total understanding of life, its organization, structure, and functioning is unknowable; however, we must seek the best possible approach to address the socio–ecosystem crisis. As stated above, knowledge and understanding of life on the planet has improved substantially in the last century. There are advances in terms of recognition of the complexity of life [31,53–61,125]. Fritjof Capra, in the *Web of Life* [69], offers an exhaustive review and detailed exposure of what he called a new scientific understanding of life.

One of the best explanations about life and its complexity is autopoiesis, a term that was introduced in 1972 by Chilean biologists Humberto Maturana and Francisco Varela to define the maintenance chemistry of living cells [55,118]. Their work revolutionized our perspective of the world, providing a clear differentiation between living and mechanical systems. They constructed this concept from systemic theoretical biology and derived all biological phenomenology from the characterization of living systems as autopoietic systems in the physical space.

For the exposition of socio–ecosystemic sustainability, clarifying the term autopoiesis is crucial. It is possible to say that autopoiesis is synonymous with living, but the concept contains the explanation of complexity behind the processes that maintain and reproduce life (therefore, a brief explanation might not be enough, and it would be worthwhile for the interested reader to search for the cited bibliography [55,118]).

An autopoietic system is a unit organized as a network of the continuous processes of construction, transformation, and destruction of components in a circular relationship of constant feedback within its ecosystem. The basic unit of life and example to explain an autopoietic system is the cell, which carries out a constant process within the environment and is associated in an organized network with other cells, forming the following system with a greater degree of complexity. This system is the individual. The complex network is maintained through its interactions and transformations, and it is continuously regenerated by the processes that produced it [55].

Life is explained as a structural coupling of nested autopoietic units, with the cell as a first order unit, complex organisms as second order units, and the social organization of individuals as third order units. Each unit is self-referenced, autonomous, determined by its organization (structure and functions), and a product of the historical transformation of structural couplings in uninterrupted sequences [55].

Living systems are units of interactions that exist within an environment. From a biological point of view, the autopoietic unit cannot be understood independently of the environment with which it interacts. The units conserve the organization of their lineage along with variations throughout their evolutionary history. In a circular interaction with the medium and the surrounding autopoietic units that "trigger" reactions—i.e., influenced by changes in the environment, but without absolute determinism—the external stimuli can generate changes in different directions or even produce no reaction at all. Circular not in the sense of being closed, but rather that it returns from the exterior to the interior of the system in an open spiral. This approach does not contradict positivism but rather completes it with a multi-causal effect's idea and with different phenomenological possibilities. The complex life is an emergence of the structural coupling in which the unit is explained only by its organization, structure, and functioning together and not by separation of any of these component parts [118].

Here, we propose to use the term socio–ecosystem to unify: the socio-ecological system [36,39,126], the human–environment system [127], or human and natural systems [128] which have been used in similar approaches in sustainability science. In this context, we prefer the term eco-systemic instead of ecological or environmental because of how the Oxford dictionary defines the terms. Environment is defined as "relating to the natural world and the impact of human activity on its condition." The environment is understood as separate from people. Ecological is defined "as relating to or concerned with the relation of living organisms to one another and to their physical surroundings." It seems more appropriate, but the concept of the ecosystem that we refer to in our approach is based on the scientific understanding of the complex dynamic system as a unit in a nested hierarchy.

Eugene Odum argued that "Living (biotic) organisms and their nonliving (abiotic) environment are inseparably, interrelated and interact with each other. Any unit that includes all the organisms (the biotic community) in a given area interacting with the physical environment so that flow of energy leads to clearly defined biotic structures and cycling of materials between living and nonliving components is an ecological system or ecosystem. It is more than a geographical unit (or ecoregion); it is a functional system unit, with inputs and out puts, and boundaries that can be either natural or arbitrary" [129].

This notion emphasizes the structure and functioning of the unit as a whole and highlights the fundamental interdependence of the components within it. Each species fulfills a specific function within an ecosystem and depends on its interactions with the other components for its survival. An important implication is that the degradation of an element of the ecosystem or the disappearance of

a species could modify the entire ecosystem and, subsequently, damage other components (or species) as well.

These approximations are consistent with the contributions made by Lyn Margulis, who showed that complex life was developed thanks to the association of different cells to deal with oxygen poisoning and that any complex individual—a human, for example—is itself a complete ecosystem, with multiple associative relationships of human and not human cells within a community [54].

