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BEYOND THE CLIMATE–NATURE NEXUS: RETHINKING INTEGRATED ENVIRONMENTAL GOVERNANCE FOR HUMAN WELL-BEING IN A CHANGING WORLD

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Abstract
Conventional environmental governance has been found to have significant weaknesses due to the convergence of climate change, biodiversity loss, ecosystem degradation, pollution, resource insecurity, and social vulnerability. The climate–nature nexus has increased understanding of the interdependencies of nature, but hasn't yet fostered a focus on the larger systems that drive environmental change and their impacts on human health, livelihoods, food and water security, economic stability, and social equity. This paper critically reviews the concept of the climate–nature nexus and proposes a framework for environmental governance that goes beyond these two perspectives to focus on human well-being and socio-ecological resilience. It shows how environmental risks are increasingly taking different interconnected pathways, but governance mechanisms remain diffuse across climate, biodiversity, water, agriculture, energy, health, and development. The factors of institutional fragmentation, policy trade-offs, transboundary environmental risks, weak accountability, unequal vulnerability, and the lack of participation in the environmental decision-making process are given special consideration. The analysis also considers ways to enhance governance capacity through adaptive governance, ecosystem-based approaches, NbS, digital-technology-enabled environmental monitoring, just transition, and multi-level participation. Integrated approaches that tackle the challenge of flood risk alongside ecosystem restoration, water security, disaster preparedness, public health, and urban environmental pressures are integrated across different experiences shared with the Netherlands, Costa Rica, Singapore, Bangladesh, and London. The paper maintains that environmental governance should not be judged solely on the basis of emissions reductions or conservation outcomes, but on its ability to preserve ecological integrity and provide health, livelihood security, resilience, and social justice

INTRODUCTION

The environment faces issues that are far more complex and cannot be seen as separate issues such as climate change, biodiversity loss, pollution, resource depletion, or ecosystem degradation. These are increasingly a unified crisis, in which changes in one element of the Earth system have cascading effects on other elements of the ecological, economic, social, and human systems (E. M. Bennett et al., 2021). The most apparent example of this interdependence is

global warming. To remain on a 1.5°C trajectory, the world would need to reduce GHG emissions by around 42% from 2019 levels by 2030 and by around 57% by 2035 if current policies continue. If current policies continue, the world will not be on a 1.5°C trajectory: the United Nations Environment Program estimates that the world would warm by about 3.1°C by the end of this century. These data illustrate that the environmental challenge is not just one of awareness of climate change; it is one of the ability of governance systems to keep pace with multiple compounding pressures, along with a level of social legitimacy (N. J. Bennett et al., 2021).

Climate change is, however, just one aspect of this change. Loss of biodiversity and ecosystems is also reducing the capacity of natural systems to support societies' livelihoods, food production, freshwater regulation and quality, soil fertility, coastal protection, carbon storage, disease regulation, etc (Mahmood, Ansari, et al., 2026). Degradation of forests, loss of wetlands, soil degradation, over-exploitation of marine resources, habitat fragmentation, and pollution are not just losses suffered by nature; they are also a decrease in the capacity of ecosystems to absorb climatic shocks and support human societies, which are becoming ever more unstable(Biermann et al., 2022). For instance, a degraded watershed can compound the impacts of drought and flood, and the loss of forests can reduce carbon sequestration, increase soil erosion, alter local hydrological cycles, and affect rural livelihoods. Likewise, declining marine ecosystems may also combine to affect fisheries, food security, and the income of coastal communities, along with ocean warming and acidification (Saleem et al., 2026). The relationship between climate and nature is thus a two-way street, with climate change fostering ecological degradation and the degradation of ecosystems diminishing nature's ability to adapt to climate change and regulate the climate (Chausson et al., 2020).

From this inter-dependence, it is clear that the concept of environmental governance needs to be understood. In this way, international and national policy systems have evolved in somewhat isolated institutional spaces, where climate policy is structured around greenhouse-gas emission and temperature limits, biodiversity policy around species and habitat protection, water policy around water resources management, agriculture policy around food production, and public-health policy around disease prevention and health provision. Institutional specialization can lead to technical expertise but also to more decentralized decision-making, which may result in policies that address one environmental issue at the expense of another (Cooke). For example, large-scale land-use changes undertaken for agricultural expansion or deforestation can lead to increased food production in the short term but can also contribute to deforestation, biodiversity loss, water stress and greenhouse gas emissions. Similarly, inadequate design of a climate mitigation measure can place pressure on lands, minerals, or ecosystems if the broader environmental and social impacts are not taken into account during the design process. Integrated governance must, therefore, go beyond the conceptualization of environmental problems as being addressed separately by different ministries, environmental goals, budgets, and regulatory bodies (Cunningham, 2021).

