19 Towards Effective Multilevel Environmental and Sustainability Governance for Shared Ecological Risks

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The Environment As a Source of Global Catastrophic Risks

Climate change; the collapse of biodiversity and ecosystem services; multiple forms of pollution, including plastic; and other environmental pressures on the planetary ecosystem are combining into existential risks to human well-being and even survival on this planet. A response is clearly needed through improved international cooperation, including mechanisms of global environmental governance. However, that alone will be insufficient. Governance improvements are needed at all levels in complementary approaches for a coherent response to these risks. Here we explore the requirements for effective multilevel environmental and sustainability governance able to address these shared ecological risks.

We first define the nature of our global environmental challenges that require governance responses. We then review briefly the principles of governance that are most relevant to ensuring the common good, defined here as a healthy planetary environment managed sustainably with justice for all Earth's inhabitants, and consider some of the governance gaps that must be filled to reduce the risk of environmental catastrophes. This includes structuring governance across multiple levels and identifying the functions relevant at these levels. In particular, we consider proposals for global environmental governance, with supporting measures at other levels. Institutions of governance cannot function in a vacuum but depend on a clear definition of the purpose of governance, the principles to be implemented, and the goals to be aimed for so that progress can be measured and learning applied. Since the future cannot be predicted, scenarios can help to identify surprises that might occur and alternative ways forward. Finally, designing the measurement systems and indicators appropriate to governance goals for human and environmental well-being can provide tools to reduce catastrophic risks and help governance institutions to build the better future we can all look forward to.

It should be noted at the outset that those in positions of governance at all levels presently fall far short of the ideals described here due to powerful egos, greed, corruption, vested interests, and lack of political will, even though they often agree in principle. This is not inevitable, and the emerging generation, with their more global perspective, has the capacity for fundamental transformation. This is addressed later in the chapter.

Global Environmental Risks

As a guide to decision-making, the recent Global Catastrophic Risk Index (GCRI) (Dahl, Lopez-Claros and Miller 2022) provides a synthesised index at the country level for global catastrophic risks, including environmental risks. The following summary of environmental risks of global catastrophe is based in part on that report.

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The rapid growth in the human population and our material civilisation powered by fossil fuels are together overshooting the planetary boundaries of our life-support systems, creating a variety of global catastrophic risks. These are damaging or destabilising the complex systems that have allowed life to evolve and created a habitable environment for our human civilisation. These threats are accelerating, producing existential threats to human society at the global level. Our only hope is to transform the foundations and aspirations of our civilisation to reduce these risks.

The Intergovernmental Panel on Climate Change (IPCC), in its Sixth Assessment Report (IPCC 2023), warns about the destructive power and increasing frequency of climate catastrophes globally, including extreme temperature events, stronger cyclones, wildfires, floods and droughts, melting ice caps and rising seas. These disasters are already occurring at growing human and economic cost. Some changes are irreversible, such as rising sea levels from rapidly warming polar regions and melting icecaps, but most could be attenuated with rapid action toward both mitigation and adaptation in the next decade. The latest science warns that tipping points beyond which a return may be impossible are very close (WMO *et al.* 2022).

The collapse of planetary biodiversity is another accelerating and largely irreversible catastrophic risk. Millions of years of evolution have populated the planet with rich and productive ecosystems that maintain a liveable biosphere, provide invaluable ecosystem services, support human food systems, moderate our climate, and, last but not least, provide beauty and support mental health. In our inability to protect sufficient natural areas, prevent illicit wildlife trade, control pollution, and limit global heating, we are causing a sixth mass extinction event, in which one million species are threatened in the immediate future, and major ecosystems such as coral reefs and tropical rainforests are being degraded beyond recovery. Extinct species cannot be replaced, and without them, the complex web of life upon which we depend will be fundamentally weakened. Unfortunately, the human cost of our neglect will only be apparent after it happens unless we have the foresight to take preventive measures.

As much as we like to think that there is a technological solution for every problem, we cannot deny that we are biological organisms whose lives are dependent on food, water and some form of shelter. We cannot eat the money in our digital account or live entirely in the virtual world of social media. Imagine if the planet could no longer produce enough food to feed everyone or if natural systems were so degraded that the remaining photosynthesis by plants was insufficient to support all life on the planet, including ourselves. Climate change and unwise development are putting our water supplies at risk, and without water, the rest of development becomes meaningless. Our food systems—both the highly industrialised agriculture in some parts of the world and much subsistence farming in poorer rural areas—are poisoning and degrading soils, eroding the biodiversity on which crops depend and increasing the impacts of climate change. Some recent years have seen the world produce less food than it consumed, effectively signalling that we are living off reserves and, at the extreme, blindly failing to meet one of our most basic needs. Since the rich can always find a way to manage, such catastrophes primarily hit the poor and marginalised masses.