Lovelock's Gaia hypothesis explains planet Earth as a super organism with homeostatic activity, defining Gaia as a complex live entity comprising the ground (earth minerals), rivers and oceans (water), atmosphere (air), and terrestrial biota [58]. In a collective publication, edited by William I. Thompson, the Gaia hypothesis is supported and three related elements are offered—a macrocosm (Gaia), a microcosm (bacteria and cellular life), and a mesocosm (mental and language)—to explain life [53].

The integrative global sciences of systems ecology [31,32], human ecology [33], notions as socio–ecosystems [34], and panarchy [52] coincide with the idea of the planet Earth as a unit (biotic and abiotic) where human beings, social systems, and their economic subsystems are nested and form part of the biosphere. This vision also coincides with some older views about the relationship between Mother Earth and the communities of indigenous people.

An important point about autopoietic systems is the observer as a living system, and any understanding of cognition as a biological phenomenon must account for the observer and his role in it [55]. The concept has also been used to explain society by Niklas Luhmann's successful explanation of social systems [130,131] and been the basis of Fischer-Kowalski's seminal work explaining the interactions between society and its ecosystem, which she calls Society's Metabolism [132–134] and has been operationalized by material flow analysis (AMF) [135].

Capra includes, in this scientific understanding, organisms, social systems, and ecosystems as living systems, with implications not only for science and philosophy but also for business, politics, health, education, and daily life. However, in light of the socio–ecosystemic results discussed above, this understanding does not seem to have the great impact required for global society [69]. Based on this advance in the way of explaining life, socio–ecosystemic sustainability proposes an autopoietic process of coupling culture with the structure and function of the biosphere. That is why we have chosen to introduce new terminology in this conceptual paper—to make a difference to the established terminology and discourse and to redirect efforts to coupling and adaptation, based on the recognition of the autopoietic and nested unit with nature in a complex and dynamic living system.

It consists of utilizing the broad concept of culture, as a system, considering its subsystems of knowledge, economics, politics, society, art, and religion as an interface with the ecosystem of which it forms a part. Culture is part of the socio–ecosystem and responds to the characteristics of complex live systems. This concept is applicable at any spatial level of the socio–ecosystem.

4.1. Definition of Socio–Ecosystemic Sustainability

Socio–ecosystemic sustainability is a process that defines the relationship between cultures and the biosphere. It is an attribute of the cultural system, determined by the degree of coupling between the structure and functioning of the ecosystem with which it interacts and of which it is a part. In this way, a specific culture can present greater or lesser coherence with natural processes: The greater the coherence, the greater the sustainability.

The process consists of utilizing the broad concept of culture as a living system.

4.2. Cultural Basis of the Analysis

The term culture is attributed multiple meanings. The Oxford dictionary defines culture as: (1) Art, literature, music and other intellectual expressions of a particular society or time; (2) the customs, arts, social institutions, etc. of a particular group or nation; and (3) development through regular training,

exercise, treatment, etc. The term is more commonly used to refer exclusively to the artistic order. Social disciplines offer many and broad definitions.

The following concept of culture that is used in the socio–ecosystem sustainability proposal is more complete:

> *Culture is a dynamic and autopoietic system comprising knowledge, beliefs and social guidelines, politics, economics, arts, and religion constructed by individuals linked in groups in order to relate to each other and to their ecosystem and, thus, to meet their needs for existence.*

In this sense, there are very diverse cultural systems—e.g., the structure and functioning of the indigenous groups; organizational culture, covering concepts and practices associated with business or institutional life—as diverse as life.

Culture is a third order autopoietic unit; it is complex and unfolds to an unpredictable future, an irreversible phenomenon in the timeline, which leads to an increase in its complexity. Culture is alive in the framework of the explanation of the living given by Maturana and Varela [55,118] and is a dynamic and unstable system according to the explanation of Prigogine and Stengers [57]. Culture and cultural processes are complex, i.e., they cannot be understood simply by the sum of their parts; rather, they must be understood by their structure and organization from which emerge different qualities that characterize the whole [115].

The elements that constitute culture, such as knowledge, beliefs and social guidelines, politics, economics, art, and religion interact with each other and manifest themselves in a particular form at different spatiotemporal scales. Cultures coexist and interact among themselves. While some interact more than others, they are seated in the biosphere, and each culture is along a gradient of influence in the ecosystems it covers and the territories that provide the resources it consumes.