The ultimate meaning of this change lies in its impact on human health. Environmental stability is not an abstract value of the environment but a condition for health, security, livelihoods, economic productivity, and social stability (Mahmood et al., 2025). The impacts of climate change pose serious risks to access to clean air, safe water, nutritious food, and secure shelter, and to a growing number of interconnected risks, including extreme heat, flooding, droughts, wildfires, changing disease patterns, and disruptions to food systems. According to the World Health Organization, only 4 major health impacts of climate change, namely malnutrition, malaria, diarrhea, and heat stress, would cost around 250,000 lives per year between 2030 and 2050 (Kasuri et al., 2024). These risks are also very unevenly distributed. Those communities that have limited infrastructure and financial resources, rely on natural resources, and have less access to health care and social protection generally have limited capacity to absorb

environmental shocks. As a result, environmental degradation is likely to perpetuate and exacerbate, rather than reduce, inequalities (Creutzig et al., 2022).

Clearly, the climate-nature connection is a development beyond a fragmented environmental perspective, but it is not sufficient to serve as the sole organizing principle for modern environmental governance (Munir et al., 2024). Governance for the next generation needs to be aware of a broader web of interconnections between climate stability, biodiversity, ecosystems, pollution, natural resources, human health, economic systems, social justice, and institutional capacity. This more comprehensive perspective has greater importance in an ever-changing world, where environmental pressures are becoming increasingly simultaneous, interconnected, and harder to reverse (Mahmood, Ali, et al., 2026). Environmental governance, therefore, should be integrated in a resilient, policy-coherent, participatory, equitable and long-term manner. Efforts must be made to safeguard the planet from the impacts of human activity – but also to transform the institutions and decision-making systems that shape how societies interact with the planet's systems. A step beyond the climate–nature nexus is a shift from climate and environmental management to the governance of the mutually entangled conditions that are essential for a healthy, secure, and resilient human future (Saleem et al., 2025).

Beyond the Climate–Nature Nexus: Reframing Environmental Interdependence

From a Climate–Nature Nexus to a Wider Socio-Ecological Nexus

The climate–nature nexus is a key conceptual leap, as it acknowledges that climate stability and ecological integrity are interlinked, not policy issues that can be addressed separately. But the modern-day environmental crisis goes far beyond this relationship (Saleem et al., 2024). Climate change, biodiversity loss, land degradation, freshwater depletion, chemical pollution, resource extraction, urbanization, and production and consumption are all affecting the Earth system simultaneously, increasing stress on it. There are feedback effects between these pressures, which can cause environmental and social risks to be magnified. It is an important condition illustrated by the Planetary Boundaries framework (Khalid, Saleem, et al., 2026). The nine planetary boundaries - which are considered critical for a relatively stable Earth system - were evaluated; of these, six were found to be already broken, such as climate change, biosphere integrity, land-system change, freshwater change, biogeochemical flows, and novel entities. All this evidence indicates that environmental governance cannot be performed with a narrow-minded lens that is geared towards atmospheric warming and biodiversity conservation, with other pressures as secondary or independent ones. One of the major challenges for the central governance is to deal with multiple interaction among Earth-system processes whose cumulative impact can be very significant in comparison to the effect of each pressure alone(Díaz et al., 2019).

This overall approach is illustrated by the freshwater system. Precipitation changes, the enhanced evaporation due to the effects of climate change, and enhanced droughts are all linked to greater glacial and snowpack loss, and more frequent extreme hydrological events (Mahmood, Munir, et al., 2026). Meanwhile, the direct manipulation of water systems by groundwater extraction, agricultural irrigation, urbanization, industry, and river modification occur. Based on the global assessment, about half of the population suffers from severe water scarcity at least part of the year and agriculture accounts for about 70% of global freshwater withdrawals. The pressures are not independent but interact with climate variability (Khalid, Mahmood, et al., 2026). At the same time, a prolonged drought may affect agricultural output, lead to greater groundwater extraction, create greater need for energy to pump the water, raise food prices and at the same time adversely affect household income. On the other hand, deteriorated wetlands and watersheds decrease natural water storage capacity, and make them more prone to flooding and drought. Environmental governance should move away from the silo approach of managing resources to managing "ecological functions" and "human

systems that rely upon them"(Food & Agriculture Organization of the United, 2024).

This is the same for land and food systems. Land use is one of the most decisive factors in determining the world's ecological condition, as the agriculture use covers about 38% of the ice-free land area. The effects of agricultural expansion and deforestation, soil degradation, fertilizer use, irrigation and livestock production on biodiversity, freshwater availability, GHG emissions and rural livelihoods are all interconnected (Arbi et al., 2026). Food systems contribute significantly to anthropogenic GHGs emissions and climate change is a growing threat to food production due to heat stress, drought, changing precipitation and extreme weather. This establishes a vicious cycle that adversely affects food production, and at the same time existing production systems may aggravate environmental degradation. Strategies that view climate policy, agricultural policy, biodiversity conservation and water management as distinct administrative domains, are in their structural setup unable to cover the whole chain of causation, however(Fuso Nerini et al., 2019).

