



Beyond a Sustainable Consumption Behavior: What Post-pandemic World Do We Want to Live in?

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The Covid-19 pandemic has uncovered the foremost struggles of the twenty first century: social-economic inequality, global value chains, national security, and the environmental crisis. None of these seems novel, as many staged fiction dystopias have been predicting and warning mankind about the negative impacts of unsustainable consumption behaviors by displaying scenarios of exponential human population and economy growth. Several scientific tools for assessing sustainability have been developed to cover social, economic, and environmental aspects, however, most of them are simply used either separately or without a solid conceptual model supporting an epistemological construct to allow for deeper and scientific-based discussions on sustainability. This work presents a perspective about possible scenarios of the world's sustainability, based on a straightforward integrated framework for its quantification. The three capitals of sustainability, summarized as environmental sustainability, productivity and happiness are combined, based on the input-state-output model, and further plotted on a 3-axis graph. Eight different combinations of the three capitals show eight potential future worlds. The least desirable scenario, named "Ineffective," depicts an environmentally unsustainable, unhappy and poor world, whereas "Paradise" is the utopia to be pursued: happy, environmentally sustainable and productive. Societies' decisions on taking action after quantitatively measuring and monitoring sustainability will be determinant in placing the world on a more developed and sustainable path, and the model proposed in this work can be useful in promoting discussions in this direction.

Keywords: sustainable world, happiness, world scenarios, sustainability assessment, sustainable consumption

INTRODUCTION

The main wounds of the twenty first century have been brought to light by the Covid-19 pandemic, as a result from man's inability to sustain the man-nature nexus. As in Andersen's ancient folktale "The Emperor's New Clothes," the human society must face the uncomfortable, inconvenient, and yet only truth: the human race's production and consumption patterns are unsustainable. Both the current and the forthcoming generations may have to struggle with global value chains crises, the rise in multipolar globalization and extreme nationalism, social inequality and poverty increase, economic crises and debt (especially in developing countries), digital exclusion, gig economy and

labor crisis, potential privacy violations and political surveillance, and climate change issues (Odum and Odum, 2001; Ehrlich and Ehrlich, 2009; Barbier and Burgess, 2020; Oldekop et al., 2020). Similar to other previous world crises, such as the 2008 financial crisis, the Covid-19 pandemic claims for attention to a turning-point time in human history, where a high risk of self-annihilation exists, and it is becoming closer (Rockström et al., 2009; Steffen et al., 2018).

None of these threats seems surprising, however, as many staged fiction dystopias such as those in *Soylent Green* from 1973, *Mad Max* from 1979, *Twelve Monkeys* from 1995, and more recently, the *Black Mirror* series, have been warning viewers about the potential negative impacts of unsustainable production and consumption patterns. From the displayed scenarios of exponential human population growth, an overcrowded world is foreseeable, where the overshoot on Earth's biocapacity (Wackernagel et al., 1999), the resulting lack of natural resources, along with the absence of minimum healthy-life standards for the entire population would lead to global wars, dictatorships, epidemics, starvation, climate disasters, and ultimately, mass extinction. Recognizing that the "Emperor has no clothes" is overdue, and establishing a new paradigm on production and consumption patterns is urgently needed, so a sustainable world is achieved. However, to be efficient, such action must be taken under a scientific lens, to support discussions and feed decision makers with strong and accurate indicators instead of guesses and desires.

Although the complexities of the human-nature nexus still need to be more deeply understood, plenty of information is available. Science has advanced in identifying and proposing alternatives to mitigate the upcoming human challenges, among which, the efforts of the United Nations (UN) by creating the Intergovernmental Panel on Climate Change (IPCC), and the Agenda 2030, which establishes the sustainable development goals (SDGs). These are fundamentally important for both theoretical and practical actions. The technological advances on global communication have been essential to the growing amount of generated, exchanged, and stored information. Several scientific tools to assess the world's sustainability or even focusing on the sustainability of production processes under different scopes and scales have been extensively discussed in the literature (Odum, 1996; Stockhammer et al., 1997; Wackernagel et al., 1999; Klöpffer, 2003; Giampietro and Martin, 2005), each one with their own conceptual models to understand how the real world works, while providing procedures for sustainability quantification.

Scientific models and tools are important in predicting the future, however, building a prosperous and sustainable future world must be adopted as the primary goal. It is time for action. The turning point is approaching, and the Covid-19 pandemic, along with all its serious related problems, offers an opportunity to rethink the future for the planet's current tenants and for the future generations. Committed with this issue, a perspective on the alternatives for the world's sustainable future is provided herein, and a novel way to understand, model, and quantify the human-nature nexus is presented. The proposed model could be used for further discussions on sustainable consumption

behaviors in the post-pandemic world, focusing on what would be really important for mankind's societal development.

