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(RE)CONSIDERING GEOENGINEERING IN AN ETHICAL BIOCULTURAL FRAMEWORK

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ABSTRACT. In the perspective of biocultural homogenization and the increasingly prominent use of technology, environmental ethics faces new challenges. Development policies, governance, and economic factors impose new ways of understanding and managing coexistence. Phenomena such as pandemics, global warming, migratory phenomena, the expansion of urban and rural areas, and the development of large-scale monocultures show us that human agency, resources, the environment, and surroundings are increasingly intertwined, both physically and metaphysically, in an increasingly encompassing organism where the dissociation between the local and the global becomes difficult to achieve. With a wide range of actions and relationships, environmental psychology and ethics have the task of rethinking the relationship between cultural elements and the biosphere, in order to achieve a balance between sensibility, responsibility, and responsivity. In this article, I aim to illustrate that a biocultural ethical framework emphasizing socio-environmental justice, applied to geoengineering, not only promotes global socio-environmental sustainability but also recognizes the crucial significance of local ecosystems in climate regulation and biodiversity conservation. To do so, I will briefly present some theoretical elements related to the importance of environmental psychology in understanding the connection between individuals and the surrounding environment. Then, I will succinctly present the concept of the ”3Hs” and its implication on biocultural ethics, and subsequently integrate specific elements of biocultural ethics into the analysis of geoengineering ethics to illustrate the need for a perspective that takes this into account. Through this endeavor, I intend to emphasize the vital role of a holistic, multidimensional perspective that guides individual values and community policies towards sustainable practices, ensuring social cohesion and dialogue, respecting the coexistence of life forms, and protecting their habitats.

Keywords: environmental ethics, geoengineering, sustainability, biocultural ethics, environmental psychology.

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Introduction

The characteristics of the social and physical environment have a direct impact on the way human behaviors are articulated, and the health status of individuals and non-human entities is directly related to the organization and manifestation forms of the ecosystems in which they reside. Moral agency is closely linked to the perceptions, evaluations, and attitudes that individuals exhibit in relation to the environment, with the anthroposystem being tightly connected to the characteristics of the ecosystem. In order to understand the dynamics of social and cultural phenomena and to identify sustainable actions or sets of interventions in accordance with sustainable development goals, it is necessary to understand how our cognitions, perceptions, and representations depend on the levels and forms of organization of the environment. In this regard, environmental psychology can help us identify how individuals perceive the environment in which they live, as well as the impact of different environmental conditions on individual actions. Technological interventions on the climate, such as geoengineering, with the aim of manipulating it to achieve positive results, make us aware of the expansion of the human environment beyond the limits imposed by what we call "natural" or "artificial" (Moser, 2009). Human settlements shape the distribution of elements in space and reshape both biotic and anthropic models of interactions, drawing new coordinates for human communities' relationship with nature, as well as with other communities and inhabitants of ecosystems. Adaptive behavior in new environmental situations depends on a certain degree of control that individuals feel they have and can exert. Thus, individuals become efficient when environmental constraints are not so strong as to lead to disorganized behavioral reactions. Moral action is dependent on the level of controllability that individuals have to act in accordance with the considerations they deem desirable (Seligman, 1975). The surrounding environment is vulnerable to the motivations and actions exhibited by moral agents, and changes in the appearance and distribution of elements in the environment directly impact on how individuals perceive and respond to environmental stimuli. Having a degree of control over environmental conditions significantly reduces the risk of uncontrolled reactions towards the environment. Therefore, the more individuals feel empowered to control their living space, the more efficient their adaptive behaviors become.

Averill (1973) contends that individuals can exercise direct command over the surroundings by altering the circumstances that vex them. This control can adopt the guise of cognitive command, encompassing the evaluation and assessment of the stress level generated by particular environmental scenarios, as well as decisional command, wherein individuals possess multiple feasible alternatives to select from. Hence, the essential prerequisites for an individual to partake in a control conduct are ascertained by the likelihood that the situation can be modified in the intended manner, the perception of the probability that a situation can alter through its own dynamics, and the valence or worth of the situation. In this framework, we can mention an ethos of motivation and, conceivably, the extent of positive reward it entails. Consequently, we can observe that behaviors associated with the environment are components of an exceedingly intricate cognitive system, wherein the situational interpretation of the environment, the degree of command, motivations, and expectations all contribute to our societal representations of space. (Parodi et.al, 2011).