Pollution is another cumulative global risk. Industry manufactures and sells chemicals and materials such as plastics in massive amounts, some of which are discovered years later to be harmful to human health and the environment. We already fix more nitrogen through chemical synthesis and fossil fuel combustion than all natural processes together, contributing to global warming, eutrophication and oceanic dead zones without oxygen.

The global push for development to meet the needs of an expanding population has proceeded within the paradigm of linear supply chains and an economy maximising profits while treating environmental and social impacts as externalities. We have pillaged a major part of Earth's land surface and the natural resources with which our planet was once so abundantly endowed while generating massive pollution and waste. The oceans are similarly being stripped of resources, overwhelmed with plastics, acidified, and filled with our pollutants. This is a creeping catastrophe as non-renewable resources become increasingly scarce and expensive, while normally renewable resources are consumed beyond their rates of regeneration. To use an economic metaphor, we are living off the capital rather than the interest of our planetary biological capacity, with environmental footprints, especially of the affluent, far beyond what the Earth can sustain.

Environmental crises are affecting countries everywhere, and they are often compounded by economic vulnerability and social instability from poverty, poor governance, corruption, and conflict. Authorities must recognise that risks today come in complex forms, interacting and reinforcing each other, and could lead to major governance and societal failures with severe consequences for the global population.

Natural disasters of geological origin, such as volcanic eruptions, earthquakes and tsunamis, present risks that are generally local or regional. However, the risks of objects from outer space striking the Earth, such as the asteroid that wiped out the dinosaurs, or a giant coronal mass ejection that could break through the magnetosphere and grill everything electrical and electronic on the planet, would certainly be global catastrophic risks. Their frequency is impossible to predict, with the latter last occurring in 1859, damaging the telegraph system, starting fires and shocking telegraph operators. Since the human and economic costs of such catastrophes would be literally astronomical, some precautionary measures should be made to protect infrastructure and provide early warning with these risks in mind.

The GCRI maps risk-occurrence at the country level as a guide to decision-making. Each of the 118 countries covered by the GCRI is evaluated across more than 85 indicators, including 22 environmental indicators for both vulnerability and resilience. It demonstrates not only that no country is free of risk but also that policymakers globally have often failed to take collective action against systemic and environmental risks. While there is an obvious correlation between the general level of development and vulnerability to catastrophic risks, with poor countries with weak or failing governments and low investment in human capital clearly at much greater risk, there is, surprisingly, a much smaller difference with respect to environmental risks, showing that these largely planetary risks threaten countries more equally and must be addressed globally (Dahl, Lopez-Claros and Miller, 2022).

Countries may be exposed to catastrophic risks through poor policy, bad geography or bad luck. Their vulnerabilities need to be considered at two levels: first, those that can be addressed largely within a country by measures within its own control or management through internal policies and actions, and second, those external risks that must be countered collectively at the regional or planetary level with some form of global governance, where national actions will usually be limited to measures reducing vulnerability and increasing resilience.

Among the ten most environmentally at-risk countries in the GCRI, six are dynamic, high-growth economies: Hong Kong, Japan, Vietnam, Qatar, Singapore, and Bahrain. Geographically, these countries lie at a latitude where rising sea levels and/or increasing global temperatures create risks. Japan ranks high in environmental vulnerability because

of major earthquakes, tsunamis and the presence of active volcanoes. Singapore and Hong Kong are small city states whose economies are hubs of global trade and finance but face severe risk from sea level rise. It is not always those countries that are most at risk that address their environmental footprint. *There is in fact an inverse correlation*: it is those countries most sensitive to climate change that use less renewable energy, while countries relatively less sensitive to the effects of climate change derive a greater percentage of their energy from renewable sources (Dahl, Lopez-Claros and Miller 2022).

Principles of Governance

In considering environmental and sustainability governance for shared ecological risks, it can help to start with a brief systems view of the purpose of governance and the major components of any governance mechanism as a basis for considering where there are environmental governance gaps.