The biosphere system, in turn, is formed by subsystems (ecosystems). The Earth system maintains processes of control, the components of which are the active processes of living beings that possess the capacity to regulate the climate, chemical composition, and topography of the planet [58,111]. Human beings organized into cultural systems are part of the biosphere, and their units are found nested at spatial levels along a gradient of scales (global, regional, national, local). This explanation is consistent with the ideas of Giddings and collaborators [8], Vernadski [111], Bertalanffy [56], the integrative science of systems ecology [31,32], human ecology [33], and the socio–ecosystems approach [34]

4.3. The Dimensions of Socio–Ecosystemic Sustainability

Figure 2 shows the relationship between a given culture and the biosphere, represented by three interacting dimensions.

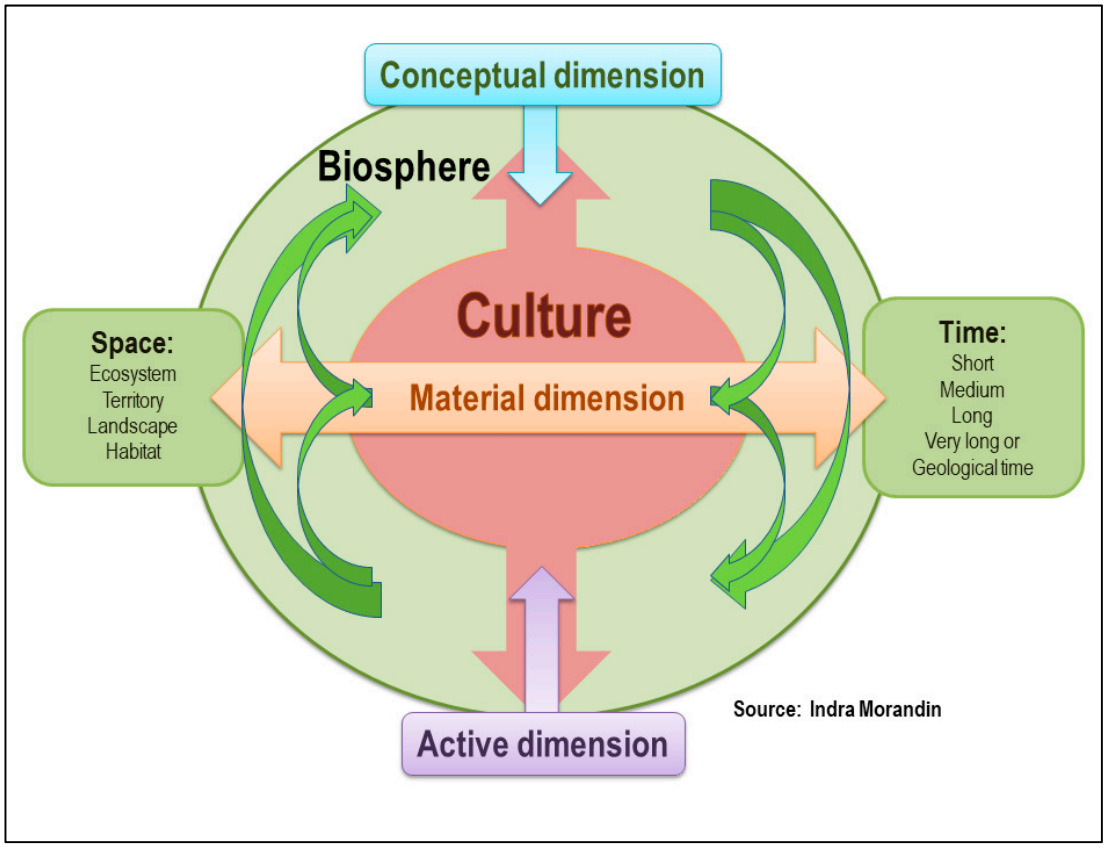

Figure 2. Graphic representation of the socio–ecosystem sustainability dimensions. Culture is framed by the biosphere, in which three dimensions converge: Conceptual, active, and material, in which the space–time phenomenology is presented.

The conceptual dimension (in blue) refers to the ontological, ethical, and epistemic vision. The concepts are constructed based on knowledge and values that oblige both the individual and the collectives to define themselves and conceptualize life. This dimension is fed not only by the system of knowledge but also by the philosophical reflection in which language and interpretation directly intervene. The objective of sustainability is part of the conceptual dimension when the aspiration is that the culture seeks or maintains coherence with the processes, functions, and structure of the ecosystem of which it is part. The conceptual dimension is loaded with subjective elements, while it is the subjects that realize the interpretation. Aspirations, scale of values, policies of action, and codes of conduct are included in this category.