Understanding social relationships is intimately tied to the social portrayals of the inhabitants of a territory, a standpoint that governs behaviors, which can be either sustainable, aligning with the requisites of sustainable development and regard for future generations, or unsustainable and ruinous. The social portrayals of individuals determine an accumulative array of ecological or non-ecological behaviors, and the principles of organization and comprehension of social reality dictate the epistemic validity of moral action (Neculau & Curelaru, 2003). Consequently, there is a close correlation between the establishment of behavioral schemas and the tangible and communal dimensions of the environment in which individuals partake, and territorial relationships exert a direct influence on behavioral adaptability. The ecological administration of space becomes contingent on the relationships with the environment structured by the individual's personal encounter, an encounter that is, in turn, influenced by the characteristics of cultural and ecological multiplicity (Rozzi et al., 2018). Therefore, an environment perceived by an individual as limiting to their objectives will incite a series of adverse emotional responses, culminating in a reactance effect that prompts the individual to react with behaviors that reinstate a sense of manageability (Stokols, 1978). Nevertheless, humans are not solely engaged in the tangible aspects of landscapes, but also in the emblematic, cultural, and linguistic elements. Language, customs, and technology are profoundly ingrained in human observation and comprehension of organic variety. The phrase "biocultural" explicitly acknowledges that the societal aspects of any perceiver, containing scholars with their investigative techniques and representational frameworks, exert a substantial influence on the formulation and interpretation of biodiversity notions. Consequently, human perceptions and comprehension of biodiversity and their surroundings can shape the manner in which humans populate ecosystems and alter the arrangement, operations, and composition of living organisms, spanning from small to worldwide extents.

A biocultural ethical framework that accentuates socio-environmental justice not only fosters worldwide socio-environmental sustainability but also acknowledges the pivotal importance of local ecosystems in regulating climate and conserving biodiversity on a global scale. Nowadays, humans wield greater influence over the biosphere compared to alternative natural forces. This realization blurs the conventional dichotomy between "biophysical" and "cultural" facets of actuality and underscores the truth that global society possesses the capability to instigate substantial alterations to the planet's climate, contamination, biological variety, and more. To comprehend the role of humans in the Anthropocene, it is vital to embrace a biocultural standpoint that surpasses depiction and raises ethical inquiries concerning human agency as the principal impetus shaping the biosphere. The disregard for ecological and cultural variety, alongside their interconnectedness within the assorted regions of our planet, has led to processes of biocultural standardization. This frequently disregarded feature of environmental crisis propels the Anthropocene, causing the loss of biodiversity and cultural richness at local, territorial, and worldwide levels. While the extent of biocultural standardization is not widely recognized, it stems from intricate and pervasive declines in both biological and cultural diversity. The widespread substitution of local ecosystems, linguistics, and cultural artifacts by cosmopolitan counterparts distorts the interaction of indigenous cultures and their surroundings. When a social group embraces universally homogenous lifestyles, it is more prone to fashion uniformly standardized habitats. Concurrently, globally uniform digitalized urban environments boost internationally uniform lifestyles and mindsets to underscore these intersections between cosmopolitan lifestyles and surroundings, and their implication for both humanity and other-than-human species, the term "biocultural standardization" was coined by Rozzi (2012).

Biocultural ethics and the „3Hs"

To counteract the effects of biocultural homogenization, Rozzi (2020) draw up the theoretical paradigm of the biocultural ethos, which emphasizes the importance of recognizing the interconnectedness among diverse life habits of various co-inhabitants, including humans and other species, who share a common habitat. While ecologists may perceive the connections between habitats, habits, and co-inhabitants, referred to as the "3Hs" (Rossi et.al. 2020) as self-evident, these links are presently confronting swift and extensive disruptions due to policies and development models that neglect to acknowledge and value the distinctive and diverse local biota and cultures. Consequently, these distinctive elements are being

