



Toward global environmental scenarios for (and by) the ‘bottom billion’?

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ABSTRACT

The current Global Environmental Scenario landscape lacks transformative socio-ecological world futures that provide pathways of liberation for the ‘bottom billion’. Drawing on decolonial thought, we develop a set of proposals for future scenario development. These proposals include participatory processes with subaltern population groups to facilitate scenario co-creation based on different ways of knowing the world; replacing fixed and ahistoric subjectivities driving global environmental and economic change with the agency of different social groups who might collectively be able to challenge the status quo of the world system; and creating visions and pathways that consistently address the colonial matrix of power by integrating decolonial environmental justice into scenario storylines. The outlined proposals pose significant challenges to conventional participatory and quantitative methods in the field of scenario research but also enable global environmental scenarios to better fulfill their potential of shaping social imaginaries towards emancipatory futures for all human beings.

1. Introduction

Global environmental scenarios (GES), defined as plausible stories of how the socio-ecological future of the world might unfold, are ‘boundary objects’ at the intersection between science, politics and society (Garb et al., 2008). On the one hand, they might inform sustainability related research and the exploration of different sets of environmental, social and economic policies, which might subsequently influence political decision-making processes. On the other hand, they can also shape the public opinion about the future by emphasizing certain development trends while excluding others. In any case, although scenarios constitute imaginaries of the *future*, they always act as vehicles for social change in the *present*, which are not neutral but inevitably incorporate certain value judgements and biases (Beck and Mahony, 2018; Gall et al., 2022; Metzger et al., 2010; Van Vuuren et al., 2012). Thus, the development process of scenarios as well as their content have a political character with potential distributional consequences in the real world already in the present. This is especially true for global environmental scenarios as they aim at influencing policy-making and societal imaginaries throughout the world. Furthermore, although GES explicitly focus on environmental issues such as climate change, energy transitions, biodiversity, food, water and/or land use, given that human systems develop within and interact with the living Earth/‘Gaia’ (Lovelock and Margulis, 1974) they inevitably include the development of global economic, political and cultural systems.

Given the deepening socio-ecological crises of the world system, GES related research is crucial to highlight near- and long-term future risks stemming from unsustainable economic processes at the global scale, and has the potential to act as catalyzing force for desirable socio-ecological futures by imagining and exploring decisive and bold structural and policy shifts at different levels. However, current GES are characterized by a strong continuity bias and the reproduction of dominant economic, political and cultural power structures (Lauer et al., 2024; Raskin and Swart, 2020). This points to a tendency of GES to preserve rather than to challenge the structurally unequal distribution of power across states, classes, genders and ethnicities, together with the associated ideologies that legitimate the status quo of the world system. Importantly, the reproduction of current structures of inequalities in scenarios about future worlds is implicit and characterized by the lack of change away from the status quo rather than by an explicit affirmation of the latter (Lauer et al., 2024). This finding points to the positionality of the knowledge of GES developers who might consider ‘neutral’, ‘objective’ or ‘normal’ processes, structures and realities that people in different positions of the social hierarchy experience as alienating, oppressive or unjust. Consequently, we hold that new approaches are needed to realize the potential of GES research. These approaches would draw from alternative currents still not fully acknowledged by the academic mainstream such as decolonial or degrowth thinking and would enter into a constructive and critical dialogue with the current literature on Global Change, Earth system sciences, Environmental and Ecological

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Economics, Integrated Assessment Modeling and sustainability policy research.

This paper aims at contributing to these new approaches by pointing out some characteristics shared by many current GES, which render subaltern population groups, especially of the Global South, invisible, and lead to an excessively narrow future space, as well as by developing a set of proposals for GES development based on decolonial thought. We conclude by discussing the methodological implications of the proposals for participatory scenario development and quantitative model simulations.

2. A narrow space of world futures

GES aim at describing ecological, economic and social developments of the whole world, which necessarily requires a certain level of abstraction. However, in practice many GES abstract from the realities of life of those at the margins of the capitalist transformation of nature and at the bottom of the global world order, which results in an excessive homogenization of the world and in biased futures of the world.

First, many GES feature a similar type of development across the world which is based on consumerism and economic growth through the expansion of market economies. For example, the Shared Socio-Economic pathways (SSPs) contrast green (sustainable) with conventional (fossil-based) development but do not envision ways of life outside a growth-based society. Thus, Western lifestyles become commonplace throughout the world. In general, the focus of GES on the ‘sustainability’ problems of the global North, i.e. ‘greening’ consumption, overlooks the socio-ecological problems in the South, such as ecological distribution conflicts that the expanding extractivist global economy already creates today (Martinez-Alier, 2004, 2021). For example, the ‘Net Zero Emissions by 2050’ (NZE) Scenario of the International Energy Agency (IEA, 2022), features some moderate behavior changes, including more recycling, a reduction in business-related long-haul trips, speed limits and fuel-efficient driving. These measures direct the attention to the lives and consumption choices of better-off classes in the Global North while socio-ecological problems of systemic character and more relevant for the rest of the world population, such as the export of (toxic and hazardous) waste to Global South countries (D’Alisa and Demaria, 2024; Mujezinovic, 2020; Stoett, 2024), deteriorations of ecological and human health due to mining activities (Le Billon and Middeldorp, 2021; Scheidel et al., 2020; Sonter et al., 2020; Temper et al., 2020), workers’ exposure to toxic substances and heat stress in the solar industry (Bakhiyi et al., 2014; Samaniego-Rascón et al., 2019) or the inability to meet basic human needs (UN, 2023) are not mentioned. Moreover, suggestions of moderate behavior change do not radically question conventional Western economic development and ways of life. For instance, car sales in the NZE scenario in 2030 are around one quarter above 2021 levels in 2030. The Agrimonde-Terra food and land use scenarios developed by Mora et al. (2020) display more diversity, including homogenized futures based on urbanization, economic growth, transnational corporations controlling the food market, ultra-processed food and generalized meat-rich diets but also collapsing economies, shorter supply chains, the spread of agroecological practices and improved access to fresh food with higher nutritional quality. However, although the Agrimonde-Terra scenarios differentiate between world regions, no special attention is paid to unequal economic relationships between those regions and how they affect the development of food systems and land use change.