Governance, as developed at the national level, is a process, generally incorporated in institutions, by which a community organises itself to ensure the collective good and general welfare. The ultimate judgement about the effectiveness of governance would, therefore, be its capacity to maximise the common good of all. Extending the concept to the global level, governance should protect and maintain the environmental systems and resources necessary for all life and ensure their long-term sustainability. This would include minimising risks and vulnerabilities and removing anything that might lead to global catastrophic outcomes.

With this purpose in mind, institutions of governance should

- enable policy development and decision-making to draw on the best available scientific information about the environment;
- consider with equity the needs and capacities of all parts of the community served;
- create a framework of legislation and regulation to define and protect the common good;
- execute the actions necessary to implement its decisions, either directly or by empowering others, to resolve through judicial means any disputes or conflicts that may arise; and
- learn from experience to improve its performance to these ends.

However, institutions are only one part of governance since they are ultimately made up of individual people. Even the best-conceived institutions will be dysfunctional if the people within them do not share the institution's purpose—that is, achieving the common good. Our lower human nature, left unchecked, leads to power-seeking, conflict, selfishness, greed, corruption, and other forms of behaviour that produce governance inefficiencies, if not outright failures. Many efforts to build more ideal systems of governance include checks and balances to try to reduce the risks of such governance failures. In stark contrast, autocrats will create systems of governance that they can manipulate and control for their own selfish purposes or sovereign national interests, where the common good is regarded as irrelevant.

There are also those institutions outside of what is normally considered government that are also centres of decision-making with an important potential influence on the common good. For example, economic entities such as multinational corporations can be wealthier and more powerful than many national governments and may be driven by a

profit motive with no consideration for the common good. They are also very effective at resisting any attempts by governments to restrain or control them. This presents a particular challenge for global environmental governance, which must find ways to extend governance to cover these other actors in society. While governments may have some ideals defined in a constitution or founding charter, such values, sense of responsibility or aim to be of service to society are seldom present in corporate legal charters, limiting the scope for action of even the best-motivated corporate executives. Many of the present global catastrophic environmental risks, including climate change, biodiversity loss and pollution, are being created largely by corporate behaviour. This is a gap that must be filled.

Addressing governance gaps should simultaneously consider the principles of justice and equity underlying all good governance, the complete set of functions of governance, the appropriate institutions to carry out those functions, the inclusion of all of the relevant actors in the community or society, the access of the institutions to all the relevant information necessary for decision-making, and the training and motivation of all those who work within the institutions.

Multilevel Governance

Another value of a systems perspective is to demonstrate the need for multilevel governance (Karlsson-Vinkhuyzen and Dahl 2021). The planetary biosphere is composed of and maintained by a great diversity of complex, nested systems, including physical processes, chemical cycles and ecosystem services. These are dimensions of planetary well-being, a common good to ensure our own survival. Human society has created its own complex web of institutions, organisations, communities, processes, and other entities, interacting in economies, information systems and forms of communication, technologies, sciences, and cultures.

This complexity requires multiple levels of governance since decision-making is most effective when close to the scale of the system being managed and the actions needed for management, in what is often called subsidiarity. While planetary environmental systems require global governance, environmental diversity around the world requires a similar diversity of governance actions. Too much governance today is concentrated at the national level, while national boundaries seldom correspond to functional environmental units like river basins or ecosystems. Again, many decisions on environment and sustainability are best taken at the local level by those directly concerned with the reality of their local community. One of the challenges in designing effective environmental governance is to ensure coherence between all these levels. For example, a catastrophic risk may be first defined at the global level. However, it may play out differently in each national context, requiring a variety of national responses. Again, resilience in the face of such risks may best be built in each local community, where flexibility is necessary and social ties are the strongest when faced with threats.

Environmental Governance Functions

The biggest governance gap today is at the global level, where the environmental risks of catastrophe are the most threatening and the least managed. At the national level, we accept that a government should ideally protect the common interest of all in the country, with institutions to adopt the necessary laws, an executive agency to enforce them, and judicial procedures to resolve disputes and determine responsibilities, even if in practice

it may often fall short. It is only logical that the same institutions of governance are now necessary at the global level, able to adopt and apply global legislation to stay within planetary boundaries and to protect us from the global environmental catastrophes now threatening our future.