From Fragmented Environmental Management to Integrated Earth-System Governance

Changing the way we think about environmental interdependence calls for a change of the governances. Typically, traditional environmental institutions have been based on administrative sectors, geographic areas and specific environmental issues (Mahmood, Baig, et al., 2026). Typically, ministries of environment, agriculture, water, energy, health, industry and planning have different mandates, budgets, regulatory tools, and performance measures. When environmental risks are trans-boundary, the institutional architecture becomes more and more confusing. Pollution from energy production can impact public health, agricultural chemicals can pollute fresh water, deforestation can change the regional patterns of rainfall, loss of biodiversity can lead to reduced ecosystem services, climate induced migration can bring additional stress to urban infrastructure, etc. The causal pathways are not the same as the lines of government, but they are similar to the lines of government (Mahmood, Saleem, et al., 2026). An integrated approach thus means that environmental decision making should take into account interactions, trade-offs, feedbacks and cumulative impacts before policy decisions are made. It is not just about co-ordinating institutions, but also the fundamental basis upon which environmental decisions are assessed(Intergovernmental Panel on Climate, 2021).

Renewable-energy project should be judged on its role in emissions reductions as well as its land use, mineral extraction, biodiversity impact, water use, employment, energy costs, and community rights. Likewise, forest conservation must be measured not only in terms of hectares conserved but also for the impact that it creates on the carbon stored in forests, water regulation, biodiversity, indigenous and local livelihoods and climate adaptation. This approach can help shift environmental governance from a set of sector-oriented measures to a framework of risk management(World Meteorological, 2024a). The idea of planetary health offers a further basis for the transition as it explicitly links the health of natural systems with human health and social well-being. Loss of ecosystems is becoming linked to decreased food security, disease exposure, heat stress, air pollution, mental health challenges and loss of livelihoods. The impacts of COVID-19 on highly interconnected human–environment systems was another reminder of the impacts of ecological disturbance, urbanization, global mobility and health vulnerability. Environmental governance needs thus to take account of risks that arise at the margins of the ecological and social systems, as opposed to being a background condition of nature(Intergovernmental Panel on Climate, 2022a).

This re-framing also needs to be more focused on cumulative and distributional effects. An environmental intervention may bring about aggregate benefits, but may have disproportionate costs to specific communities (Mahmood et al., 2024). Renewable-energy projects, such as massive wind and solar facilities, conservation measures, carbon-offset plans, the extraction of transition metals, and water management projects can all

serve environmental goals, but at the same time generate local land-use, job, access, resource, or cultural issues. Procedural participation, distributive justice and recognition of local knowledge should be integrated into the governance, in addition to the ecological and economic evaluations. It is not only about making policies environment friendly but making policies environment friendly in a coherent manner, socially legitimate, and environmentally sustainable in order to support the well-being of humans for a long term(Intergovernmental Panel on Climate, 2022b).

Human Well-Being as the Core of Integrated Environmental Governance

Environmental Change, Health, and the Foundations of Human Well-Being

Rethinking environmental governance is of special importance for the benefit of human well-being as environmental systems are the physical basis on which health, nutrition, living standards and social security depend. Climate change, biodiversity loss, Pollution and ecosystem degradation are no longer a single event, but are occurring at the same time. According to the World Health Organization, malnutrition, malaria, diarrhoeal disease and heat stress alone are responsible for about 250,000 additional deaths every year globally, due to climate change, between 2030 and 2050, with the overall health impact much larger if cardiovascular and respiratory diseases, injuries, mental-health impacts and displacement are also considered. This relationship is more pronounced when the temperature is very high. Increased climatic vulnerability is evident through the Lancet Countdown 2023 assessment, which showed that the number of people aged over 65 dying due to heat stress has risen by ~85% between 1990-2000 and 2013-2022. Climate resiliency needs to be understood as a health-system problem and not just an emissions-management goal, however, in environmental governance(Intergovernmental Panel on Climate, 2023).

An integrated perspective is also needed given the case of air pollution. Ambient and household air pollution are estimated to cause some 7 million premature deaths each year, according to WHO. Fine particulate matter, specifically PM2.5, affects cardiovascular diseases, strokes, chronic respiratory disease, lung cancer and other adverse health conditions. In parallel, however, air pollution is also related to energy systems, transportation, industrial activity, urban design, agriculture, and climate policy. Thus, policies which can enhance energy efficiency, increase clean and green public transport use, lower fossil fuel consumption and help improve urban planning have the potential to provide both climate and health benefits at the same time. Policies, on the other hand, that fail to consider these interactions can induce unwanted health burdens. The health dimension is therefore a useful tool for assessing the effectiveness of an environmental policy in achieving human wellbeing more broadly than just in terms of the environmental indicators it targets(Intergovernmental Science-Policy Platform on & Ecosystem, 2019).