Development pathways of the majority of GES, especially those coupled to quantitative simulation models, are also characterized by an anthropocentric and instrumental understanding of the living Earth that is reduced to its capacity to act as source and sink of the human economy. This implies that non-human living beings on the planet have no future besides being useful for human production and consumption. The neglect of non-human life has been recently addressed by the

biodiversity scenario development exercise of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) that has led to GES exploring various ways of ‘human-nature’ interactions, attributing relational and intrinsic value to ‘nature’ (e.g. Durán et al., 2023; Pereira et al., 2023). However, these scenarios also tend to abstract from differences between center, semiperiphery and periphery regarding ways of life, languages of valuation and interactions with the natural environment. Attempts at combining the IPBES based Nature Futures Framework (NFF) (Lundquist et al., 2021) with the SSPs show that GES featuring alternative ‘human-nature’ interactions do not have to constitute a barrier for scenario quantification (Alexander et al., 2023; Dou et al., 2023).

Second, many GES reproduce rather than question the power structures that constitute the world system. Consequently, addressing the sustainability conundrum often involves combining economic growth with technological solutions (Lauer et al., 2024), an approach emblematic of an eco-modernist paradigm. Importantly, although economic growth and technological progress, such as the efficient use of natural resources or the transition to alternative energy systems, alleviate environmental problems GES barely envision socio-ecological futures with full convergence between countries. In this way, economic inequality is naturalized as even in ‘sustainable’ futures access to energy and economic output remains unequal between world regions. The neglect of structural factors at the economic and political level also renders GES blind to ecological and social cost-shifting processes that might be triggered by ‘green’ technological solutions (Sovacool, 2021). For example, various 1.5°C GES that try to find technological pathways to meet climate goals envision the large-scale application of bioenergy carbon capture and storage but ignore the associated risks of land rush dynamics and dispossession in the Global South (Bluwstein and Cavanagh, 2023).

Last, GES often abstract from concrete social actors driving global economic and environmental change, and from conflicts of interests between these actors. Global institutions, governments and the private sector tend to act as the main drivers of change in the scenarios whereas people are reduced to their role as consumers and producers (e.g. IEA, 2022; O’Neill et al., 2017). Even when GES include a wider range of actors such as communities, cities, local authorities, academic institutions or NGOs, marginalized social groups are typically absent.

Apart from the content, the development process of GES itself is dominated by corporate and scientific experts from the Global North. For example, the different global energy scenarios contained in the World Energy Outlook 2022 were developed by the technical staff of the IEA and included a peer review process with significant corporate involvement: 18 % of the entities involved in the process were multinational corporations, mainly from the energy and mining sector (BP, Shell, Repsol, Glencore, ExxonMobil, Chevron, Iberdrola...). The remaining entities involved were public institutions like the European Investment Bank or the World Bank, research institutions, universities, lobby groups for different energy technologies and to a lesser extent NGOs, think tanks, public companies or public-private partnerships (Lauer et al., 2025). The overwhelming majority of these entities belonged to countries of the Global North, notably the US, UK, Japan and France. While the scenario development process of the SSPs did not involve corporations, the participating scientists are affiliated with a narrow range of only 34 entities, most of them universities and research institutions from Global North countries such as the US, Germany, Austria, Japan and France (cf. O’Neill et al., 2012). These are only two paradigmatic examples for a general pattern in the GES literature.

Importantly, the points just outlined do not imply that GES research is fundamentally deficient. GES are constructed to serve very different purposes, which include the exploration of very specific questions in the technological or biophysical realm (e.g. Capellán-Pérez et al., 2015, 2019; Lereche et al., 2023), and even the development of a hypothetical future space merging fictional with factual elements (e.g. Merrie et al., 2018; Pereira et al., 2023). When researchers are only interested in how

social aggregates drive technical variables an abstraction from complex interdependencies, economic disparities and power inequalities on a sub-global level might appear reasonable. Also, big governments, corporations and certain international organizations *de facto* act as the main drivers of global economic-environmental developments, and thus, it is comprehensible that GES focus on these actors. At the same time, in the current GES literature there is a striking lack of scenarios with a focus on the poorer half of the world population, especially the 1.2 billion people affected by acute multidimensional poverty (UNDP & OPHI, 2022) that could be described as ‘bottom billion’. However, these populations are of central importance when it comes to global environmental and economic futures, as they are most heavily impacted by global environmental change (IPCC, 2022), often directly rely on the environment for livelihood reasons (Martinez-Alier, 2003) and bear the brunt of ecological cost-shifting and environmentally destructive rapid industrialization of countries within the world system. For them, the capitalist promise of mass consumption has yet to be fulfilled, which through conventional capitalist development would create massive pressure on the biosphere. GES, in which necessary changes in the world system occur that allow these populations to shape their own development pathways toward materially, culturally and ecologically satisfying conditions, have yet to be developed.