eradicated and substituted with a restricted and standardized array of biological species and cultural habits on a global scale. Rozzi introduced an approach to biocultural preservation that established correlations between assimilation, reliance, socio-economic disparity, and the relocations encountered by regional populations from their original territories. The preservation of ecosystems is not solely acknowledged from a scientific standpoint but also held in elevated ethical esteem as a fundamental prerequisite for ensuring the welfare and safeguarding of the ethnic heritage and cultural practices within these local settlements. To attain equity and sustainability, Rozzi (2003) claimed the necessity of putting together the governmental, financial, and epistemological features, supporting the preservation of various and distinct habitats and the living habits that have evolved in each specific area. In order to protect a habitat, it is essential to shield it from the detrimental actions driven by imbalanced self-interests of particular individuals or groups, which can lead to the deterioration of ecosystems, biotic communities, and specific populations. The protection of habitats is grounded in a fusion of both legal and moral frameworks, which may differ across diverse countries. (Callicot, 1994).
Within the model of the biocultural ethos, the idea of habitat encompasses three interrelated aspects, where alterations in one feature precipitate modifications in the others. These three elements are the (1) biophysical dimensions, (2) the cultural and symbolic-linguistic dimensions and the (3) the social, structural, and technological components (Rozzi, 2015). All of these dimensions are potentially impacted by the effects of climate engineering, and the short- and medium-term consequences can be irreversible, causing destabilization and modification of natural mechanisms and landscapes, community policies and practices, thus changing the way individuals relate to the technosphere, their peers, the goods, and resources. Therefore, the concept of "co-inhabitants" bears ethical and ontological implications that are interconnected and serve as a critique of the dominant theoretical model of environmental benefits. The framework in question suggest that individuals manage the ecological outputs, thus considering humans as the sole active agents with their own interests. However, within the biocultural ethos's conceptual framework, the term "co-inhabitants" adopts a more extensive interpretation to underscore three crucial traits of the diverse beings (both humans and other living entities) that partake in a biotope.

Firstly, co-inhabitants are perceived as individuals rather than things. Secondly, their identities and well-being are co-formed through their interdependence with other human and wildlife entities. Lastly, co-dwellers inhabit in the same environments that they collectively shape by their shared living arrangements. These associations are characterized by ecological complementarity and reciprocity, involving transfers of substances and forces. Hence, the conservation and protection of biodiversity becomes crucial conditions for the existence and well-being of these diverse co-dwellers. Co-inhabitation implies reciprocity, acknowledging the mutual interdependence and shared responsibility between humans and the broader ecological community. (R. Rozzi et al. 2020). I have introduced the theoretical model of the biocultural ethos' 3Hs as a design that provides knowledge in three important areas. Firstly, it enhances our comprehension of the complex multidimensional and multiscale processes involved in global changes. Secondly, it aids in the formulation of policies that effectively integrate moral, governmental, and eco-related components within our today's tech-oriented society. Thirdly, it supports decision-making mechanisms by evaluating the potential ramifications of development projects on the preservation or destruction of living environments, ways of life, and the welfare of co-dwellers. By using the 3Hs scheme of the biocultural ethos, we can navigate international community towards energy-efficient forms of cohabitation among the quickly transforming socio-ecological scenarios. This framework serves as a valuable tool to navigate the intricacies of our changing world and make informed decisions that prioritize the long-term well-being of both humans and the broader ecological community.

Essentially, the biocultural ethos framework recognizes living environments as encompassing these interconnected dimensions, emphasizing their interdependence. Changes in any one dimension inevitably impact the others, highlighting the intricate relationship between biophysical factors and the living organisms they sustain. Biocultural ethics is a field of study that analyzes and evaluates the environmental and societal factors contributing to both biocultural homogenization and biocultural conservation. It employs a conceptual framework and methodology that facilitate collaboration among biologists, engineers, anthropologists, ethicists, and other professionals in researching and redirecting environmental change towards a sustainable future. Also, it establishes connections between human existence and the diversity of co-dwellers with whom humans share their identities and well-being. This ethical approach encompasses inter-species relationships, expanding the moral relevance of biotic components to the community. Unlike popular contemporary ethical norms, which primarily concentrate on human conduct while neglecting their surrounding environments, biocultural ethics integrates human customs, living environments, and the communities of co-dwellers. These "3Hs" of biocultural ethics encompass various aspects, including the ecological, language-based, and societal-institutional-technological dimensions Within each domain, it is crucial to examine power dynamics and varying responsibilities related to the origins and remedies for ecological challenges. These statements are not exclusively factual but carry normative value, aspiring to utilitarian truth. Biocultural ethics endeavors to promote social-environmental fairness by endorsing the sustenance of biological variety and cultural heterogeneity (Rozzi, 2013).