The process of building elements of global environmental governance began with some of the early environmental conventions and the creation in 1972 of the United Nations Environment Programme (UNEP) at the United Nations Conference on the Human Environment in Stockholm, Sweden. UNEP was designed at the time to be a small secretariat intended to catalyse and coordinate action across the whole UN system and its specialised agencies. It was to assess the global environment based on the best science and recommend environmental management measures to be implemented by others, including national governments. Over the years, many additional multilateral environmental agreements (conventions) have been adopted to address particular environmental challenges, one of the most successful of these being the Montreal Protocol to protect the ozone layer. The result is a patchwork of global and regional legislation, mostly voluntary and therefore unenforceable, while global environmental problems have continued to grow to become catastrophic threats. There have been many proposals to strengthen global environmental governance, but only by making some minor improvements, such as giving the UN Environment Assembly universal membership, unlike the previous UNEP Governing Council.

Most recently, the Policy Brief to the Climate Governance Commission *Towards a Global Environment Agency*: *Effective Governance for Shared Ecological Risks* (Karlsson-Vinkhuyzen and Dahl 2021) provides a detailed review of a proposal for the reform of UNEP and reform proposals for other institutions. The Brief describes why climate change requires a broader view of governance. It supports proposals for more general system reform (Lopez-Claros, Dahl and Groff 2020) and makes many other suggestions for ways forward. It explores principles for global governance, such as subsidiarity and governing complex risks. It identifies the essential governance functions of knowledge provision, deliberation and legislation, enabling and implementation, building trust and justice, and learning and reflection to make adjustments as necessary. These are followed by design proposals for how these functions could be incorporated into a Global Environment Agency. In suggesting ways forward, the Brief notes that the ideal would be to include these as part of general global governance reform. However, an institutional evolution of UNEP may be more immediately possible, giving it an orchestrating function across the UN system, while the UN Environment Assembly could take on legislative responsibilities related to planetary boundaries. A Global Science Council could provide integrated assessments across all dimensions of global environmental risks. An International Court for the Environment could take on judicial functions. Given the urgency of responding to the risks represented by climate change, effective global governance of this risk through binding global legislation could be a first step in building trust and establishing precedents for progress in other areas (Karlsson-Vinkhuyzen and Dahl 2021). These functions are elaborated briefly in the following sections.

Improving Science Advice

The foundation of scientific advice is adequate research and monitoring. While much is already being done, Earth observation systems need to be connected with participatory observations, including by indigenous and local communities and citizens in general, to

increase public understanding and support. Developing countries need the capacity to contribute to this research and monitoring. Monitoring is also needed of the direct and indirect drivers of environmental risk in social and economic systems. A transdisciplinary Global Research Council should fund research on emerging global environmental problems and on the effectiveness of response measures, aiming for the capacity to model the whole global system and to identify risks of major failures.

Scientific assessment processes (IPCC, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Global Environment Outlook, etc.) need to be coordinated, perhaps under a joint administration, to build a more comprehensive assessment of the whole global environment, one that is linked to regional and national assessment processes and which feeds advice into all global and national agreements and decision-making mechanisms. A Global Science Council could provide integrated overviews of the whole planetary and human system, combining natural and social sciences. The results of scientific assessments should be arrived at transparently and distributed widely without government interference. Assessments should provide guidance for the necessary policy options, legislation and regulations to remain within planetary boundaries.

Global Environmental Legislation

The most essential step towards achieving global environmental governance and reducing the risk of catastrophic failures will be creating the capacity for binding global legislation where planetary boundaries are threatened or exceeded. Such legislation should be enforceable on all states; non-governmental entities, such as corporations; and individuals, with relevant penalties for infringements.

While considerable progress has been made in global environmental legislation through international conventions, such as those on climate change, biodiversity and chemicals, there are three basic weaknesses:

- agreements are adopted by consensus, representing always the lowest common denominator;
- they are basically voluntary, with no effective enforcement mechanisms;
- they are fragmented into many separate single-issue agreements with little possibility to integrate them or to address cross-cutting issues.

These weaknesses reflect governance founded on national sovereignty, with primacy given to the economy and its corporate embodiment.

An institution is needed that can deliberate effectively on the global common environmental good, including equity and inclusivity, one that is open to the voices of those potentially affected, in a common effort to ensure planetary security. A first step could be an expanded mandate and responsibility for the UN Environment Assembly. While states will obviously have a central role unless ultimately representatives can be directly elected by the peoples of the world, there should be consultation with civil society and other stakeholders, perhaps with an advisory Civil Society Chamber. The result should be binding legislation, perhaps adopted by majorities varying according to the issue, enforceable on states and other entities, even those that refuse to join in and blatantly fail to comply with actions necessary to protect the global interest of all.