3. Decolonial thought and GES

We argue that GES could become more consistent, plausible and desirable for the poorer half of humanity and the ‘bottom billion’ by engaging with decolonial critiques of Western development and decolonial approaches to environmental justice that can help to question, unlearn and undo dominant myths and practices currently obfuscating the construction of ecologically and socially just visions of global futures. Thus, in the following, we use the three core concepts of decolonial theory – the coloniality of knowledge, being and power (Maldonado-Torres, 2007; Quijano, 2000; Restrepo, 2018) – to develop a structured set of proposals that future scenario exercises could consider.

3.1. Addressing the coloniality of knowledge

Decolonial and feminist approaches to epistemological questions have in common that they reject the idea of a ‘zero point of observation’ and instead emphasize that knowledge is embodied in and produced by people with different ‘race’ and gender. Consequently, decolonial theorists criticize the claim of Western epistemology to be neutral and universally valid (Mignolo, 2013). This critique is especially pertinent for the development of GES because many conditions necessary for the successful application of the ‘classical’ reductionist scientific paradigm are not given in a nested and complex global social reality. This implies the need to question and unlearn the constructed meaning of ‘objectivity’ or ‘impartiality’ by taking positionality and embodied knowledge seriously in GES development. Decolonial approaches to environmental justice (DEJ), might support undoing epistemological violence, i.e. the imposition of one particular way of knowing, in GES construction by fostering the dialogue between different knowledge systems (Ramcilovic-Suominen, 2022; Rodríguez and Inturias, 2018). This requires not only unlearning the hierarchic dichotomy between ‘objective scientific knowledge’ from the North and non-Western, non-scientific ‘subjective experiences’ from the South (Santos, 2018) but also the active construction of ‘otherness’, given that the ‘other’ has experienced systematic oppression by colonial, patriarchal and capitalist systems: ‘other’ worldviews, conceptions of development and well-being, political practices and modes of life (Álvarez and Coolsaet, 2020; Rodríguez, 2020). Addressing the coloniality of knowledge should be understood as acknowledging limits of ‘purely’ scientific procedures in the construction of global futures rather than as a negation of the merits of scientific theories and methodologies. A recent example of dialogues between

different ways of ‘knowing’ is given by the GES exercise of the IPBES which differs from the more ‘technical’, expert-based approach of the IPCC (Borie et al., 2021).

An obvious way of ‘decolonizing’ GES is to broaden the circle of those who participate in GES development. For different purposes and scenario types, different participative methods developed by scientists and practitioners (Chambers, 1983; Ernst et al., 2018; Gonsalves et al., 2005; Pereira et al., 2021) might prove adequate. GES using direct participatory methods would undo the ‘expert paradigm’ in scenario creation to include subaltern ‘stakeholders’ of the global future such as the urban poor and homeless; the rural poor and landless; marginalized groups depending on the natural environment for their livelihoods such as small fishers, peasants and pastoralists who often intersect with indigenous communities; the ‘low-skilled’ working classes in the world’s peripheries, semiperipheries and centers¹; refugees and migrants; and young people. Although they might not possess scientific knowledge, they all embody local and practical knowledge about their life realities which might be very different from what would be predicted according to scientific theories (Chambers, 1983). In this respect, even increasing only the diversity of ‘experts’ would constitute a step in the right direction as current GES development is dominated by scientists from few geographic territories, few disciplines, and a narrow range of theories regarding the world’s social reality.

In cases where direct participation is not the most suitable or viable method, more indirect participative methods might be employed. For example, alternative knowledge systems could be considered through focus groups or interviews with members of subaltern groups, which could subsequently inform the GES development process. Equally, reiterative rounds of feedbacks are possible in which the core themes in the storylines of already developed GES, or main results of storyline quantifications are presented to these groups, and then adapted or contextualized based on the perspectives and proposals expressed during the process.

When neither direct nor indirect participation is feasible, a thorough literature review regarding the lived experiences, priorities and knowledge of subaltern groups especially but not exclusively in the Global South prior to the scenario construction can at least reveal the current state of knowledge, and, more importantly, ignorance and data limits on the realities of life, cosmovisions and local knowledge of subaltern groups.

Actively including alternative ways of knowing the world, including local, practical and indigenous knowledge from a variety of geographic and social places can prove beneficial for different types of GES (cf. Pereira et al., 2021).