Biocultural morality highlights that numerous communities worldwide manifest conservation-minded and harmonious coexistence practices (Callicott, 1994). Furthermore, it underscores that a small number of identifiable actors are accountable for many significant environmental issues (Rozzi et al, 2008). Consequently, analyzing global environmental change as a broad conflict between humanity and the environment is both distorted and unjust. To address this, biocultural standards seek to recognize and hold individuals accountable for socio-ecological challenges. The application of biocultural morality promotes further exploration and admiration of biological and cultural variety, alongside their interconnectivity, in educational initiatives, policy formulation, and everyday customs. This approach counters the adverse repercussions stemming from the homogenization of biocultural diversity. Therefore, it is crucial to emphasize the importance of ethical collaboration among individuals and communities due to the global impact of geoengineering. This impact will have far-reaching consequences, influencing our perception and management of landscapes, biodiversity elements, and the intricate connections between the human-influenced environment and the natural world.

Geoengineering in the biocultural ethics model

First and foremost, we can only consider geoengineering as an additional option alongside adaptation and mitigation, rather than a solitary intervention devoid of efforts to tackle the root causes of global warming. The available options for manipulating the Earth's climate can be broadly categorized into two groups: those that seek to mitigate global warming by reducing greenhouse gas levels (carbon sequestration) and those that aim to limit sunlight intensity reaching the Earth (solar radiation management). For the purpose of this paper, I will solely focus on solar radiation management because, unlike carbon sequestration, it has the potential to artificially cool the climate at a faster rate, even though its effects are not immediate (although it addresses the underlying cause of global warming, which is the volume of carbon dioxide in the atmosphere). Specifically, one solar radiation management procedure proposes the continuous release of hydrogen sulphide (H_2S) and sulphur dioxide aerosols (SO_2) into the stratosphere. Atmospheric aerosols are particles suspended in the air, consisting of gas or liquid, and they exist in the atmosphere due to both natural occurrences and human activities. These particles have a significant impact on the climate. They directly affect solar radiation by absorbing a portion of the incoming solar energy, and they also indirectly contribute to cloud formation, resulting in a cooling effect. This phenomenon reduces the amount of solar energy reaching the Earth's surface and atmosphere, reflecting a small fraction back into space. Solar radiation management procedures strive to decrease the amount of solar energy reaching the Earth through various methods, including space-based approaches, modifications to stratospheric aerosols, marine cloud whitening, and alterations to surface albedo. Redirecting one to two percent of the sunlight that reaches the Earth back into space would lead to a cooling effect equivalent to the projected warming resulting from doubling the levels of greenhouse gases compared to pre-industrial times (Cherry & Todd, 2021).

The technique of marine cloud whitening involves generating a fine mist of seawater droplets that rise into the atmosphere, forming sea salt aerosols. This process entails spraying micron-sized droplets of seawater beneath marine stratocumulus clouds within the turbulent boundary layer. As the residues left behind after the droplets evaporate reach the cloud level, they introduce numerous new cloud condensation nuclei, effectively enhancing the cloud's albedo and reflecting solar energy back into space. This procedure would cool the Earth by an amount comparable to the cooling effect expected from doubling atmospheric greenhouse gas concentrations (Bellamy, 2016). Due to the Earth's climate system's sensitivity to alterations, these technological procedures may yield unintended outcomes, such as changes in global precipitation patterns and distribution, an upsurge in acid rain, alterations in sky brightness and coloration, reduced solar insolation for photovoltaic and thermal energy production, delays in mitigating ozone layer depletion, potential drastic warming if abruptly discontinuing atmospheric sulphate aerosol injection, increased plant productivity, potential adverse impacts on health and healthcare, and disparate regional climate changes.