THE WORLD IN A CUBE: MODELING THE HUMAN-NATURE NEXUS

The human society operates as a thermodynamic open system, in which flows of energy and materials from the natural environment enter the human production systems with the purpose of delivering goods and services that sustain human life. The input-state-output model offers an objective way of understanding the sustainability of such system (Coscieme et al., 2013; Pulselli et al., 2015), as it summarizes the sustainability capitals (environment, society, and economy) in a logical and consequential order, by recognizing that any productive system operates under thermodynamically open boundaries (**Figure 1**). The environment feeds the larger economy with resources to be concentrated, transformed, and further used to promote societal development. The environment, on the other hand, also faces the role of diluting and recycling the waste from human production processes. The environment is the physical basis upon which society and economy develop (Pulselli et al., 2015). Both roles of the natural environment as a resource provider and wastes diluter/recycler are equally fundamental principles to achieve sustainability under biophysical constraints (Daily and Ehrlich, 1996), and the Earth's limits in supporting growth must be recognized and respected, as there is only one planet humans can live in Wackernagel et al. (2002).

Based on the input-state-output model, **Figure 1** presents the proposed conceptual model that may allow for a better understanding of sustainability under a scientific-based lens and subsequent discussions on the theme. It was drawn vertically to illustrate that the natural environment "maintains" the entire economy and the development of society. Besides, it represents the biophysical connections among the capitals, and allows to identify the most adequate indicators to feed each one, representing the state of the whole system. This conceptual model is of paramount importance, since it supports the choice of indicators that better reflect the function of each capital, thus providing a holistic perspective of the system. Environmental sustainability indicators, such as ecological footprint and energy accounting, may be selected to represent the natural environment, while productivity represents the economy (i.e., goods production, gross domestic product) and happiness represents the society. It is worth highlighting that, differently from the model presented by Pulselli et al. (2015), the model proposed in **Figure 1** provides an exchange of flows (two-way), in which physical interactions occur among the environment, economy, and social capitals.

It is assumed herein that the goal of every human production system is to produce and provide well-being for human populations by delivering goods and services, whereas well-being is defined as a lifestyle based on values, such as education, health, family, spirituality, leisure and ethics, thus disregarding the frenzy of overconsumption, typical of a materialism-based lifestyle. In this sense, "achieving a happier society" should