First, although the global scale is central for the governance of environmental and economic change, the impacts of environmental degradation as well as of global environmental and sustainability policies are always experienced at the local level (IPCC, 2022). Taking into account alternative knowledge systems would enable the storylines of GES to be more sensitive to the differentiated impacts of probable developments and policies favored by big corporations, states and international institutions. This would highlight different socio-ecological risks resulting from business-as-usual as well as policy scenarios that otherwise would have remained hidden. For instance, local knowledge can point to negative side-effects of low-carbon technologies and investments on the livelihood or health of different social groups (Corbera et al., 2017; Sovacool, 2021). Similarly, especially in areas where scientific data is sparsely available – which applies particularly to very poor regions and states of the outer periphery (Fattou, 2016) – local and practical knowledge might assess to which extent people would be harmed by, and can adapt to, adverse environmental change. To offer a more realistic picture of probable global futures, GES would need to

¹ Statistically, it is probable that these subaltern groups are constituted disproportionately by non-males and non-White people.

include these differentiated impacts and possible dynamics of conflict and resistance they might provoke.

On the other hand, the search for desirable global futures would also be greatly enhanced, and become more representative, if scenario developers promoted the inclusion of multiple ways of knowing the world. For instance, including ‘environmental defenders’ (Global Witness, 2023) and people involved in environmental distribution conflicts in Western scenario building processes such as the European bioeconomy could increase the chances of questioning, unlearning and undoing myths and paradigms in Western culture, such as technoscientific progress, economic growth, (trade) liberalization or urbanization, given that at the commodity frontiers of global capitalism the full implications of these concepts become palpable (Giuntoli et al., 2023). Based on local and practical knowledge, members of subaltern groups will be able to assess what the realization of corporate preferences for automatization or genetically modified seeds without fundamental change in the capitalist state-based world order means for their own livelihoods. For example, the inclusion of stakeholders as different as Via Campesina and Syngenta in the development of food scenarios has shown that actors’ perceptions about desirable food futures varied greatly and that ‘food security’ futures appeared insufficient to those actors claiming ‘food sovereignty’ (Saghai, 2021). It is likely that the inclusion of different knowledge system will also provoke the unlearning of value systems and languages of valuation different from predominant techno-economic values (Martinez-Alier, 2013). For example, ‘relational’ modes of life do not reduce land to an exploitable resource but attach social and ethical meaning to it which includes reciprocal obligations that also extend to non-human beings (Álvarez and Coolsaet, 2020). Clashes between value systems also imply that there is no ‘best world’ for everybody but rather that one actor’s desirable world might be structurally coupled with another actor’s dreaded future. For example, state-based solutions might be rejected by groups that experience systematic state repression, corruption and the arbitrary exercise of power (Bocarejo and Ojeda, 2016). On the other hand, the dismantling of great corporations or global redistribution policies as proposed for example by the degrowth movement (Fitzpatrick et al., 2022), might fundamentally clash with the interests of the current power elites. Thus, the inclusion of a broad diversity of participants with different embodied knowledge would limit the possibility of the implied socio-ecological cost-shifting of certain desirable futures to go unnoticed and incite scenario developers to search for future worlds involving systemic and structural changes that appear desirable and feasible for the poorer half of humanity rather than for the world’s top 1 %.

3.2. Addressing the coloniality of being

The concept of the ‘coloniality of being’ refers to the construction of subjectivities such as the colonizer and the colonized, as well as to the experience of subaltern populations of being rendered ‘less human’ and inferior, all of which legitimizes oppression and injustice between humans (cf. Ndlovu-Gatsheni, 2013; Restrepo, 2018).

Thus, addressing the coloniality of being implies searching for pathways toward futures that end oppression and injustice, as well as identifying those tendencies that make unjust futures possible. In line with this, DEJ calls for systemic changes that eliminate the root causes of social and environmental harm, such as extractivism, ecologically unequal exchange and colonial violence, rather than the more equal distribution of environmental harm (cf. Álvarez and Coolsaet, 2020; Givens et al., 2019).

Current GES often concentrate on abstract entities such as ‘the world’ or on classical actors and stakeholders such as ‘businesses’, ‘decision-makers’, ‘politicians’ or ‘civil society’. The latter is understood as separate, third sphere, complementing the political and the economic sphere, rather than as a battleground for socio-cultural hegemony, and state-society-interactions are not explicitly acknowledged. This understanding of civil society in GES overlooks the potential of civil society for

resistance and transformation that can take place through the development of an alternative hegemonic project pushed by oppositional movements including activists, intellectuals, the media and subaltern groups themselves (Koch, 2022).

The narrow focus on powerful actors renders invisible and nameless all other social groups that not only will bear the brunt of the negative impacts of the current and future world economy but also actively reproduce or challenge parts of global political hegemony on a daily basis. Thus, the construction of DEJ-based scenarios requires to unlearn the notion that subaltern groups are merely objects influenced by abstract forces operating above the local sphere such as governance institutions and multinational corporations or global environmental change. This can be done by directing more attention to the capacity of collective action, resistance and systemic transformation of those population groups that are not fully integrated into the capitalist world economy. Using methodological frameworks developed to study how these collectives operate between adaptation, resistance and transformation in the context of global environmental change, ‘green’ politics and the steady expansion of commodity frontiers might give insights about possible future socio-ecological-economic developments (Cui and Brombal, 2023).

A stronger focus on the potential for the transformative agency of different social collectives within the GES storylines would provoke the international and scientific institutions normally involved in GES creation to focus on the difficult question of which developments in the near future could bring about changes in subjectivities of currently oppressed agents. Importantly, subjectivities can differ greatly among subaltern groups as structural and persistent oppression can lead to apathy and resignation (Okwuadimma and Biereenu-Nnabugwu, 2021) as well as to collective resistance movements (Scheidel et al., 2020; Temper et al., 2020). In any case, granting visibility to normally neglected groups in global socio-ecological futures acknowledges not only their existence and agency but inevitably points toward the need of strong and urgent transformative action on a global scale in which those groups themselves might play a decisive role.