The active dimension (in violet) refers to the practices, actions, and methodologies (individual and collective) conducted in daily life. It represents the manifestation of the subject, expressed in its decisions, activities, and inactivity. This dimension has measurable and objective elements, but it is influenced by the conceptual dimension, i.e., the people realize their concrete actions according to the knowledge, scale of values, and emotions that constitute their subjectivity.

The living unit acts in circular relation with its environment and the surrounding units. Individuals and groups influence, and are influenced by, their interactions. These interactions are flows of exchanges of information, matter, and energy. Units, in this case individuals and organizations, take decisions every day, act according to certain patterns and habits, and carry out their activities. From positivism, we cannot expect to have different results if we act in the same way.

The active dimension is the key to the social transformation necessary to cope with the socio–ecosystemic crisis, but two important points must be borne in mind: (1) Actions are always strongly influenced by beliefs and knowledge, and (2) the adaptive power of an autopoietic unit responds to interactions with its particular medium. In other words, individual and collective

adaptation power is associated with their knowledge and their capability to act, and the response is not completely predictable because these are living systems.

If we analyze cultural diversity, it can be explained from the adaptive capacity of different social groups over time. As Shanin observed, cultural differences are determined by the unique characteristics of the ecosystems in which the groups established [117]. Max Neff explains that, although basic human needs are the same, different cultures address them in different ways [136]. The culture of globalized consumption, exacerbated and wasteful, becomes a series of actions that exert pressure on the socio–ecosystems. The results are already evident, but if the process continues along the same line of action, the planetary limits will ultimately force an end to this behavior.

The material dimension (in orange) refers to the spatiotemporal phenomenological field and is objective and measurable. It is the result of the manifestation of the relationship between the culture and its ecosystem, i.e., of the subject(s) in the territory. It is the dimension of the physical space we call an ecosystem, territory, habitat, or landscape, according to the academic discipline and forms of measurement of the phenomenon. The scale can be from cells and organisms to ecosystems or the whole biosphere, and the amplitude of the analysis defines the degree of detail. In the same way, the temporal component moves in intervals of time—short, medium, long—and very long in which case it deals in geological times. In this dimension, the concrete results of the activities must serve as a feedback to the system. The objective of sustainability must be the maintenance and optimization of ecological integrity, i.e., of the structure and natural function of the ecosystem [137], for which reason measurement of ecological integrity is fundamental.

4.4. Interaction among the Dimensions of Sustainability

The dimensions of sustainability interact in a learning process of coupling within the ecosystem. It is a circular relationship and maintains a continuous feedback. This process is valid from any autopoietic unit in different scales, be it a single cell, an individual, or a social group.

It is important to note that the culture formed by a group of individuals in a network follows the logic of the coupled autopoietic units, i.e., families, companies, and organizations. These interrelated networks in the following scale increase the level of complexity and new qualities emerge, i.e., social or religious groups, industries, countries, regions, etc.

Figure 3 presents the dynamic of learning that moves between knowledge, perceptions, and interpretations of the reality of the being (observer) or of the collectivity of subjects. It materializes in their decisions and actions, which are in turn media for the construction of their reality. The interaction of the individuals, among themselves within their ecosystem, generates results that in turn influence the perception, changing the original state.