One aim should be the adoption of a 'treaty of treaties' establishing the fundamental principles of international environmental law. Another would be to consolidate the many

existing provisions in multilateral environmental agreements into coherent global legislation applicable to all countries, not just those that are party to existing agreements, preserving the best of what has been learned and useful mechanisms for implementation. For adaptability to a constantly evolving global environment, there should be regular meta-deliberation on the effectiveness of global environmental governance itself to ensure necessary reforms while avoiding backsliding.

Polynodal Governance Implementation

At the apex of multilevel governance, there needs to be an institution, a Global Environment Agency (GEA) or equivalent body, responsible for the health and sustainability of the planetary environmental systems and able to minimise, if not avoid, global catastrophic risks. It should be neither simply catalytic and coordinating like the present UNEP nor an independent specialised agency, which would simply create another silo amongst others. It should have an orchestrating function, with the authority to determine the global actions needed and the roles of international agencies, nation states and other actors to implement them, and the mission to support all the different actors in carrying out their roles. This would include capacity-building, technical assistance and financial support when necessary. It would prepare regular reports on progress in implementation and compliance, and collaborate with other international institutions to incorporate environmental responsibilities into their statutes and work programmes. It would obviously need to have a secretariat with the staff and financial resources necessary to carry out its mission.

International Court for the Environment

Trust is necessary for effective governance. The institutions for global environmental governance should be trustworthy and should lay the foundation for trust among governments. They should have their own accountability mechanisms and procedures to ensure compliance by states, with the necessary incentives in rewards or sanctions, as well as assistance to states needing additional capacity and support.

Since there is always the potential for conflict among states, dispute settlement mechanisms are required, starting with negotiation and arbitration. As a final resort, the global judicial system should include an International Court for the Environment that is able to issue binding settlements and to interpret the law in specific cases. Standing should be granted to competent civil society organisations to present their observations in these cases. Governments will only give up clinging to national sovereignty when they can trust that justice will be done.

Learning and Adaptability

In a time of rapid environmental change, institutions need to be able to learn and adapt. They must listen to the Earth system, rethink core values and assumptions and adjust governance accordingly. This should include the capacity to share both good practices and the lessons learned from inevitable failures, to assess any unexpected environmental changes, to organise expert review and policy recommendations, and to communicate rapidly any necessary warnings and response alternatives.

There can be unanticipated impacts between social and ecological processes. A whole-systems overview is needed between developments in the economy, in national

planning, in the use of territory and resources, and their environmental and social consequences. Short-term actions frequently have a long-term impact. Global institutions need to be in constant dialogue with all the relevant parties to avoid negative consequences.

National Governance

The next level of the challenge is the inefficacy of environmental management at the national level. Even the most environmentally responsible governments balance environmental requirements against other economic and social priorities and pressures. National interests come before more vague or distant global risks, although the increase in disasters related to climate change has recently hit home. International agreements are easily signed, but implementation generally fails through a lack of political will and the power of vested interests to block action. Then there are all the countries where governments are more autocratic and concerned primarily with holding on to power, often linked to corruption. There, little or no priority is given to the common good, even national good, not to mention global security, with the result that environmental concerns may be denied or actively combatted as a threat to other interests. Beyond that are the failed states where government hardly exists, and conflict is rampant. All this makes effective international cooperation for global risks virtually impossible.

National action also needs to be reinforced against the pressure of economic actors intent on short-term profit from resource exploitation and pollution. As already mentioned, many entrepreneurs and corporations function in the present economic paradigm in which profit and short-term return on investment are the measures of success, and the ends justify any means. Natural resources are there for the taking, and any impacts are externalities to be ignored or taken care of by someone else. The fossil fuel industry has known for decades that its activities were leading to global heating without this knowledge having any impact on their business plans. Then there are all the illegal activities and organised crime which also have a significant environmental impact and are even harder to control.

Local Governance

In application of the principle of subsidiarity, more community empowerment needs to be another priority in governance. Local communities must acquire the capacity and knowledge to manage their own environmental resources sustainably and avoid, at their own level, contributing to global risks. This also will help them to reduce their vulnerabilities and reinforce their collective resilience, which, in many ways, is the best insurance against any global catastrophe that might occur. For example, a village or neighbourhood that encourages community gardens and local agriculture to increase self-sufficiency will have access to healthier food requiring less transport and build solidarity. Indigenous peoples had to evolve local food production that respected nature to ensure their survival.