At the same time, the search for an active construction and inclusion of the ‘other’ in DEJ, requires the undoing of idealized, fixed and ahistoric subjectivities of subaltern groups. For example, representing indigenous people as ‘environmental conservationists’ and peasants as ‘environmental destroyers’ does not correctly depict the lived experiences and actions of any of those collectives and leads to exclusion and oppression in the context of conservation policies (Bocarejo and Ojeda, 2016). Equally, ‘local communities’ do not constitute homogeneous blocks free of power hierarchies and conflicts of interest. As a multitude of case studies in the field of political ecology have shown, the fact that subaltern groups are oppressed or marginalized by current power structures does not imply that they are unaffected by or isolated from the global and expansive character of capitalist ideologies, social relations of production and ways of integrating ever more non-human matter into the capitalist sphere of production. Subsequently, hoping to escape the ‘coloniality of being’, subaltern groups themselves might partly reproduce capitalist discourses and practices, and take reformist rather than radical standpoints (cf. David, 2013; Hilton, 2011). Last, constructing an artificial dichotomy between the ‘native (South)’ and the ‘foreign (North)’ is also misleading given the subversive processes through which colonized population appropriated cultures and practices that were originally forced upon them (Quijano, 1999). Thus, unlearning of predetermined ontological assumptions about marginalized groups and their relationship with the world system is facilitated by the acknowledgment of the complexity of global social reality and the need to directly engage with different subaltern groups without predetermined, fixed mental frameworks.

Approaching the coloniality of being in GES would also mean to question the social construction of subjectivities such as ‘underdeveloped’, ‘developing’ or ‘developed’ in the scenario storylines. These labels create hierarchies between societies and suggest a universal, natural

and objective development pathway, with ‘developed’ countries taking the lead and the non-Western world following. This implies a ‘modernization’ process through which certain ideological premises of organizing societies and economies are transferred unilaterally from the Global North to the Global South. Far from the creation of a unified and idealized westernized globe the historical reality has produced declining living standards, widespread poverty and complete dependence from foreign powers in countries of the outer periphery (Fattouh, 2013, 2016), a rise of religious fundamentalism (Emerson and Hartman, 2006) and authoritarian state capitalism (Sallai and Schnyder, 2021). It is highly doubtful that the abyss between ‘ideal’ and ‘real’ development will become smaller in the future.

Besides, the terms ‘developing’ and ‘developed’ avoid the central question of GES, which is ‘Development toward what?’ and instead implicitly equate development with economic growth. Assuming fixed subjectivities seems to lock developing countries in a constant position of ‘backwardness’ while developed societies seem to have already reached their final destination. This discourse also ignores the triad of capitalism, imperialism and racism whose historic dynamics continue to reproduce power asymmetries and hierarchies in the world system. After all, the ‘development’ of one part of the world produced and still produces the ‘underdevelopment’ of the remaining part of the world given the reliance on capitalist development on cheap energy, materials, land and labor (Moore, 2017, 2018).

The term ‘developing’ also cannot capture the enormous heterogeneity between and within countries constituting the ‘Global South’. GES assuming homogeneous economic and technological development, political interests and reactions to socio-ecological problems greatly simplify the future and overlook conflicts between countries of the Global South as well as geopolitical North-South alliances that have their historical roots in colonialism and imperialism.

All the points just outlined imply an impossibility of constructing probable or desirable GES while abstracting from sub-global heterogeneities and conflicts of interests between actors on the regional, national and sub-national level. The global reality and its future developments are not the result of ‘one world’ but rather of many ‘worlds’ that want to unfold on planet Earth (Escobar, 2012). It is precisely the expansive character of capitalist social relations and ideologies that not only creates continuous homogenization throughout the world but also provokes constant polarization and differentiation. Destructive and inequality-increasing capitalist dynamics lead to the maintenance, production and reproduction of ‘alternative’ worlds at the margins (e.g. peasant or indigenous movements, solidarity economies) and within the center of the world economy (e.g. ecovillages, transition towns or the degrowth movement).

3.3. Addressing the coloniality of power

A decolonial approach to GES would question the legitimacy of all imagined futures that are labeled as ‘sustainable’ but implicitly reproduce the coloniality of being by maintaining those global institutions and power structures that mediate the unequal treatment of human beings. In other words, GES need to engage more explicitly with questions of power in the context of desirable futures.

The colonial matrix of power developed by Quijano consists of four interrelated domains of control: (1) the control of the economy: this includes the exploitation of labor, land appropriation and the control of natural resources; (2) the control of authority through institutions and armed forces; (3) the control of gender and sexuality; (4) the control of subjectivity and knowledge, which intersects with the coloniality of being and the coloniality of knowledge addressed in Sections 3.1 and 3.2.

GES could address the coloniality of power in two steps. First, visions of different futures are needed in which the colonial matrix of power has been overcome.