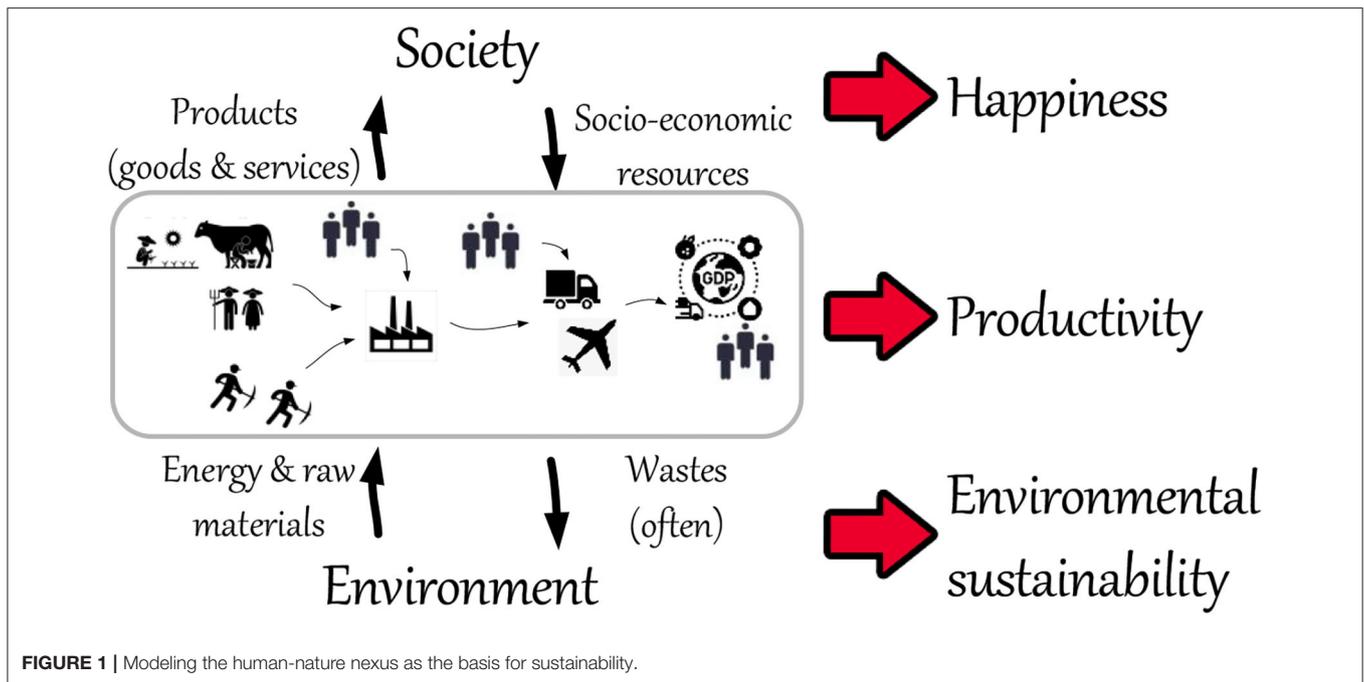


FIGURE 1 | Modeling the human-nature nexus as the basis for sustainability.

be the ultimate goal of the global economy, happiness being a state of human well-being based on two main aspects: (i) affective, which relates to the presence of positive feelings such as pleasure and joy and the absence of negative feelings such as pain, fear, and sorrow; and (ii) evaluative, which refers to our positive evaluation of our own lives at a certain moment (Loizzo, 2012; Helliwell et al., 2020). Several factors may affect human wellness, including a healthy natural environment, as it provides physical and mental health, social cooperation, cultural and spiritual fulfillment, and many other benefits that lead directly and indirectly to happiness (Loizzo, 2012; Helliwell et al., 2020). Also, a positive relation exists between the state of happiness and sustainable behaviors, as happy people are more prone to engage in sustainable practices, such as waste management and sustainable consumption habits (Loizzo, 2012). Furthermore, happiness affects human productivity, shaping job market outcomes and even companies' performance. In return, a highly productive society with decent work and job opportunities drives higher levels of happiness. Although a cause-effect relationship can hardly be established, it seems clear that a healthy environment provides better conditions to achieve a happy society, which, in turn, will be more efficient, and productive. At this point, the analyst should be aware of the potential dependency of a chosen indicator on another (with either positive or negative influence on each other, under an either linear or non-linear behavior), that may influence a system's performance as a whole. However, the proposed model allows such decision to be made by the analyst, under well-presented criteria.

The three selected indicators for the sustainability model of Figure 1 can be quantified, each one under its own rules and meanings, and used to support the discussion about the sustainability of the system under study. Multicriteria approaches

can be used to evaluate strategies, such as weighting and merging indicators; additionally, these can be individually assessed through comparisons with judiciously established goals and thresholds and/or similar systems.

ALTERNATIVES FOR OUR FUTURE: WHAT WORLD DO WE WANT TO LIVE IN?

Figure 1 allows for an analytical assessment of sustainability, when detailed and separated information is needed. However, synthetic assessments are also important to provide information under a larger scale, i.e., a general picture of the system's performance, by aggregating all previous pieces of information. Using a 3-D cube (Figure 2), a combination of the three dimensions of sustainability is possible, in which each indicator represents an axis, maintaining its identity and complementary informative capacity. For the purposes of this work, the axes in the cube are divided into two domains by assuming high (good) and low (bad) performances to visually categorize the overall state of the system. The modeling approach is flexible, and the analyst may establish other domains when needed, always respecting the thresholds established by each chosen indicator. The cutoff values established for environmental indicators depend on their concepts and meanings (for instance, one planet is the cut off for the ecological footprint), while the average world value can be established for both happiness, and productivity. The combinations of the three indicators with their low and high domains generate internal sub-cubes that categorize the eight possible alternative worlds (Figure 2).