Food, Water, Livelihoods, and Environmental Security

Access to food, water, productive ecosystems and secure livelihoods also is essential to human well-being. All of these foundations are at risk from environmental degradation and are linked in a variety of ways. In 2022, nearly 2.2 billion people had no access to safely managed drinking water and nearly 3.5 billion people had no access to safely managed sanitation. Simultaneously, agriculture consumes about 70% of global freshwater withdrawals, and thus there exists a direct linkage between water governance, food security, ecosystem conditions, and rural livelihood security. Climate change exacerbates this challenge by increasing the length of droughts, altering precipitation, heat stress, flooding and reduced water supply in climate-sensitive areas. The outcome is more than just an environmental issue, it is a combined threat to the household livelihood, nutrition, public health and social stability. It is from this interdependence that food systems are a prime example. In 2022, around 735 million people are estimated to have been hungry, and hundreds of millions of people to have

suffered moderate or severe food insecurity(International Energy, 2023).

Climate variability and extreme weather is becoming a faster threat to agricultural production and biodiversity is becoming a threat to pollination, soil fertility, genetic diversity, and natural pest control. Most, approximately 75%, of global types of food crops rely at least in part on animal pollination services, so the loss of these animals can have economic and nutritional impacts beyond biodiversity. Another example is soil degradation, about one third of the world's soils are estimated to be degraded, which affects food production and relies on more chemical inputs, more irrigation and more land development. Livelihood security is also perfectly intertwined with ecosystem condition. Forests are estimated to support the livelihoods of 1.6 billion people, including significant numbers of people who depend on forests for their livelihoods, relying on forests for food, shelter, fuel and income. Fisheries, mangroves, coral reef and other marine resource-based livelihoods are important to coastal communities for their livelihood and food security. However, during the deterioration of these systems, households often suffer multiple losses of income, nutrition, physical protection and cultural resources(International Energy, 2024a).

Environmental Inequality, Vulnerability, and the Principle of Just Governance

The impacts of environmental degradation are not uniform. The smallest contribution to environmental pressures are often made by the populations with the lowest ability to cope with environmental impacts. This imbalance between the two means that the issue of justice is always part of discussions on environmental governance. The Intergovernmental Panel on Climate Change has repeatedly confirmed that climate-sensitive communities with relatively low levels of climate change drivers are the ones who are most vulnerable to a particular climate hazard(World Meteorological, 2024b). Smallholder farmers, low-income city dwellers, coastal communities, indigenous people, children, elderly and those in areas with poor infrastructure may be more vulnerable to environmental risks and have less ability to cope with the impacts of climate change. Environmental inequality goes beyond climate change. High levels of air pollution are often found in urban centres, around people's homes, and around industrial sites, waste sites and major transport corridors. Limited access to cooling, secure jobs, and insufficient green space are also possible risk factors that could impact households with lower incomes, as are inadequate housing and housing conditions(International Energy, 2024b).

Likewise, for communities that rely on subsistence farming or natural-resource extraction, an ecosystem's degradation can result in a significant disruption of their livelihoods. The patterns show why there can be significant differences in lived experiences as reflected in these aggregate environmental indicators. Governance, therefore, should include the human and environmental dimensions, in the sense of effectiveness and distributive impacts. Going beyond the simple goal of cutting national emissions or restoring ecosystems or enhancing renewable energy generation, the goal should be to bring about environmental transitions that will benefit the lives of people without imposing undue burden on the weakest members of the society. Hence, the notion of a just transition is a key aspect of integrated governance. Employment options and pathways, retraining, social protection and regional investments are needed for workers and those communities that rely on carbon-intensive industries; meaningful participation and fair distribution of benefits are needed for communities impacted by conservation or infrastructure projects(International Labour, 2018).

The rights and knowledge of indigenous and local communities must also be taken into account when making decisions about the environment, as their livelihood and culture are often linked to the environment. When putting the human into the centre, it does not mean putting the human in front of nature's economic interests. Instead, it notes that human success is so closely tied to thriving ecological systems. Clean air, stable climate conditions, fertile soils, dependable

freshwater supplies, productive oceans, biodiversity, and resilient ecosystems are all other types of foundational infrastructure that make traditional measures of economic development more precarious. Integrated environmental governance should therefore aim to achieve two things: firstly, to preserve the integrity of Earth systems and secondly, to bring about environmental transition while fairly distributing the benefits of ecological stability and the costs of environmental transition(International Resource, 2020).

Institutional and Governance Challenges in an Interconnected Environmental Crisis

Institutional Fragmentation and the Problem of Silo-Based Governance

A major hurdle to integrated environmental governance is the fragmented institutional arrangement to manage interconnected environmental systems. The ministries, agencies, laws, budgets and monitoring systems for climate change, biodiversity, water, agriculture, energy, public health, land use and pollution are typically separate. This is a historic pattern of environmental policy as a series of discrete issues were recognized and addressed through specific regulatory jurisdictions. But today's environmental threats are more often trans-institutional in nature. A drought, for instance, is a water security issue, an agricultural issue, an energy issue, a food security issue and a public health issue. However, these dimensions can be controlled using institutions containing few coordination mechanisms(Jordan et al., 2019).