With regard to the economic dimension in the matrix, the research

around ‘post-growth’ (Jackson, 2013, 2021) and ‘degrowth’ (Kallis et al., 2018) becomes relevant since these approaches aim at reducing the Global North’s consumption of cheap labor, land and resources from Global South countries. As a result of a profound unlearning and undoing of ‘growthism’ (Schmelzer, 2024), futures engaging with the coloniality of power in the economic realm would probably problematize the unequal exchange of labor and resources, and picture more equilibrated labor and material flows between the Global South and North. The economic control of the center over the periphery ultimately stems from an unequal distribution of capital linked to a global division of labor that traps peripheral countries in primary sector activities. Thus, in global futures where capital is redistributed on a large scale, peripheral economies would in principle be in a better position to fulfill the basic human needs of the population and to adapt to and mitigate adverse global environmental change (IPCC, 2022). Capital redistribution is related to the elimination of the global debt regime, another medium of economic control rendering heavily indebted societies completely dependent on their creditors (Kapijimpanga, 2023; Zajontz, 2022).

Reducing the scale of the global economy is necessary to halt and alleviate the persistent destabilization of biogeochemical cycles and gains importance when considering the flourishing of non-human life. Decolonial perceptions of environmental justice attempt to move beyond a human-nature dichotomy that considers humans valuable subjects and non-humans value-free (and therefore costless) objects. Expanding the concept of environmental justice to include both humans and non-humans (Menton et al., 2020) requires profound changes in production technologies but ultimately also a reduction in the global socio-economic metabolism. However, as the global metabolism shrinks, questions of distribution between social groups become even more important to avoid drastic increases in human poverty and suffering. Therefore, the integration of a strong convergence in people’s access to resources, production capacities and economic consumption in GES is crucial not only to reduce the control over the economies of the Global South but also to guarantee that basic human needs can be met in a downsized global economy (cf. Hickel, 2021).

The different types of GES could engage with these topics in their own respective ways. For example, energy scenarios could focus on strengthening renewable-based energy sufficiency and autonomous renewable-based industrial development in Global South countries rather than on converting renewable energy from the South in a tradable commodity to be exported to industrialized countries (Okpanachi et al., 2022). Climate scenarios could integrate strong global convergence in consumption and degrowth instead of betting on speculative negative emission technologies with uncertain socio-ecological effects (Fuss et al., 2014). A small part of the literature has recently begun to move in this direction (Keyßer and Lenzen, 2021; Li et al., 2023; Nieto et al., 2020). Equally, climate scenarios could explore the relationships between inter- and intra-national capital distribution and climate finance while land scenarios could make ownership conflicts, dispossession and displacement explicit and imagine socio-ecological futures where access to land is not mediated by gender, class and race. Global food scenarios could critically examine conflicts of interest between the handful of corporations controlling the global agro-chemical and food industry and smallholder farmers that jointly provide a third of the world’s food (Clapp, 2021; Lowder et al., 2021). Likewise, they could envision a global food system whose reproduction does not depend on the degradation of human and planetary health (Bodirsky et al., 2022).

The economic dimension of the colonial matrix cannot be addressed without changing the institutional/political dimension. Thus, rather than extending the current power structures into the future, GES developers could question to which extent the three main actors shaping global economic and environmental governance – states, corporations and IOs – reproduce the colonial matrix of power. For example, indigenous people manage or have tenure rights over a great amount of ecologically intact territories (Garnett et al., 2018) and claims for

self-governance within these territories under informal indigenous or other customary authorities (Temper, 2019) run counter to a centralist, state-based implementation of global conservation and biodiversity governance (Schmidt and Peterson, 2009). Strong corporate presence in economic and environmental global governance entails the risk of creating regulatory frameworks which favor the profit interests of multinational corporations operating in the South over livelihood, spiritual and cultural needs affected local communities might have. Finally, the inter- and transnational economic regime, including the IMF, Worldbank, WTO, the global financial regime and investment law, constitutes the legal framework which promotes the expansion of capital from the center toward the world's peripheries and which renders an 'autonomous development' of Global South countries impossible (Schneiderman, 2022).

Decentering states, corporations and IOs in global governance, also means thinking about new and more egalitarian forms of decision-making. In this respect, GES scholars could engage with recent developments in the debate about global democracy (Scholte, 2014): While this field of political thought has been traditionally mainly concerned with liberal approaches of extending liberal (capitalist) representative democracies to the global level while ignoring economic inequalities and cultural differences, in recent years, attempts have been undertaken to approach ideas of global democracy through dialogue and mutual learning between groups from different nations, religions, ethnicities and genders (Scholte, 2020).

Last, the overwhelming majority of GES ignores the military and armed forces in spite of the significant greenhouse gas emissions of the military sector (Ahmad, 2023) and the disastrous impacts of armed conflicts not only on human but also on non-human life (Kong and Zhao, 2023). Although the monopoly of violence is the common denominator of all states in the international system, there are great military imbalances and the history of invasions of great powers into other territories they regard as within their sphere of influence illustrates that the 'free' trade regime has to be backed up by military power that can ultimately secure access to resources (cf. Le Billon, 2004). GES that do not engage with this dimension of power greatly underestimate the future potential for armed conflicts in the Global South. Thus, from a perspective of decolonial environmental justice convergence in economic power would need to be linked to convergence in military power and a new global security regime alongside a new economic and environmental regime. This is partly reflected in degrowth policies that demand reducing military spending alongside lifestyles of sufficiency and global redistribution (Fitzpatrick et al., 2022).