One of the eight possible worlds in Figure 2 is assumed to be the one human kind should pursue. However, before determining which one, the differences and similarities among those should

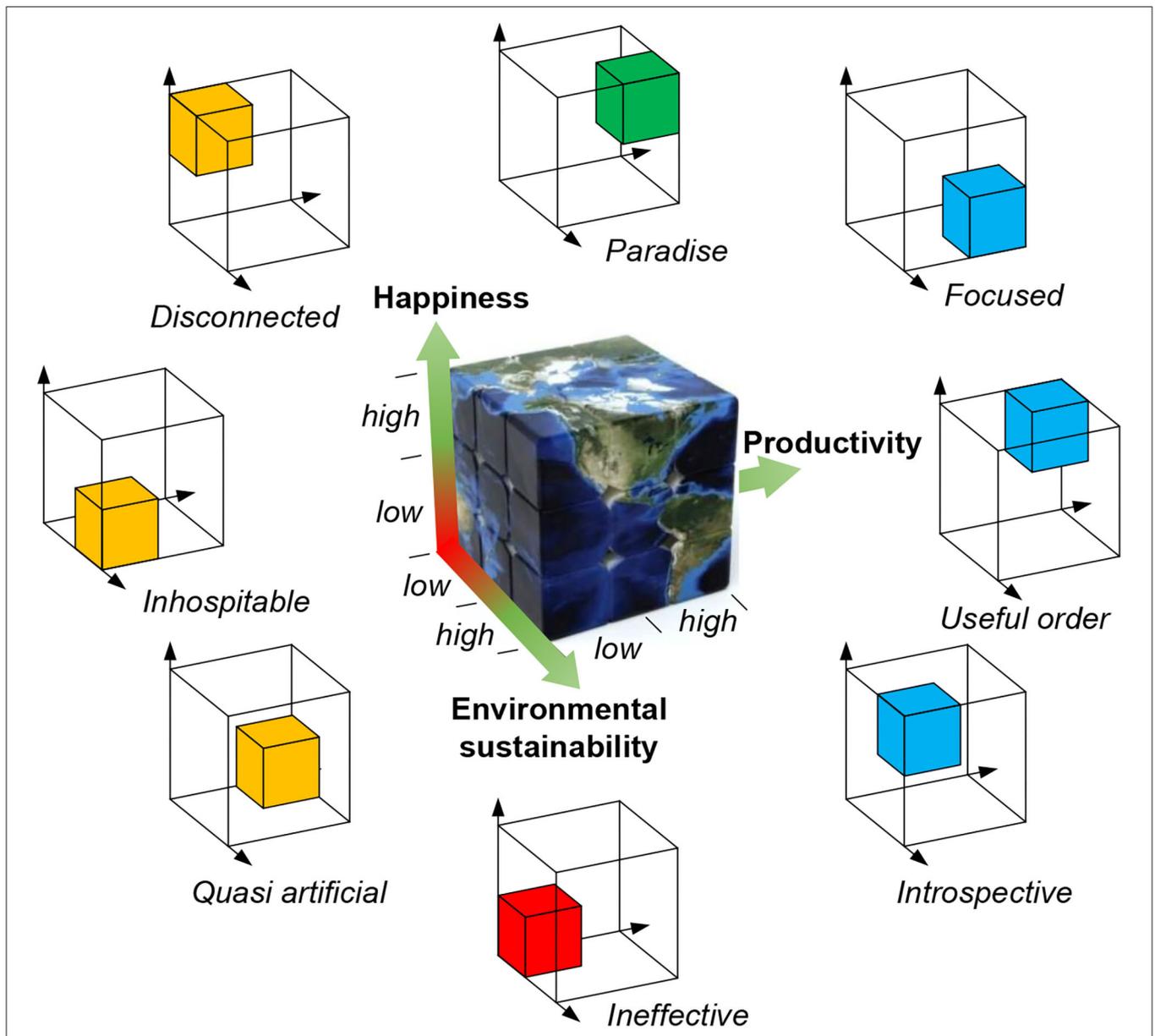


FIGURE 2 | Eight possible worlds. Source: modified from Pulselli et al. (2015). Worst-case scenario (red): Ineffective (environmentally unsustainable, unproductive, and unhappy). Lower-intermediate scenarios (yellow): Quasi-artificial (environmentally unsustainable, unhappy, and productive), Inhospitable (environmentally sustainable, unhappy, and unproductive), and Disconnected (environmentally unsustainable, happy, and unproductive). Upper-intermediate scenarios (blue): Focused (environmentally sustainable, unhappy, and productive), Useful-order (environmentally unsustainable, happy, and productive), and Introspective (environmentally sustainable, happy, and unproductive). Best-case scenario (green): Paradise (environmentally sustainable, happy, and productive).