Mechanisms should be created to build coherence across all these levels. Fortunately, there is an active ongoing discussion internationally concerning the need for global governance reform, stimulated by the UN Secretary-General's report *Our Common Agenda* (UN Secretary-General 2021), the work of the High-Level Advisory Board on Effective Multilateralism (Karlsson-Vinkhuyzen and Dahl 2021) and the Stockholm+50 International Meeting (Dahl 2022b), among others, leading towards the Summit of the Future in 2024.

Human Resources

One of the most important determinants of effective governance is the quality of its human resources, both of the governors and the governed. It is people who operate institutions and who implement or disregard their decisions. Therefore, their motivations and values, their education and understanding, their short- or long-term perspectives are of great importance. Any improvement in governance also requires attention to the human dimension.

Education is, therefore, an essential support to the kind of governance transformation that is called for to reduce global environmental risks (Lopez-Claros, Dahl and Groff 2020, ch.19). This necessitates a wide extension of environmental education and sensitisation at all levels so that the scientific reality is both known and understood. Particular attention is necessary to those who will be employed in the public service. What personal characteristics are required, and how can they be cultivated through education and training? This will need to go beyond technical training in specific areas of environmental competence. A desire to be of service to the common good of humanity and the natural environment will make a significant difference to effective governance.

It is probable that even deficient institutions run by officials having a true desire to serve could be more effective than perfect institutions in the hands of self-seeking officials concerned only about advancing their careers and material success. So many governments, in the hands of determined autocrats and despots, have ended in disaster. Institutions that share responsibility collectively, that provide for checks and balances, that encourage wide participation, will be less subject to the often-negative influence of individual personalities and motivations.

Information Resources

One governance challenge when relying on information systems, whether financial accounts or scientific assessments, is that they generally make the basic assumption that the past is a good guide to the future, with the result that they tend to support planning and decision-making based on business as usual, or at the most gradual evolutionary change. Unfortunately, as history shows, this is rarely the case. There are always surprises. These can be either negative, such as crises and catastrophes, or positive as a result of innovations that can change the course of social evolution (Bill and Melinda Gates Foundation 2022). Systems science already tells us that change is not usually linear but follows what are called punctuated equilibria, when some crisis or innovation changes the potential of the system, triggering a period of rapid change and innovation to adapt to the new environment which gradually settles into a new and more stable equilibrium until an external change precipitates a new leap forward. An innovation may come as a surprise, but it can also be intentional, designed to transform society.

Since such periods of rapid change are often unpredictable, those making recommendations to government can turn to tools, such as scenarios, stories that start with different sets of assumptions and imagine what the alternative future might look like. These can lead either to decisions that take into account the possibility of such transformations or at least contingency planning that can be turned to rapidly if necessary.

This is particularly relevant when trying to anticipate catastrophic risks. In most cases, plans are made to reduce some obvious vulnerabilities and to build capacity for the necessary response measures, at least within the limits of available resources. The GCRI is intended to help governments respond in this way (Dahl, Lopez-Claros and Miller 2022).

Positive Scenarios

A second possibility is to design positive scenarios for new directions for society that would reduce or eliminate the human-induced causes behind many catastrophic risks. These can build on human ingenuity and our capacity for innovation. Scenarios can then be consciously pursued, consulting widely on the alternative future that is imagined, attracting public support and hopefully building the political will to move forward in that new direction.

Negative scenarios are nothing new. Already in 1972, the report to the Club of Rome on *The Limits to Growth* (Meadows *et al.* 1972) used computer modelling of major world trends to show that business as usual would reach planetary limits and cause the collapse of civilisation by the mid-21st century. The message was rejected in economic and political circles, but repeated updates of the model have confirmed its general conclusion, and recent events are consistent with its projections. From the perspective of global catastrophic risks, these include an economic collapse, perhaps from a general debt crisis, with major currencies losing their value; a climate catastrophe with widespread environmental destruction and drought; rising sea levels and the mass migration of climate refugees; famines aggravated by the collapse of global trade; repeated pandemics; disruption of communications technologies and the Internet by natural events or human intent through cyberwarfare; a return to extreme nationalism, the rise of autocrats and dictators, failures of national governance; and a closing of frontiers as countries try to isolate themselves from chaos elsewhere; civil wars and even a world war between democracies and autocracies, possibly leading to a nuclear winter. In the integrated world economy of today, any one crisis could trigger others in a complex catastrophe from which the surviving remnants of humanity would only slowly recover. Scenarios in support of governance could explore each of these and suggest preventive or compensatory actions.