Thus, stratospheric aerosols holds significant potential as a partial measure to mitigate global warming. Compared to other geoengineering approaches, it produces immediate effects that can also be reversed by ceasing sulphur injections if problems arise. However, even if successful, the use of sulphur aerosols serves as a temporary solution, as warming will resume once the injections cease. Solar radiation management fails to address other negative consequences of rising anthropogenic CO2 emissions, such as ocean acidification. Therefore, relying on stratospheric aerosols alone cannot be regarded as a viable strategy to combat climate change but rather as a means to buy additional time to directly address the root causes. Nonetheless, substantial efforts must be dedicated to determining the most efficient execution of injections and conducting extensive research into potential unintended effects before implementing this geoengineering technologies (Keith, 2021). According to Royal Society Report (2009), the SRM methods with the greatest potential, ranked in order of priority, are (1) stratospheric aerosol methods, having the advantage of more uniform distribution of their effects compared to other techniques and can be implemented relatively easily, (2) cloud brightening methods,(with the advantage of being readily deployable and can be tested on a smaller scale with fewer governance concerns compared to other SRM strategies and (3) space-based SRM methods, providing a more consistent cooling effect compared to surface or cloud-based methods, being a cost-effective option compared to other SRM methods. However, the development of the space-based SRM technology is expected to take several decades. While the feasibility of implementing geoengineering measures involves considerations of policies, governance, and costs, solar radiation management (SRM) can serve as a temporary alleviation of concerns regarding the impending ecological catastrophe (Scott, 2018). Certain scholars have proposed that geoengineering procedures could contribute to raising awareness about climate change and the urgency of adopting policies and practices that mitigate the impacts of pollution and waste management (Wagner & Merk, 2019).

Furthermore, by comprehending the ongoing interconnectedness and adaptability inherent in the functioning of all living systems, we can observe how our actions can result in substantial amounts of waste, burdens, and debts (Scott, 2018) that may be inherited by future generations. Even if solar radiation management (SRM) strategies would be implemented, their effectiveness would hinge on international adherence to these technologies, necessitating global awareness among nations regarding the supportive role of geoengineering in conjunction with clear pathways toward a fundamentally different lifestyle. Such a lifestyle should prioritize biodiversity, safeguard the delicate atmospheric equilibrium, and promote responsible resource usage. The SARS-CoV-2 pandemic, the war in Ukraine, and the embargo on Russia's gas and oil exports serve as examples of situations where ecological concerns take a back seat to sanitary, political, and economic interests. Nevertheless, research in biotechnology, applied studies on ecosystems, and policies related to resource management and waste must persist. Moor (2005) argues that the rapid emergence of new technologies (referred to as technological revolutions) often catches analysts off guard, including psychologists, sociologists, anthropologists, and ethicists. Their tendency to apply outdated analytical methods may lead to failures due to the mismatch between the values inherent in the new technological paradigm and the methods employed for analysis. Consequently, we find ourselves in a realm that calls for new conceptual frameworks and procedures.

To address this need, it is crucial to recognize that applied ethics are dynamic organisms, constantly evolving and confronting new challenges. This implies that within the realm of ethics surrounding emerging technologies, it is crucial to continuously situate ourselves in relation to their development, anticipate their trajectories, and devise new analysis strategies. Grasping the entirety of a technological revolution is challenging due to information loss during its emergence. Therefore, Moor's second recommendation emphasizes the establishment of improved collaboration among ethicists, scientists, social science researchers, and technology specialists—a multidisciplinary approach is essential. I underscore the significance of this issue because it represents the sole means through which we can obtain a comprehensive understanding of the world that may be shaped by climate engineering. Without such an approach, ethical dilemmas will proliferate, and the sciences attempting to address them will deplete their resources justifying pseudo-problems that could have been averted. The third enhancement for the ethics of emerging technologies entails the imperative to develop more intricate ethical analysis methods, recognizing that ethical theories often prove simplistic and offer limited assistance in dealing with specific situations. Applied ethics must continually engage with challenges in the present to avert the "shock of the future," enhancing their working mechanisms and identifying the underlying logic of scientific evolution. Even in the face of unforeseen dilemmas, research in climate engineering must persevere and advance.

There is an obvious need to minimize the risks associated with deliberate interventions such as solar radiation management (SRM), ensuring that research proceeds in accordance with the moral principles of science and avoids serving private interests or arbitrary manipulation (Ackerman, 2017). The governance of geoengineering should be framed within a framework that considers moral principles upon which researchers, public, and private entities can rely. The Tollgate Principles (Gardiner & Fragniere, 2018) offer such a framework, encompassing the entire process of framing, authorization, consultation, trust and accountability, technical feasibility, predictability, and social protection of geoengineering strategies. Moreover, there is a need to transition from an investigator-driven scientific program to a robust mission-driven research structure (Morrow, 2019). Furthermore, there is a requirement for comprehensive on-site research that involves all stakeholders and potentially affected communities of solar radiation management (SRM) strategies. This research aims to establish a collaborative body between local institutions and the central government, facilitating the inclusion of diverse values, ideas, perceptions, and beliefs while informing communities about the impacts of geoengineering strategies. Public engagement plays a vital role in ensuring the reliable and trustworthy implementation of SRM strategies.