be understood. The *Ineffective*, *Quasi-artificial*, *Useful-order*, and *Disconnected* worlds are characterized as dystopian worlds that could relate to a natural capital collapse. *Ineffective* is the least desirable scenario, while *Quasi-artificial*, *Inhospitable* and *Disconnected* are lower-intermediate worlds characterized by two indicators with low performance and one with high performance. Particularly, the *Quasi-artificial* scenario resembles the world that, as Covid-19 revealed, mankind is currently living in. It

represents a society that has exceeded the Earth's biocapacity to sustain life, and pursued high productivity at high environmental costs, while failing to provide well-being to society. In a systems' evolutionary perspective, by going further on this pathway, a scenario of climate change, poverty and social conflicts may result in mass extinction of the human kind, perhaps leading to an *Ineffective* world. At this point, whether this scenario really represents life in its deeper meaning or whether other

values may be deemed more important than productivity is debatable. As nature always manages to recover and reorganize itself, natural ecosystems may resurge either with or without humans. The *Disconnected* world resembles the existing poor communities, where the lack of sanitation, malnutrition, and low income are major concerns, while people live in joy and peace, nevertheless.

The upper-intermediate worlds (*Focused*, *Useful-Order*, and *Introspective*) achieved high performance for two of the three indicators, rendering these worlds far from conceivable, and yet, undesirable. The *Focused* one represents an environmentally sustainable and productive world where people somehow fail to obtain satisfaction. *Useful-order* is a world with a happy and productive population who disregard environmental protection, resembling many current developed countries. Such world could not prevail over generations, given the impossibility of a truly social-economic development without a healthy environment to support it (Coscieme et al., 2019). Therefore, such scenario should be avoided. The *Introspective* world relates to a scenario of environmental sustainability and social happiness, however, at lower productivity rates. It can be comparable to the traditional livelihood communities, mainly indigenous, where people rely on natural renewable resources to sustain their needs without aiming high productivity for goods and services in order to achieve happiness. Although this world could sustain itself over long periods in geological time, it is only achievable by reducing the human population, which is unlikely to happen in time to prevent the environmental collapse.

Finally, mankind's best shot is the *Paradise* scenario, where societies live within the Earth's biocapacity with enough resources to sustain a healthy and happy lifestyle for the present and future generations. This can only be achieved by changing the current business-as-usual production-consumption mentality to a more circular one (living under natural biophysical restrictions), and understanding that life is far more than materialistic satisfaction. The Doughnut Economics model (Raworth, 2018) may represent the *Paradise* scenario.

The *Paradise* scenario combines low pressure on the natural environment, high productivity, and happiness; logistic operations appears as an important tool for the first two capitals. Although exercises in predicting the future of human society as presented in this work can be useful in modeling and supporting decisions, building the desired world demands higher efforts through an effective science-based strategy that must be implemented urgently. Despite all negative consequences, world crises, such as the Covid-19 and the financial crisis in 2008, represent a both rare and narrow window of opportunity, in which a shot must be taken at promoting a more sustainable world. In pandemic times, mankind can more easily understand that eternal growth is a panacea, that fossil energy is running out and that climate is changing, in other words, humans are temporary Earth's tenants rather than its owners. The current production-consumption patterns (business as usual) model has proved to fail at providing well-being for the entire population, while creating a time-bomb concerning social, political and environmental aspects just about to explode. Therefore, why

should society return to the “old normal” world instead of remodeling it into a new, efficient and sustainable “post-normal” one?

As emphasized by Coscieme et al. (2019), all existing economic systems are humans' abstractions that are far from the material reality. The old concepts and premises behind the classical economic theories are not set in stone, thus they should be constantly revised and improved in function of the different realities, so the problems faced by humans under different circumstances can be solved. Such theories must be deemed old-fashioned, and cannot help in achieving a more sustainable world. According to Odum and Odum (2001), the business-as-usual was important during the growth phase that mankind has been enjoying over these last 100 years, supported by large amounts of available energy resources, and where efficiency was not the main target. However, a new paradigm must be established to face the societal issues of the new millennium, as the world is getting close to the start of the de-growth phase, with low availability of resources.

Alternative technologies for energy transformation, goods and food production (including logistic operations), human health and education, environmental protection and climate regulation are well-known, in current times. Nevertheless, world leaders and decision-makers are failing to take effective measures against a world collapse (Ferdig, 2020). Adequate existing scientific tools, such as the one presented herein, attempts to better clarify the synergic relationship or nexus between nature and humans, support discussion among the most different stakeholders, and give support to put the current world on a more developed and sustainable path. The ultimate goal is to achieve the desired *Paradise* world (environmentally sustainable, happy, and productive) that dissociates consumption from happiness, while maintaining the positive synergy between happiness and the production of real wealth.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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