This fragmentation has repercussions that can be seen in the global assessments. Land-use change, direct exploitation of organisms, climate change, pollution and invasive alien species are among the key interacting drivers of biodiversity loss identified by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). These pressures come from a variety of sectors of the economy, for which biodiversity policy is not sufficient. Likewise, the Global Resources Outlook has shown that the extraction and processing of natural resources are responsible for over 55% of greenhouse-gases, as well as about 90% of terrestrial biodiversity loss and water stress. The figures reflect an inherent governance paradox – economic sectors outside environmental institutions often make environmental outcomes. Good governance needs to include mechanisms that link environmental goals to policies and decisions in energy, infrastructure, trade, agriculture, industry, finance and urban development(Mace et al., 2018).

Policy Conflicts, Trade-Offs, and Unintended Environmental Consequences

Sustainability results are not guaranteed with integration since there are multiple environmental goals that can be at odds. If impacts of policies for climate change are not addressed in a broader context, then new pressures on land, water, minerals and biodiversity can be created. The case of rapid growth of its renewable energy is illustrative. A major transformation away from fossil fuels is possible using solar, wind, battery storage, EVs, and transmission infrastructure, but requires land and critical minerals like lithium, cobalt, nickel, graphite, copper and rare earth elements. Under the scenarios of a transition to a low-carbon economy, the demand for a number of critical minerals is projected to grow multiple times by 2040 according to the International Energy Agency. A poorly managed transition to a low carbon economy could therefore lead to a decrease in carbon emissions and an increase in the burden of mining, habitat destruction, water use and local tensions. There's another possible paradox for bioenergy. The up-scaling of production for energy crops could be considered as a contribution to the goals of renewable energy but can be in competition with food production or natural ecosystems(Organisation for Economic & Development, 2021).

Likewise, afforestation can lead to biodiversity losses in areas where ecologically unsuitable, single species forests are planted instead of a variety of native forests. The following examples illustrate why a single measure is not a good indicator of policy success. However, carbon reductions should not necessarily be read as progress in general environmental measures, if they come along with substantial biodiversity loss, depletion of water

resources, food insecurity or social displacement. Assessing synergies and tradeoffs, thus, must be a systematic exercise to be carried out before the implementation of policies in integrated governance. SEA, LCA, Cumulative-Impact Assessment and scenario modelling are tools that can identify impacts that are not captured by sectoral planning. The institutional challenge is to make these tools have a real influence in the actual decision-making process, instead of being used as procedural demands at the end of important decision-making processes(Pörtner et al., 2023).

Multi-Level Governance, Transboundary Risks, and Weak Accountability

While environmental systems work trans-geographically, governance is largely organized in national and administrative systems. Rivers cross borders, pollution in the air moves across borders, migratory species rely on several ecosystems, and climate-related risks flow through the global food chain, energy supply, trade and financial flows. This results in a natural system of processes that differ from the political system of powers. A country can have robust home environmental policies, and still be vulnerable to environmental harm from another country. The climate regime is an example of this challenge. The climatic effects of the emissions depend on the geographical location of the emissions (they are not a place-dependent effect), but greenhouse gases mix globally in the atmosphere. However, national governments continue to be the primary actors to implement. The Paris Agreement relies heavily on NDCs, but the total of global commitments have been too low to put the world definitely on a 1.5°C trajectory. This is a reflection of the ongoing mismatch between collective environmental needs and policy action at the national level(Richardson et al., 2023).

Another challenge is posed by transboundary water governance. There are over 300 shared river basins and hundreds of millions of people who rely on transboundary aquifers. As water becomes scarce, competition among agricultural, domestic, industrial, and ecological users can be exacerbated and political tensions can develop between states as the institutions for cooperation are weak. Pollution in the marine environment, plastic pollution, air pollution, the illegal wildlife trade, and biodiversity conservation are other areas of governance in which similar issues arise (Yasin, Munir, Shehzadi, & Saleem, 2026). The more responsibilities are spread between different levels of government, the less accountable is the government. Environmental standards can be set by national governments, and land use planning and implementation is under the provincial, regional or municipal level of control. Integrated governance can turn into a political promise instead of a political reality without clear accountabilities, effective monitoring, clear reporting and enforceable standards(Rockström et al., 2023).

Participation, Knowledge Gaps, and the Politics of Environmental Decision-Making

Another challenge has to do with who is included in the sphere of environmental governance and who's knowledge is accepted as legitimate. Although technical knowledge is required to grasp complex processes of the Earth system, the principles and guidelines for distribution of costs and benefits of the environment can only be drawn from scientific assessments. Competing interests with regard to access to land, jobs, energy costs, conservation, infrastructure and resource use are always part of environmental decisions. Excluding affected communities can thus be a threat to both legitimacy and implementation(World Health, 2023). Indigenous and local knowledge is of special importance. Native populations control or possess areas with significant biodiversity and there is growing evidence that many indigenous-managed landscapes retain high ecological integrity. But, much of conservation and development work has been done without engaging the communities that are directly affected by their landscapes, their way of life and their cultural identity. This can lead to displacement, conflict and distrust, and poor conservation results. There's a big gap in knowledge-governance as well. Another difference between environmental systems and political ones is the unpredictability, nonlinear feedbacks, tipping points, and delayed effects they

experience; annual budgeting cycles and short electoral cycles are more common in political institutions(Romanello et al., 2023).