Hence, the moral principle of publicity becomes essential, recognizing the significant impact of geoengineering on the quality of life for individuals and species, as well as the interactions among institutions and moral agents in terms of rights, justice, welfare, political legitimacy, and compensation strategies (Blackstock & Low, 2019). Research should be conducted in accordance with the precautionary principle to mitigate situations where SRM strategies result in incomparable or irreparable unintended negative effects. It is crucial to conduct computer simulations, analyses, and test technology functioning within a stable and predictable context (Wolff, 2019). The implementation of solar radiation management (SRM) has implications that extend beyond national borders, potentially impacting various regions worldwide (Heyward, 2019). Ecosystems' ability to mitigate the effects of human activities is already overwhelmed, with tipping points being exceeded and subsequently overlooked. The loss of biodiversity, soil degradation, ongoing acidification of oceans, disruption of nitrogen cycles, and significant global changes in air currents, coupled with severe air pollution, all necessitate a sustainable and enduring strategy. This strategy should begin with public policies and extend to lifestyle changes, altering our patterns of consumption and reevaluating our self-perception in relation to our possessions and actions. The challenges posed by geoengineering, including feasibility, moral hazards, governance issues, research-related obstacles, and risk-related dilemmas, will intersect with existing problems. The current economic growth model, which relies on the exploitation of natural resources like oil, gas, wood, and coal, will ultimately lead to a collapse (Sturloni, 2017). Introducing another form of human intervention into the Earth's climate system could potentially result in irreversible environmental transformations. Without a global consensus on strategies to keep global temperatures within safe limits (which are regularly surpassed and revised in every global environmental summit), engaging in irreversible climate interventions through alternative technologies would be at least dangerous, if not irresponsible and ultimately catastrophic (Shue, 2018; Dooley and Kartha, 2018). Given the complexity of the Earth's system, any large-scale attempts to influence the functioning of living systems and ecosystem interactions require careful consideration. SRM could have significant environmental consequences, such as reduced global precipitation, increased acid deposition, and diminished oceanic productivity. Additionally, if SRM were to prove successful (even on a long term), there is a risk of commercializing geoengineering technologies, which would have unprecedented global impacts in political, scientific, social, and ecological realms. In such a scenario, there is a heightened likelihood of addressing symptoms rather than underlying causes, leading to a weakening of moral agency and motivations (Nerrico, 2018).

Ensuring public safety and providing transparent information to the public, along with controlling access to geoengineering technologies, are imperative. It is crucial to establish robust and practical protocols for monitoring and verifying the activities of companies involved in producing the necessary components or systems for geoengineering. These companies should have safeguards in place to protect their data and equipment used in small-scale tests of geoengineering procedures. The results of these tests, as well as the associated impacts and risks, should be effectively communicated to the public (Smith, 2020). Having the context of geoengineering research and its possible implications, biocultural morality advocates for an approach that is willing to explore the interconnections among individuals, living creatures and their habitats. To accomplish this, interdisciplinary cooperation between ecologists and philosophers is vital in bringing insights from scientific perspectives, while conserving and promoting local cultural and moral dispositions that are strong and sustainable. Thereby, biocultural morality aims to increase consciousness about cohabitation of different living beings and to help individuals cultivate the communication skills with a diverse range of people as well as other non-human beings. This form of communication goes beyond mere verbal or rational exchange and encompasses physicality, emotion, and the practice of co-inhabitation in daily living. Biocultural dialogue is not confined to far-off areas but can also be nurtured in the urban dwelling places of cities.