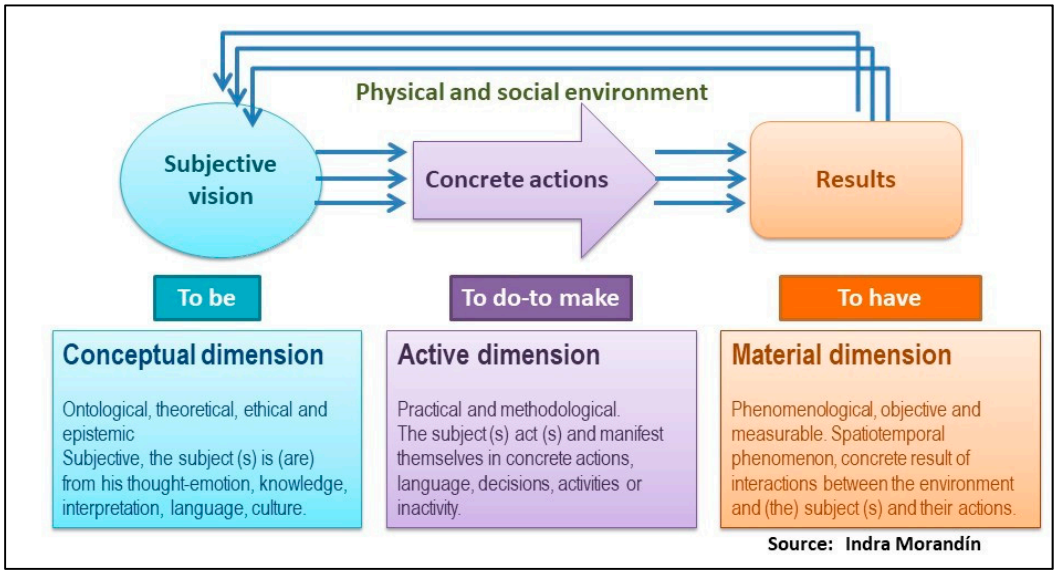

Figure 3. Based on that proposed by Maturana and Varela, the flow of dynamic feedback between the dimensions of the process of learning and adaptation of socio–ecosystemic sustainability is presented. The communication of information, material, and energy flows from one dimension to another in an uninterrupted spiral process and in constant feedback with the ecosystem.

It is a dynamic flow of feedback between that reality, interpretation, concrete actions, and their results that interacts with the surroundings and transforms into the knowledge of being. This dynamic belongs to the living beings (autopoietic), according to that proposed by Maturana and Varela [118] and is the process through which the units both adapt to and influence the ecosystem. It should be noted that species that do not adapt simply disappear.

The system of knowledge plays an important role in the dynamic process of adaptation proposed by socio–ecosystemic sustainability. For this reason, communication between disciplines and human activities is necessary—that of ontological reflection, above all.

4.5. Transdisciplinarity and the Role of Scientific Disciplines

Scientific disciplines and other non-scientific knowledge constitute the core of the conceptual dimension and contribute to the functioning of a culture. The conceptual dimension relates different types of knowledge in a bigger system, which is influenced by interpretative elements.

In this framework, the different disciplines are connected to each other, they share concepts and progress, and, in many cases, even the divisions between them are unclear. However, some focus their work on understanding the phenomenology of nature—on the material dimension, such as the exact and natural sciences, i.e., biology, chemistry, physics, geography, meteorology, and ecology, among others.

Another group of disciplines is occupied mainly with the active dimension, i.e., engineering, economics, administration, politics, and education. These are practical disciplines, rather than reflexive, and their task is centered mainly on methodologies; in other words, they address how to generate and obtain desired results. To these disciplines can be added those human activities that are also practical but are not necessarily related to the academic or scientific sphere. The disciplines of the active dimension hardly ask questions about the ontological meaning of their economic goals since, as Naredo says, they are completely absorbed in the "mythology of economic growth" [14].

The disciplines that are occupied with the conceptual dimension—i.e., those that focus most effort on ontological and ethical interpretation and reflection of being and life—are generally considered less practical and objective, since they include metaphysical themes. Other areas of culture such as religion and other bodies of beliefs can be classified in this dimension and constitute fundamental components

for the interpretation of life. The conceptual dimension is important since it forms the basis for the actions of individuals.

Some of the heterogeneous socio–ecosystemic approaches described above recognize the interaction between culture and nature; however, this recognition is expressed in the language of each discipline or cultural area based on its own background and knowledge, but they integrated a biocentric notion.

Figure 4 shows some examples of academic disciplines with the colors (as used in Figure 2; Figure 3) corresponding to the dimension of sustainability in which their main efforts are focused. The socio–ecosystemic approaches represent a bridge between disciplines by the transversal and transdisciplinary way of addressing the culture–nature relationship.