On the side of positive scenarios, two examples can illustrate what is possible: An economic transformation could include a rapid transition to a circular economy, with an end to excessive consumption and a return to a materially simpler lifestyle favouring social relationships and the growth in intangibles such as knowledge, science, art and culture. Community organisation would be at a more human scale of neighbourhoods and villages enjoying greater solidarity, including integrating migrants and refugees. There would also be a more balanced distribution of wealth between and within countries of the north and south, compensating for the historical impacts of political, economic and corporate colonisation while eliminating extreme poverty and providing meaningful work for all.

Systems science shows that a fundamental transformation is best practised first at the level of values (Meadows 1999). Many of our problems are due to collectively dysfunctional human behaviour that reflects a vacuum in what could be called ethical or spiritual values, leaving our animal nature to dominate, with egotism, greed, lust, pride, and even violence accepted as normal human behaviour. Yet there is a higher human potential that can be cultivated through education. In the past, these higher spiritual values originated with figures like Moses, Buddha, Christ, and Mohammed, founding faiths that led to the blossoming of whole civilisations. Can we not imagine a scenario for a leap forward in our spiritual evolution? This would involve a renewal of the universal values found in all religions, stripped of dogma and human interpretation, and updated for the needs of a unified world society, such as is envisioned by the Bahá'ís.

In this second scenario of spiritual transformation, where human values take priority over the material dimensions of life, everyone would find their place with dignity and the opportunity to fulfil their potential. Universal education would empower everyone with the values of unity in diversity, including marginalised and indigenous peoples. All the religions and spiritualities would recognise their essential unity of purpose. While being content with little materially, a rich community life would emphasise science, art, culture, and being of service to others. Technology and the economy would be of service to human well-being. Human society would be in harmony with nature, working to regenerate natural resources for a truly sustainable civilisation. Governance would be collective and participative without individuals exercising power. In such a scenario, transformation could begin at the grassroots in local communities, learning as they go and gradually scaling up through social action and public discourse.

While distinct scenarios can be developed as discrete entities, it is equally possible to imagine them, for example, in combination with an economic collapse leading to a transformed economy, creating a positive social movement in which a fundamental evolution in values can take place. Although political resistance to change is high, the increasing social fragmentation and failure of governance at all levels may painfully open the door to such essential renewal.

Indicators and Other Measures of Risk Governance Performance

One reason why we are threatened by a growing number of global catastrophic risks is because our main accounting systems, indicators and measures of progress ignore the main drivers of those risks. These are not on the agenda of decision-makers, especially those in government and business, and there is little political will to do anything about them. Governments adopt declarations of good intentions, such as the UN 2030 Agenda and its Sustainable Development Goals (United Nations 2015), and the Paris Agreement on Climate Change (UNFCCC 2015). But there is a general failure of implementation. Scientists have been warning for decades about the major global environmental risks, but most political leaders—especially those with autocratic tendencies and the executives of large multinational corporations—have other priorities and continue their damaging activities, outweighing all efforts to address the problems. Governments hide behind their national sovereignty, and powerful business lobbies, often involved in corruption, prevent any global attempt at governance or regulation of business.

One cause is our reliance on financial accounting and measures of progress, such as gross domestic product (GDP), which measures the flow of money in the system and encourages endless growth. We are trapped in an economic paradigm that calculates everything in terms of monetary profit and loss, capital and interest, return on investment, and the theoretical efficiency of the market. Yet these have no inherent relationship to human or planetary well-being. Many corporations consider only profit and return on investment while ignoring the decline in environmental and social capital and related costs, treating them as externalities to be borne by the whole of society. Modern neoliberal economic thinking is founded on the assumption that people are fundamentally selfish, competitive and aggressive; thus, we accept as normal that markets and politics are powered by ego, greed, apathy, and violence, and that our society values wealth, power and fame for a few.

All that cannot be monetised or bought and sold is ignored. A stable climate has no inherent economic value. Climate change only enters into financial accounts when it causes damage. Since releasing carbon into the atmosphere drives global heating, we

consider carbon taxes. But the only value that is placed on the other half of the carbon cycle, where nature has sequestered carbon from the atmosphere for millions of years, is when this can be sold as carbon credits to offset releases. Similarly, preserving biodiversity has no economic value unless it provides measurable ecosystem services for the economy or attracts tourists.