Government may therefore be more interested in 'short-term economics' than 'long-term ecological resilience'. This gives rise to a structural orientation towards reactive governance instead of anticipation. Solutions to these challenges need to involve institutions which have the capacity to link scientific evidence, local knowledge, long-term risk assessment and public involvement. Environmental governance needs to be more adaptive, transparent and accountable and must include procedures for amending governance rules in response to new knowledge. Most importantly, integration needs to be more than just institutional coordination, it needs to be at the political level at which environmental priorities are set. The link between the environmental crisis and the interconnection of problems, short-termism and sectoral interest, cannot be effectively governed through institutions which were developed on the basis of isolated problems and defined by brief time horizons and sectoral interests. It demands governance mechanisms that are able to understand ecological interdependencies, make trade-offs explicit and transparent, coordinate governance and decision making processes across scales, and maintain environmental governance that is socially legitimate and scientifically defensible(Romanello et al., 2021).

Rethinking Integrated Environmental Governance for a Changing World

From Sectoral Coordination to Adaptive and Systems-Based Governance

A paradigm shift in integrated environmental governance is needed, from coordination between different environmental sectors to governance to socio-ecological systems. Traditional environmental policy has often measured success in terms of specific goals, for example, decreasing the amount of greenhouse gas emissions, planting more forests, cleaning up water, or creating protected areas. These indicators are still relevant, but can mask interactions between environmental systems. A more holistic perspective would look at the potential of policies as a whole, to enhance ecological and social resilience, lower cumulative risks, and contribute to human well-being. This is especially significant as the current environmental issues are multifaceted, rather than one-dimensional. Climate stability, biodiversity, availability of freshwater, food systems and human health are emerging as reinforcing aspects of planetary resilience in the context of the Planetary Health Alliance and associated research on the Earth system(Seddon et al., 2020).

Adaptive governance is an important institutional solution to this complexity. Adaptive governance is different from typical governance frameworks that set fixed policies in response to relatively stable environments that may be characterized by uncertainty and the need for continuous learning, monitoring, experimentation, and policy adaptation. This is especially applicable in situations where the environmental threshold is not known or is in flux. For instance, water-management institutions that are facing more variability in rainfall cannot just depend on the historical hydrological averages. They need dynamic allocation systems, drought forecasting, groundwater monitoring, measures of demand management and contingency planning. Likewise, the protection of biodiversity is not possible by relying exclusively on fixed protected areas in the event of changes in temperature, which are driving the shift in species distribution and the changes in the composition of ecosystems(Seddon et al., 2021).

Increasing frequency and economic damages of environmental disasters continue to give weight to the importance of anticipatory governance. Since 1970, weather-, climate-, and water-related disasters have been responsible for over 2 million deaths and losses of about US$4.3 trillion in the global economy, according to the World Meteorological Organization (WMO). These losses illustrate the shortcomings of governance systems that react mostly in a disaster phase when environmental hazards have occurred. The importance of early-warning systems, risk mapping, ecosystem restoration, resilient infrastructure, climate resilient agriculture and integrated disaster risk planning in significantly

reducing exposure and vulnerability. Both the success of multi-hazard early warning and the value of this approach are well illustrated: Early warning is one of the most cost-effective ways to mitigate disaster impacts, and countries with full early-warning coverage have experienced significantly reduced disaster mortality(Tickner et al., 2021).

Another vital aspect of integrated governance is nature-based solutions. The restoration of wetlands, mangroves, forests, grasslands and urban green spaces can help to restore biodiversity, sequester carbon, regulate water, protect against flooding, and benefit human health. For instance, mangroves buffer shorelines, support fishery resources and capture significant amounts of carbon. However, the use of nature-based solutions must be socially and scientifically suitable. Ecosystem restoration is not a matter of a tree-planting goal but of ecological outcomes which will depend on species selection, hydrology, landscape connectivity, soil properties, and local community involvement. The governance question is then how to incorporate ecological knowledge into a broader-based economic planning process and social priorities without using NbS as a tool to replace structural reforms(Turner & Wills, 2022).

Integrated governance can be further enhanced by digital technologies and environmental data (Khan, Ahmad, & Munir, 2025). With the use of satellite observation, remote sensing, geographic information systems, artificial intelligence, environmental sensors, and high-resolution climate models, governments are increasingly able to know, in near real time, about land-use change and deforestation monitoring, water availability, environmental pollution, and environmental risks (Raza, Munir, & Khan, 2025). However, technological capacity is not enough to ensure good governance. The data must be available to the relevant institutions, shared and accessible across sectors, transparent enough to allow for accountability, and usable to support policy decisions. But if not, the mushrooming of environmental information could coexist with continued institutional fragmentation (United Nations Development, 2024).