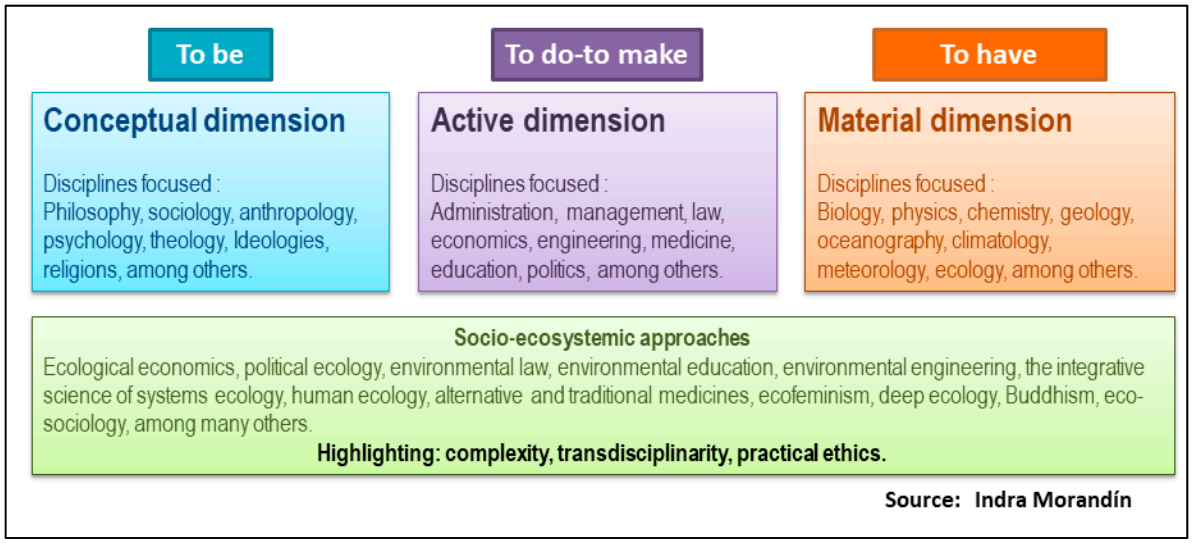

Figure 4. The disciplines focused on each dimension of the process towards sustainability. The conceptual dimension is shown in blue, the active dimension in violet, the material dimension in orange, and the ancient and emerging socio–ecosystemic approaches are identified in green.

Socio–ecosystemic sustainability is a process of coupling the culture towards a better relationship with the biosphere; in other words, to move the learning process towards socio–ecosystemic sustainability, with the clear objective of maintaining and optimizing the structure and functioning of the ecosystems and their ecological integrity. This objective requires overcoming the lack of communication between the scientific disciplines, although it is also necessary to consider other activities such as public policies, business, and daily life.

Disciplinary specialization allowed furthering of the knowledge; however, the coupling process that allows a culture to adapt to the ecosystem demands communication among disciplines and the integration of other activities, a proposal that coincides with Max-Neff [63], García [64], and Nicolescu [125,138], among many others.

The contribution of each discipline is invaluable, but each specialty isolated is an incomplete knowledge. As such, that of the interdisciplinary is not a trivial aspiration, it is necessary. As Rolando Garcia proposed, an interdisciplinary team should study a complex system in a common conceptual and methodological framework derived from a shared conception of science–society relationship; it will define the problem to study under a single approach resulting from the specialization of each member of the research team, and the association of specialized visions may strengthen an analysis. [64].

While interdisciplinarity helps to establish dialogue between different scientific disciplines, it can keep science isolated of other practical knowledge and of the general public. This can be addressed by transdisciplinary science. Max-Neef [63] also argues the importance of recognizing transdisciplinary knowledge as a network that should be articulated to find solutions to specific

problems. The transdisciplinary option and the dialogue of knowledge offers more a comprehensive possibility to include other areas of culture, such as art, religion, politics, economics, business, and science, of course. The idea is to recognize human knowledge as a system which cannot be reduced to its parts or understood with dissociative parts. The sum of the parts generates a supra-addition that expands the horizon and opportunities.

It is necessary to recognize that human activities are concentrated on the active dimension but are focused on economic objectives. Practical occupations that currently focus on mainly economic objectives often do not realize the seriousness of socio–ecosystem problems. People achieve their goals; they do not question them or measure the consequences. For example, there are technological "advances" with terrible consequences in socio–ecosystem terms. The results in the material dimension discussed above demonstrate that the process is badly directed.

5. Socio–Ecosystemic Sustainability as an Attribute and Cultural Aspiration

The dimensions of sustainability as a coupling process work in a continuous cycle (in a spiral), which is directed at new stages. The direction it takes has a close relationship with the objectives of the cultural system and the individuals within, i.e., the conceptual dimension and the subjective elements that direct their action.

An ontological change is necessary (conceptual dimension) so that the efforts of public policy, the different academic disciplines and society in general interact around socio–ecosystemic sustainability. However, this will only be seen reflected in the material dimension if the change has influence in the active dimension. In this case, it may be possible for humanity to find alternatives to solve the socio–ecosystemic crisis within the framework of the coupling and learning process proposed by socio–ecosystemic sustainability.

The autopoietic process of coupling functioned for millions of years for different species, and, for this reason, focusing on this dynamic is encouraging. Human society has a high capacity for adaptation and currently has knowledge and tools that generate changes at unprecedented speeds. The key is found in the clarity of the objectives that direct the efforts.