Additionally, it underscores the importance of integrating and embracing the multitude of eco-conscious local rituals and knowledge into policy, economy, and school-based education. We can distinguish between various meanings concerning sustainability. Thus, we can discuss either expansive sustainability, which seeks to establish mechanisms of environmental justice and political control, or moderate sustainability, namely a gradual transformation of the current socio-economic system without radically altering the structure of environmental policies (Stevenson & Dryzek, 2014). The expression "place-based" refers to three separate levels of encounter. Primarily, through practical engagement, it is possible to observe and investigate constituents and operations of biocultural variety which are frequently disregarded or misrepresented in formal learning, public strategy, and dominant worldwide paradigms. Subsequently, by engaging with their sentiments and reason in interchanges with other entities in their environmental, semiotic, and systemic conditions, participants acquire a comprehensive perception of biocultural variety. Ultimately, and most notably, through direct meetings with other human and other ethical recipients, the comprehension of biocultural variety is transmuted from a simple notion to an immense encounter of co-residence. This encounter permits other entities to surpass their status as mere objects of exploration and obtain the position of co-residing subjects.

Within this framework, the expression "culture" is employed to denote a modern comprehension where culture is no longer perceived as the antithesis of natural surroundings but as the concomitant presence of essential hereditary aspects such as togetherness, correspondence, and custom (McDaniel, 2002). From a pragmatist standpoint, culture may be viewed as a system that guarantees the continuous safeguarding of a communal group, acting as a mutual regulatory mechanism that fosters a sense of unity and aims to establish constancy throughout timespan (Orr, 2002). Consequently, sustainability, initially comprehended in a restricted sense, becomes an implied central objective within any culture.

Theoretically, a sustainable culture would be sustainability that is collectively endorsed, mutually agreed upon, and easily understandable, as well as being institutionalized and internalized so that it is transmitted through customs, patterns, habits, and even emotions. In a moral culture of sustainability, its principles are embraced and put into practice on a day-to-day basis. Similar to the manner in which accomplishments like democracy, freedom, autonomy, and education are deeply ingrained in the cultural backdrop and only come to the forefront when threatened, sustainability should also become a fundamental cultural notion and achievement that guides the collective. At its core, a culture of sustainability involves translating and embodying the key doctrines and perspectives of eco-friendliness notions into everyday life. It goes beyond merely defining and implementing complex rules and indicators associated with sustainability concepts. Instead, it entails the collective institutionalization of the underlying humanistic principles that form the basis of these concepts, such as global awareness, intergenerational justice, and an expanded understanding of our relationship with the environment. When we delve into the authentic essence of sustainability and contemplate its assertions of being worldwide, integrative, to some extent anthropocentric, and intergenerational, we come to comprehend the complete breadth of its scope. It encompasses nothing short of the welfare of humanity as a whole, perceiving all moral actors as members of a community or, from an ecocentric standpoint, recognizing all beings as interconnected kin.

Among other factors, two elements support this approach. Firstly, the pervasive integration of technology into our natural living environment has resulted in the disappearance of nature, significantly undermining any sustainable ecological framework. We observe that nature is manipulated, transformed into a technical state, losing its intrinsic identity as it merges with technological artifacts and culture. In ecological contexts where technology and nature are inseparably intertwined and unpredictable, the traditional distinction between technology and nature becomes meaningless. Then, the ecological crisis serves as a stark demonstration that the prevailing notion of technology as a means of controlling and harnessing nature is yielding consequences that jeopardize the continuance of humankind. The ecological crisis is essentially a manifestation of a paradigm primarily centered on the division of humanity, culture, and the technological disruption of nature. Therefore, it is imperative to reassess our relationship with nature and technology, recognizing the need for a more harmonious and mutually beneficial coexistence. This shift entails embracing a perspective that transcends the dichotomy between technology and nature, acknowledging their interdependence and seeking sustainable solutions that uphold the integrity of both.

There is a concern that the implementation of geoengineering may lead to the marginalization of ethical issues and superficial justifications. This could occur either because certain ethical concerns are deemed too sensitive for public discourse and consensus is difficult to achieve, or because discussions on potential dangers are sacrificed in favor of the belief that geoengineering is preferable to inaction (Rickles et al., 2018). Such an analysis necessarily involves discussions on moral solidarity, distributive justice, and informed consent. It requires clear and transparent evaluations of costs, impacts on human rights, intergenerational effects, and the formulation of compensation principles in relation to food justice and unrestricted access to basic resources. In terms of compensation principles, it should be noted that there is currently no clear and unified strategy at the policy level regarding the agents (institutions, governments, industry stakeholders, large or small polluters) responsible for covering the costs of implementing SRM technologies. The concepts of separation, autonomy, and individuality can estrange human beings from their natural environment. These concepts promote and imply power dynamics. However, placing excessive emphasis on these notions can be perceived as a misconception for two primary reasons. Firstly, from an ethical standpoint, overvaluing and prioritizing these concepts diminishes the importance of the environment, paving the way for violence and exploitation. Secondly, epistemologically, if the emphasis remains purely theoretical without any basis in reality, it can lead to erroneous conclusions and ineffective actions.