Just Transitions, Policy Coherence, and Inclusive Environmental Transformation

The political and socio-economic impacts of environmental transitions should also, and invariably, be addressed as part of integrated environmental governance. Mitigation, restoration, resource conservation, and pollution reduction can offer significant economic opportunities but also cause job displacement, higher transition costs, and land and resource reallocation. The International Labor Organization has estimated that a transition towards a greener economy could generate some 24 million jobs worldwide by 2030, while losing some 6 million jobs, meaning the transition is not necessarily 'job-destroying' and cannot be done automatically 'fairly'. Its results are largely driven by education, labor market policies, social protection, investment, and regional economic planning. Thus, the notion of a just transition is crucial to integrated governance (United Nations Environment, 2019). Coal miners, fossil fuel producers, traditional energy users, and those working in environmentally taxing industries need to find viable transition opportunities to other jobs, not shoulder the burden of decarbonization. Resource-intensive industries may need to be retrained, upgraded, economically diversified, and have social protection measures implemented within communities. Households, however, should not be unduly affected by increased energy, transport, or food prices that may be caused by environmental reforms. A poor poverty/social exclusion outcome cannot be considered a successful governance outcome if it is accompanied by a larger increase in emissions.

Policy coherence is also key. Political goals are often set high for the environment, while the budget, infrastructure, agricultural, and industrial policies do not support them. The Organization for Economic Co-operation and Development has repeatedly stressed the need to coordinate public policies across sectors to achieve sustainable development outcomes. This principle involves governments considering the environmental impacts throughout policy-making, from budgeting and taxation to subsidies, procurement, infrastructure investments, and trade policy. A

specific instance of this is environmentally destructive subsidies. Fossil-fuel subsidies, environmentally harmful agriculture, and resource-intensive production are funded by governments that simultaneously implement climate and biodiversity programs, resulting in confusion in the policy system (United Nations Environment, 2021a).

There should therefore be common environmental and well-being indicators used across ministries to implement integrated governance. National planning could integrate these factors into an evaluation framework covering greenhouse-gas emissions, ecosystem integrity, water security, air quality, exposure to environmental hazards, employment, health outcomes, and inequality. The effects of public investments on the environment and society could then be used to assess them alongside the economic ones. People's engagement should be at the heart of this change. Environmental policies are more likely to be valid and lasting if affected communities are involved in their design and implementation. This is especially relevant to land restoration, renewable energy facilities, protected areas, the allocation of water resources, and urban redevelopment. Indigenous peoples and local communities should not be seen as actors only after the event, to be consulted after decisions have been made; rather, their knowledge, rights, and capacities can be part of environmental management (United Nations Environment, 2021b).

Toward a Human-Centred and Resilient Environmental Governance Framework

The above analysis revealed that today's major problem with environmental governance is not a lack of environmental institutions, scientific information, or international pledges, but rather the continued fragmentation of governance arrangements amid the growing interconnectedness of environmental risks. Environmental decision-making needs to be reorganized to focus on the shared goals of ecological integrity, human well-being, social justice, and long-term resilience within a human-centered, resilient system of environmental governance. This framework should acknowledge the interconnections among climate stability, biodiversity, freshwater, food systems, public health, livelihoods, and economic security as the building blocks of human prosperity. The objective should recognize that "durable human well-being" itself relies on healthy ecological systems, but not at the expense of prioritizing human interests and needs over ecological integrity (United Nations Environment, 2023b).

Integrated risk assessment is a good starting point for a practical framework. Prior to the approval of key policies or infrastructure projects, governments should consider the climate, biodiversity and pollution, water, food, health and socio-economic risks as a single package. The Netherlands offers a good example of the years-long evolution from a policy of river control to a more comprehensive "Room for the River" policy, which includes a range of interventions. The program not only aimed to address the engineering aspects of flooding but also examined river widening, dike relocation, building flood channels, lowering floodplains, and landscape restoration. Over 30 projects were implemented along the Rhine river system that integrate flood protection with spatial planning, ecological rehabilitation, and enhanced landscape resistance. What is important is that this not only protects human settlements against nature but also changes the nature of the relationship between human settlements and natural hydrological processes (United Nations Environment, 2023a).

Resilience based on the ecosystem should be a second pillar. Ecosystems are infrastructure that must be recognized as providing measurable services to society as part of environmental governance. Aesthetic, ecological, social, health, and hydrologic values are enhanced by mangroves, wetlands, forests, floodplains, grasslands, and urban green spaces, which also help mitigate physical risks. This is evident in the restoration of mangroves in coastal areas. Mangrove forests help buffer wave energy, stabilize shorelines, provide nurseries for fisheries, and sequester significant amounts of carbon. Their destruction thus adds a number of social vulnerabilities to the single ecological loss(World Health, 2022).