Alternative Accounts

One solution is to develop an alternative set of accounts for valuations more organically related in a systems perspective to the functioning of the biosphere, the desirable direction of human society and the right of every human being to a life of dignity and fulfilment while mapping across major types of catastrophic risk: environmental, human and social. Such accounts could use alternative measures that are scientifically, socially and ethically relevant, defining progress directly in terms of both human and environmental well-being. These could measure the climate system, sustainable energy supplies, biosphere integrity, pollution reduction, a regenerative food system, the integration of nature and culture, and the comprehensive use of human capacities in healthy communities. Making these realities and their human and natural consequences more visible should touch both minds and hearts, stimulate meaningful conversations and inspire a spirit of solidarity in action. One effect will be to privilege those positive actions that will reduce risks and head off global catastrophes.

A new accounting system should be based on the underlying values and principles that define our human purpose, presently identified by our global society as human rights and obligations. In summary, the foundational principle of justice includes the right of everyone to human dignity and to equitable treatment, leaving no one behind, with special attention to women, children, the disabled, and those otherwise marginalised. As a social species, humans cannot fulfil these rights individually but only through relationships with others, requiring each of us to feel solidarity with everyone else, maintenance of our common property and protection of the common good. This expresses the fundamental truth that we are one human family and citizens of this planet in all our diversity, above any other more limited identity.

A systems perspective helps us to understand the enabling conditions for a more realistic view of progress and well-being, avoiding environmental risks and providing conditions and resources for us and all life to exist. The planet has three energy systems: solar thermal energy maintaining the climate at temperatures suitable for life; the biospheric energy system capturing solar energy in chemical forms through photosynthesis and feeding everything, including human beings; and nuclear decay providing geothermal and nuclear energy. Energy accounts should measure this flow. The biosphere, with its ecosystems and living species, provides many renewable ecosystem services, sustainable natural resources and all our food. Non-renewable resource use must ultimately be circular to avoid running out. Many substances we have extracted or invented are polluting our environment. For these three dimensions, we are now overshooting planetary boundaries and threatening our future in ways that are becoming catastrophic risks. This requires moderating our material civilisation, restoring past damage and enhancing the regenerative capacities of nature.

For human well-being, we have our own enabling conditions: basic physical needs for shelter, energy, water, and security; food and a sustainable food production system; and good health to enable us to reproduce safely and contribute to society. These should not be conditioned by any artificial limitation such as nationality, ethnicity, religion, or place of birth. Their loss can lead to catastrophe.

We have collective social needs for dignity through work and service; for knowledge, science, culture, and education; and for values, individually through ethics and spirituality to improve our character, collectively with principles and system rules to organise our communities and institutionally to provide rules for system organisation. Human civilisation emerges through cooperation and reciprocity, building institutions that allow ever-higher scales of organisation in space and time, perpetuating an ever-advancing society. While these dimensions do not directly contribute to catastrophic risks, they are important in determining our risk vulnerability and resilience, and can accentuate or diminish their impacts. This systems perspective maps out the framework for a solidarity accounting system that measures what is really important (Dahl 2021, 2022a).

Together, all these forms of natural, human and social capital would become the basis for a new global definition of wealth and progress, expressed in a set of complementary currencies, no longer subject to manipulation in the national interest of states, founded on scientific standards of human and natural well-being, and simple and logical enough to inspire wide public acceptance. By basing the accounts on an ethical perspective of human purpose and well-being for the whole human race in its oneness and diversity, the system can become the tool for global solidarity, driving social progress, including all nations and peoples with justice and equity. This then becomes the standard against which risks of catastrophe can be measured. Oversight would be the responsibility of institutions of global governance, in the same way that national central banks take decisions to ensure national economic well-being under the oversight of national governments. Each country could adapt the accounts to its national situation as a guide to national policy. The approach even lends itself to use in local communities to read the local reality and stimulate meaningful conversations about solidarity and social action.

The accounting system proposed here using non-financial measures can define this new vision of progress and motivate positive action, heading off catastrophes. It can guide us to restore climate stability and productive ecosystems and prevent pollution, with all the risks these otherwise imply. It can define a society able to meet the basic material needs of all with proper nutrition and good health, to provide meaningful work and access to education, to encourage knowledge, science, art and culture, all by fostering the values and spiritual capital that would be the measures of an ever-advancing and risk-free civilisation.

In conclusion, we see a confrontation today between catastrophic risks and political realism. Those risks are accelerating, with severe impacts already visible. They can only be reduced or avoided through acts of consultative will to implement what is proposed here. If not, we can be certain that some catastrophe will finally lay waste the forces of inertia and resistance and clear the way for the survivors to rebuild for a better future. Wisdom would obviously suggest that we chose the former path.

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