Fundamentally, it is vital to acknowledge that placing excessive emphasis on separation, autonomy, and individuality can have adverse repercussions for both ourselves as human beings and the interrelated systems we inhabit. Embracing a more comprehensive perspective that recognizes the interdependence of individuals and their environment is crucial for fostering sustainable development and social harmony. This entails the need to strengthen our character, diminish the dimensions of hubris, support sensitivity and entrepreneurship in the realm of technology with an altruistic approach, nurture tenacity and the spirit of observation, self-reflection, and critical thinking. We find ourselves metaphysically entangled in a web of interdependencies, wherein self-care must manifest as a mature moral, emotional, and psychological inclination towards caring for the entirety of our identification (Stoenescu, 2016). Any alteration to the structure of an element within a system will inevitably impact the entire system. Nothing eludes the system, thus introducing any element requires careful evaluation of its local and global consequences on the entire biophysical system. Hence, as geoengineering arise as an feasible option, all significant participants in the fields of science, society, medicine, law, technology, and politics must engage in an open dialogue, embracing a holistic perspective and fostering cooperative attitudes. There is a strong need for an unprecedented interdisciplinary endeavor to address this global challenge. Establishing a common ground for exploration, contemplation, action, and implementation concerning climate change is of utmost importance, and decisions need to be promptly implemented, having a necessary attention given to the moral principles of subsidiarity, justice, publicity, and precaution.

Conclusion

In the face of global changes, we require interdisciplinary philosophical and scientific approaches. The challenges posed by socio-ecological dilemmas compel us to reconsider the fundamental basis of our understanding of nature, the environment, and our role within them. This includes our communities, resource utilization, and the fulfillment of our needs. It is important to recognize that the right decision is not always the easiest one, given the multitude of options and ideological influences we encounter daily. To navigate sustainable development and respect for future generations, we need public policies that are clear, transparent, intelligent, and creative. Prudence is essential in areas where we have limited understanding of the interconnections between human agency and fundamental ecological values. Simultaneously, it is evident that action is required. We must expand our relationships and cultivate motivations aligned with moral principles that safeguard the interconnected web of biodiversity. Technologies, by mediating relationships between humans and the world, actively contribute to our moral framework. The profound integration of human beings and technological products in our lives means that even our ethical judgments and choices are shaped by technology. Recognizing this interplay is crucial for assuming responsibility for the societal and existential impacts of technology.

As the effects of geoengineering transcend borders and potentially disrupt the diversity of inhabited areas and habitats, it becomes our responsibility to acknowledge the necessity of a bioethical common ground—an all-encompassing environmental ethics—encouraging the development of communication, evaluation, and implementation mechanisms and tools for technologies that can manipulate transnational ecosystems. Furthermore, we must be aware that technologies are frequently employed to justify harmful and irreversible interventions in economic, social, cultural, or natural domains, resulting in significant costs and potential new issues through a slippery slope effect. Consequently, resolutions regarding geoengineering investigative endeavors should be accompanied by proper notification and discussion with those potentially affected and their delegates. duly considering their self-declared interests and values. We should strive to strengthen environmentalist values by recognizing the natural world as an irreplaceable reservoir of essential necessities that enhance human life quality. Upholding these values should transcend differences and the number of individuals within a community. We should place importance on cultural and knowledge diversity within habitats and be responsive to their needs. The Capitalocene era comes at a cost, and the crises we encounter serve as a reflection where metaphysical questions and daily observations intertwine. Ultimately, intelligence, understanding, compassion, and the courage to act convey a message to ourselves. It is crucial not to fear making mistakes; thus, research in geoengineering and beyond should persist and improve. Simultaneously, our loyalty and commitment to ourselves demand resistance to conformity, the inclination towards submission and destruction, and the imposition of a moral rigor that will ultimately preserve not only the beauty of biodiversity but will serve as a response that humanity offers back to life—a gift acknowledging the miraculous opportunity to be here, now, on Earth.

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