Conservation spending needs to be more strongly compared to the costs avoided from flooding, loss of livelihoods, ecosystem degradation, and climate adaptation. Another key case is the Costa Rican forest transition. By providing ecosystem services, expanding forests and implementing policies to promote recovery, Costa Rica has transformed itself from having about one-quarter of its land area in forests in the late 1990's to more than half in recent decades. This experience shows that actions for ecosystem restoration can be linked to economic incentives and rural livelihoods, in addition to conservation actions. But the case is also an example of how policy design matters: ecological recovery is enhanced when multiple policy instruments create financial incentives, regulate land use, involve community participation, and strengthen institutional capacity (United Nations Environment, 2024).

Health needs to be part of an eco-centered approach. Experience in London shows how the synergistic role of "integrated" strategies, combining environmental protection with public health, can be useful. The ULEZ was established in central London in 2019 and has since been expanded to other parts of the city, in an attempt to incentivize economic and regulatory measures to reduce transport pollution. Common sense is more significant than specific policies: Environmental interventions should be assessed by their impact on respiratory health, cardiovascular disease, pollutant exposure, mobility, and the quality of urban life. Heat planning, urban vegetation, water security, sanitation and waste management can all be planned and managed in a similar fashion using health parameters as a basis. Integrated governance in the city context should therefore be a key pillar of environmental resilience(United Nations Environment & International Resource, 2024). Cities are home to over half the world's population and account for around 70% of the world's CO2 emissions. Meanwhile, residents of urban areas are at high risk from heat, air pollution, floods, water shortages, and infrastructure disruptions. One example is Singapore where the management of water security is integrated. The country's “Four National Taps” water strategy involves local catchment water, imported water, highly treated reclaimed water (NEWater), and desalination. Singapore has embarked on diversifying its water sources and integrating water infrastructure into urban planning to reduce reliance on any single water source. The case illustrates the value of diversification, investing in technology, managing demand, and long-term planning at the institutional level, which can help strengthen resilience (United Nations World Water Assessment, 2024).

Social justice and just transition should also be included within the framework. Vulnerable communities can not only be systematically exposed to environmental hazards but also disproportionately affected by the costs of environmental reform if environmental governance is to be viewed as resilient. If environmental governance is to be viewed as resilient, vulnerable communities can not only be systematically exposed to environmental hazards but also disproportionately affected by the costs of environmental reform. Bangladesh is a good example of adaptation-oriented governance. The cyclone preparedness system in the country has matured to a very high level, including cyclone forecasts, cyclone shelters, cyclone early warning committees, and volunteer networks in the communities(Watson et al., 2021). A sharp drop in cyclone death tolls over the past few decades reveals that, besides the intensity of the hazard, society's vulnerability also depends on the extent of its institutional preparedness for the hazard, its communication, infrastructure, and community participation. This is an important sign of the lessons learned in environmental governance: Resilience is both a social and institutional capacity and an ecological and technological attribute. Multi-level and participatory governance is another requirement. The national government plays a key role in legislation, funding, and international agreements, but implementation is often carried out at the provincial, regional, municipal, and community levels. Environmental governance should, therefore, identify clear accountability at various levels and coordinate vertically (World Health, 2021).

Conclusion

The climate crisis and the current environmental crisis show that the challenges of climate change, biodiversity loss, ecosystem degradation, pollution, water insecurity, food-system instability and risks for human health can't be effectively managed as individual policy issues. While the climate–nature nexus has been a good catalyst for understanding the relationships between climate stability and ecological integrity, a more comprehensive conceptual and institutional framework is needed, as shown by the analysis presented here. Environmental pressures are now acting through multiple pathways, with ecological shocks and stresses affecting human health, living standards, livelihoods, social safety, and well-being. As a result, the focus on environmental protection is no longer enough; today there is a need to change governance systems that are fragmented, and the risks they must deal with are increasingly systemic. The findings presented in this paper suggest that institutional fragmentation, policy silos, conflicting policy agendas, transboundary threats, lack of accountability, limited participation, and a short-term orientation continue to hinder effective environmental governance. Meanwhile, case studies from the Netherlands, Costa Rica, Singapore, Bangladesh and London illustrate the ability to link ecological protection to flood resilience, water security, forest restoration, public health, disaster preparedness and enhanced quality of life through an integrated approach. All these cases demonstrate that more effective environmental governance is achieved when ecological processes, social vulnerability, economic conditions, and institutional capacity are taken together. A human-centered approach does not mean 'putting humans before Nature', but rather that the health and wellbeing of humans is intrinsically linked to a healthy and stable Earth system and functioning ecosystems. The principles of ecological integrity, resilience, justice, participation, policy coherence, and adaptive capacity are thus a basis for future governance. Climate mitigation, biodiversity conservation, ecosystem services restoration, pollution reduction, health protection, and livelihood security must be pursued in collaboration as goals, not just as administrative tasks. In the end, the paradigm shift from climate–nature to integrated socio-ecological governance is needed to go beyond the climate–nature nexus. This shift would allow governments to foresee and assess compound risks, make inevitable compromises, better allocate environmental benefits and costs, and create societies that can remain healthy, secure and resilient in dynamic, rapidly changing environments.

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