Finally, the relationship between GES and control over gender roles and sexuality is less obvious in GES focused on broad ecological-economic dynamics. However, gender roles and sexuality play a key part in the reproduction of capitalist modes of production (Oksala, 2017) and in the reproduction of societies in general. Thus, these topics become relevant with regard to population policies and the debate about the size of the human population (Daily et al., 1994). It has been noted long ago that the global socio-economic metabolism and the associated environmental pressure increases with affluence as well as with population size (Holdren, 2018). Especially when attributing intrinsic value to non-human life, GES figuring reduced fertility rates and a decrease in the global population can be justified. Considering this dimension of the colonial power matrix would prompt GES researchers to search for visions of socio-ecological futures where changes in the human population are not the result of neocolonial practices of population control through gender and sexuality norms.

GES depicting different 'liberated' worlds free of the colonial matrix of power have value in themselves because scenarios can influence social imaginaries and introduce possible futures into the discourse that were unconceivable or unpronounceable before. As a second step, GES scholars could move on to develop different plausible pathways of change that might connect the present status quo and the envisioned futures. These pathways will of course differ according to the concrete

content of the developed GES and could be informed by different knowledge systems and the perspectives of subaltern groups (Sections 3.1, 3.2). Given that addressing the coloniality of power has distributional consequences, the central question becomes under which circumstances currently powerful actors give up or lose some of their power. Importantly, these actors can be identified and analyzed: 17 global financial corporations control more than one trillion dollars in capital, are managed by only 199 interconnected directors, and are heavily invested in both giant corporate media and the top global weapon producers (Phillips, 2018). These companies also exert considerable influence over key biomes such as rainforests or boreal forests (Galaz et al., 2018). 13 corporations control 11–16 % of the global marine catch and 19–40 % of the most valuable stocks (Österblom et al., 2015), only 4 corporations dominate the global seed and agrochemical industry (Clapp, 2021) etc. Arguably, any feasible pathways toward 'desirable' futures for the bottom billion must particularly engage with the factual presence, intentions, fears and actions of this embodied concentrated power.

4. Discussion

4.1. Quantitative modeling and DEJ-informed GES

Our proposals for introducing decolonial perspectives into the GES literature have focused mainly on qualitative scenarios or storylines. This does not deny the importance of quantitative modeling in the field of GES research. Quantitative simulations and modeling can be useful for assessing the plausibility of GES visions and pathways in technical terms, such as finding required rates of change to achieve specific ecological or social objectives or detecting unintended side effects of certain environmental or economic policies. However, the quantitative simulation of GES based on decolonial perspectives might require significant unlearning and undoing of common practices in the construction and logic of quantitative models. First, although Integrate Assessment Models (IAM) manage to produce detailed information on the development of a series of technological and biophysical variables, they lack the necessary disaggregation in the social realm that would be required from a DEJ viewpoint. For example, currently there is no IAM able to show the evolution of inequality under different GES along the intersecting categories of class, gender, race and geographic territories. The lack of disaggregation in the social realm is partly due to a lack of data on which IAMs rely, especially for Global South countries constituting the world's peripheries and semiperipheries. Consequently, it is practically impossible to obtain information on variables such as the evolution of ecological distribution conflicts, subsistence economy or multidimensional poverty via IAM simulations. Instead, these variables would need to be estimated from the average GDP p.c. values through regression analyses. Furthermore, due to the opacity of quantitative models, their reductionist approach to social reality and built-in biases favoring dominant structures and ideas, successful participatory processes involving different ways of knowing the world and the future become extremely challenging (Saghai, 2021).

Model development informed by DEJ-based GES probably would draw on techniques that can depict non-linear dynamics, different interacting agents and changing institutions (Köhler et al., 2018), and that include biophysical, social and economic variables which are actually significant for subaltern populations in the Global South (and North). Likely no model would be able to completely 'depict' a storyline or development pathways in quantitative terms but rather models could be developed or used to gain more insights about specific aspects of the scenario. These include changes in the ownership of land, material, labor and financial flows between regions, the evolution of the level of economic or military concentration, and climate change adaptation, mortality rates and quality of life of the 'bottom billion'.

4.2. Participation and GES

As outlined previously, GES development could greatly benefit from participatory processes including subaltern populations, rendering results both more realistic and more diverse. Incorporating a wider range of voices would help existing biases in GES which is especially important when it comes to the co-creation of 'sustainable' or 'desirable' futures. However, the inclusion of subaltern and marginalized groups in GES development poses several challenges. First, researchers might face difficulties to reach out to the rural and urban poor, migrants, peasants, indigenous people, low-skilled workers etc. as they often live in hard-to-access areas with limited or no internet and telecommunications infrastructure. Additionally, their native languages might not be English or other European languages, which further complicates communication. Second, members of those collectives might be unwilling or unable to participate in GES development processes as future global environmental and economic developments might seem too far away from every-day struggles and concerns. Unlike corporate and political stakeholders who are accustomed to expressing their opinion, potential participants might feel reluctant to be interviewed. Moreover, when asked to express perspectives on developments and social realities beyond the local realm, participants might reproduce dominant discourse promoted by corporate and state media. Third, since members of subaltern populations likely never have participated in similar exercises before, participatory GES development must avoid manipulating participants through the framing of specific problems or trends (Cooke and Kothari, 2001). Likewise, drawing on local knowledge should not become a one-sided extraction of data (Helm et al., 2023).