The subjective and objective evaluation of life and the elements that allow society to properly function must be taken into consideration. In this sense, a cultural reassessment linked to the proper functioning of the socio–ecosystem can help to reconsider many fundamental issues, just to give some examples.

5.1. Food

Food is the most tangible relationship that individuals have with the Earth; the quality of the products offered by the land plays a central role in physical development and health. The industrialization of food, involving cultivation with agrochemicals, transformation, and the addition of preservatives, artificial colors, flavors, and packaging, implies high costs that makes this food products inaccessible to the low-income population. In addition, we must consider that, under the logic of the market, waste is considered preferable to lowering prices. Thus, the multi-billion dollar industry generates health problems, inequitable distribution, and large volumes of solid remains and waste, as documented by Food and Agriculture Organization FAO [139].

The alternative, organic food, requires the certification of agroecological products that once again makes them inaccessible to the majority. Healthy food is considered a luxury only to people with high incomes. Small agroecological production units are a solution for food, according to the proposal of Via Campesina (https://viacampesina.org/en/), the international campesino movement, and the trade and environment review of United Nation Conference on Trade And Development UNCTAD [140], with important repercussions on health and accessibility to high quality food.

5.2. Health

Health and nutrition are intimately linked. In addition to the arguments already made, the health of an individual of any species, including humans, depends on the health of the ecosystem with which it interacts. In addition, the physical and mental health of individuals is closely linked to cultural functioning, degree of stress, and diet quality, while the pollution of water, air, and soil has repercussions on people's quality of life. The competition generated by the market vision also impacts mental health and undermines the solidarity, cohesion, and trust necessary for good social functioning. However, drug dependency does generate another multi-billion-dollar industry.

5.3. Education

Education has become a series of instructions focused on the qualification of individuals for employment. Educational plans do not concentrate on sharing knowledge for the functionality of individuals, families, and society. The knowledge and sensitivity that allows people to live their daily lives with ethical and aesthetic criteria are also outside the economic formula. The knowledge that enriches the conceptual dimension does not impoverish the one who shares it, but the logic of competition is a great obstacle to the dispersion of knowledge and functional development of society.

It is very important to consider that the socialization of knowledge can help the functionality of people and their social groups. The illusion of power obtained through the ignorance of others leads to an ignorant society and such a society is detrimental for anyone. Education is one of the greatest elements of inequality and creates gaps that begin in early childhood and are difficult to resolve afterwards. However, there is some progress in this area with the knowledge society and the use of information and communication technologies (ICT) in virtual education.

There is much to be done, but it is necessary that the people themselves have a genuine interest in approaching the advances of knowledge and seeking the development of critical and informed thinking. Otherwise, other multi-billion-dollar entertainment industries will concentrate more on the distraction of people and thus waste a potentially powerful educational tool.

5.4. Economy

The economy can be limited to its social function of optimization of scarce goods, currently interpreted as monetary resources, but from the point of view of socio–ecosystemic sustainability, it represents the resources we can take from nature, without hindering its operation and functionality, and the time that individuals can dedicate to work, which need not necessarily be considered employment. The care and work in the own home is key to maintaining the quality of life. It is the economy that Schumacher referred to when he said that small is beautiful [16]. A socio–ecosystemic economy may have a practical background in campesino subsistence economies.

The exchange of surpluses versus production thinking of the market is perhaps not a dichotomy; indeed, a healthy combination of both can contribute. Indigenous groups have been effective administrators of their territories for hundreds of years; their appropriate management allows them to live within the ecosystem, which differs substantially from seeing the territories as a source of "natural resources" that can be taken as a means of enrichment and exploiting them until their exhaustion.

The model of unlimited economic growth always requires more territories to exploit, and the conserved lands of the indigenous groups are thus particularly attractive, which explains why they are being displaced by the new extractive projects [88,89].

While complex, it is necessary to measure the efficiency and effectiveness of decisions and actions in terms of tangible indicators of social-ecosystem functionality rather than simply monetizing everything. Nevertheless, monetization can be an excellent tool that is very useful to balance surplus exchanges.

Each economic agent must reflect and make a self-transformation for the leap towards a more functional society; it is vital to rethink social and environmental responsibility, not as a matter of philanthropy or marketing but as an urgent issue of health and safety. This notion is very important,

since forced external impositions can generate considerable resistance. The socio–ecosystemic crisis is a threat to global security and stability, but it is also an opportunity for those who are able to visualize a better future and work towards it. Environmental education is a powerful weapon that can help.

Ultimately, if we know the limits of a finite planet are being reached in this generation but still insist on economic growth, sooner or later the collapse of the model is inevitable. The opportunity that arises now is that, with knowledge of the risk, it is possible to act to avoid an abrupt transition.

5.5. Politics

Politics plays a fundamental role in the institutional configuration of human society. The interpretation proposed by Elinor Ostrom [141] about the common goods is a significant advance, which also has not permeated the active dimension.

Economic and political goals focused on a vision of market, growth, and consumption are not coherent with the natural processes of the biosphere, but neither do they appear coherent with the functional development of individuals and their society. However, the issue continues to be analyzed by some socio–ecosystemic approaches, with notable progress.

Life on the planet and being alive is a good argument for seeking dialogue between individuals and coherence in the three dimensions of socio–ecosystem sustainability. It must be an inclusive process that respects the diversity of races, beliefs, preferences, age, ideologies, and many dichotomies that divide people. Dichotomies that are an illusion that do not allow us to see that we are part of the web of life [69], but dichotomies can be overcome with dialogue [108] and concepts like the of excluded middle principle of Nicolescu [125]. Once again, the solution to the old supposed dichotomy between freedom and equity is a healthy and functional combination of both.

6. Conclusions

Socio–ecosystem sustainability was built with elements from different areas of knowledge and practical activities. An exhaustive review was conducted in order to compile the most appropriate concepts and offer a theoretical construction that allows progress. There are many contributions that could not even be cited, and, while this is not the first attempt to propose a solution to the socio–ecosystemic crisis, we hope it will be useful for that purpose. It can be improved through the autopoietic coupling process itself. The main importance is to focus our attention on the relationship between human beings and nature, based on an understanding of life.

People, including scientists, are observers participating in the autopoietic network of life. This gives us responsibilities as members of the community and part of the socio–ecosystems with which we interact.

It is foolish to pretend that we can solve the current socio–ecosystemic crisis with the same order of ideas that were created and by undertaking the same actions. The socio–ecosystemic crisis currently faced by society was generated by the economic goals of growth and consumption and cannot be resolved by following the same logic. There is sufficient evidence to consider that economic growth is a socio–ecosystemic failure and may even be the cause of the crisis itself.

The global problem cannot be tackled with isolated actions. Its complexity must be understood and addressed with profound changes, understanding, and recognition of the complex Earth system and coupling of human society as a subsystem.

Inequality cannot be resolved by increasing the material consumption of the entire population beyond their basic needs. This goal is an error that implies acceleration towards the planetary limits. However, real material, functional, and existential needs must be met by creating appropriate conditions and opportunities, not for 10% of the population, but for the consideration of 7700 million people and upwards.

The socio–economic–political system, focused on the market, drives competition between individuals and collectives. The ambition was defended by Milton Friedman, Nobel laureate in economics in 1976, driver of economic liberalism (see his apologia of ambition: https://youtu.be/

baAv4RItdhU). Competition and ambition are used to stimulate creativity because individual aspirations are assumed to feed progress. However, when the competition becomes unfair, and ethical values are transgressed, the cooperation necessary for life in a community is demerited and society breaks apart. A climate of bloody competition also slows the transfer of knowledge, since it is considered a tool of dominion, power, and competitive advantage. For this reason, inequality transcends the economic sphere. From the socio-ecosystemic perspective, such progress should be questioned. To know, understand, and act from the characteristics of life also means allowing autopoietic processes to work. It is precisely to promote processes of change based on recognition of our role in the web of life. We must consider that there are advances and proposals from heterogeneous socio–ecosystemic approaches that are waiting to be addressed and assimilated by society.

An ontological change means that individuals generate changes from within the system based on a wider recognition of themselves and their surroundings. Human activity must be centered on ethics and on their relationship with nature and their fellow beings. Life and people's well-being and health are important. The economy must protect and serve people, not vice versa.

An improved understanding can help to change the economic and social patterns that have dragged society into a socio–ecosystem disaster. It requires a cultural change in search of the integral wellbeing of everyone. Accept subjectivity and feed it with knowledge and ethical values. Redefine the parameters of success and aspirations of individuals and groups; evaluate progress through functional aspects; prioritize equity, seeking generalized well-being without transgressing individual liberties. There will surely be a diversity of local solutions to these goals, and we should not underestimate the human capacity for adaptation.

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