Despite these challenges, we believe that the participation of subaltern groups in GES development is possible. While it is true that such participation has not yet been achieved, there are other experiences with certain similarities that allow for optimism. For example, there have been successful cases at the local level in the elaboration of development plans in which indigenous communities have played a leading role. One such example is that of Life Plans (Planes de Vida), planning tools driven by and for Indigenous peoples, aimed at articulating their self-governance, vision of "good living," and autonomous development in contrast to conventional extractive models (Vieco, 2019).

In various regions of Latin America, Life Plans have served as a means for Indigenous communities to articulate visions of a less extractive and more ecologically sustainable future. One case is that of the Peruvian Amazon, where several communities have used them to strengthen collaborative management of their territories and define their development priorities (Ravikumar and Ojeda Del Arco, 2025). Similarly, in the border regions shared by Peru, Brazil, Colombia, and Ecuador, these plans have been crucial for peoples such as the Secoya (Siékopai) to defend their territorial rights and negotiate their place within broader conservation strategies (Delgado Pugley, 2024). Another case, in the Ecuadorian Amazon, is that of Kichwa organizations such as FOIN, which have worked to "indigenize" these instruments, infusing them with their own planning philosophies to model alternative futures based on their worldview (Grefa et al., 2024). These examples demonstrate the agency of these groups in constructing desired socio-ecological futures.

These successful cases can be understood within the analytical framework of Gaventa's (2006) power cube, which examines the spaces, places, and forms of power in which participation occurs. Life Plans do not emerge from closed spaces, where decisions are made exclusively by state actors or experts without any consultation. Nor are they merely invited spaces, created and defined by external authorities (governmental or non-governmental) that invite participation on their own terms. Instead, these processes fundamentally represent claimed or created spaces. They are initiatives that emerge organically from Indigenous communities and organizations based on shared concerns and identities, allowing them to autonomously articulate their visions of the future, negotiate from a position of strength with other actors, and

actively shape policies and discourses affecting their territories and lives. In the case of GES development, it may be difficult to imagine that the initiative would come from the subordinate groups themselves. However, even if they are initially included by external institutions, the experience of participation could lead to the emergence of their own initiatives, which could be supported, if necessary, by other organizations belonging to those segments of the global civil society that aim at expanding alternative social spaces through counterhegemonic practices. At the same time, gradually increasing the representation of subaltern groups in policy or visioning process might provide the opportunity for these groups to engage in agenda-setting activities and strengthen counter-hegemonic projects 'from within', provided that they are not co-opted by current powers. (cf. Koch, 2022).

A methodological approach to facilitate inclusion is the use of participatory frameworks for exploring the future, such as the Three Horizons Framework (Schaal et al., 2023; Sharpe et al., 2016). This approach is particularly suited for engaging with normative futures and developing pathways towards them by valuing diverse forms of knowledge. It allows participants to identify unsustainable elements of the present system (Horizon 1), envision transformative futures grounded in their values and aspirations (Horizon 3), and explore the innovations and actions that could bridge the two (Horizon 2). By using accessible methods like storytelling, this framework can help translate subaltern groups' lived experiences and worldviews into locally meaningful narratives of change, making their participation in GES development not only feasible but also actionable. This can empower local action and ensure that the resulting scenarios are less detached from the realities of the majority of the world's population.

Finally, it is important to highlight that GES informed by the perspectives of subaltern groups will likely be less appealing to decision-makers from the Global North and more difficult to translate into concrete policy actions. This is because, instead of 'speaking truth to power,' they would challenge 'power' itself. However, in the best case, these GES could shift the discussion about the future of humanity and the Earth from narrow academic, corporate, and political circles in the Global North to broader debates at a global level, as they would appear less detached from the reality of life for the majority of the world's population.

5. Conclusion

In this paper we have presented a series of proposals of how the field of Global Environmental Scenarios (GES) could engage with insights from decolonial theory and decolonial environmental justice to develop socio-ecological and economic global scenarios that are relevant, plausible and/or desirable for the 'bottom billion' or the poorer half of the world's population. We have shown that the design of current GES often implicitly prioritizes sustainability issues, environmental problems and realities of life of relatively privileged classes from the Global North. Likewise, GES tend to portray narrow and homogeneous development pathways and powerful actors shaping global environmental and economic development. Thus, from a decolonial perspective, GES would do well to pay more attention to different ways of knowing the world, the agency of subaltern population groups to generate profound changes in the world system and to fundamental justice concerns that address the highly unequal access to ecological and economic goods which are mediated by class, race, gender and nationality. Implementing some of our proposals will likely be challenging both with regard to successful participatory processes involving subaltern populations and with regard to the modeling of developed scenario storylines. Although we draw on decolonial thought to structure our argument the outlined proposals can be of interest to scholars from different scientific and theoretical fields who are interested in unlearning certain practices and epistemological paradigms that are often taken for granted, thereby unlocking the potential of GES to open up emancipatory options for the 'bottom billion' already today.

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Luis Llases: Methodology, Formal analysis, Conceptualization.
Arthur Lauer: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization.
Paola López-Muñoz: Methodology, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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