Für Mensch und Umwelt

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The interconnected challenges of climate change, biodiversity loss and environmental pollution

Drivers, interdependencies and impacts of the triple planetary crisis

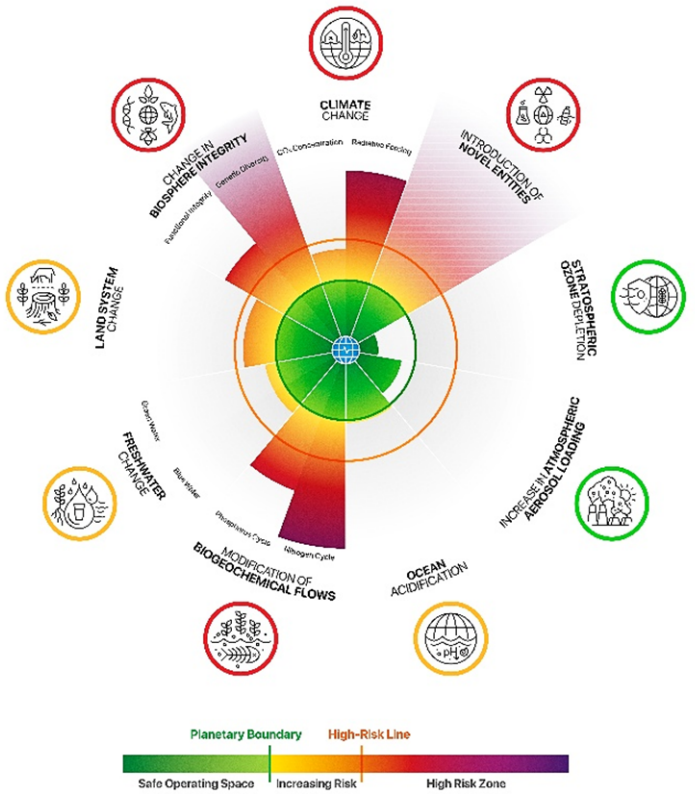
The environmental crises of climate change, biodiversity loss, and environmental pollution now constitute a systemically interlinked "triple planetary crisis". It is driven by overlapping socio-economic dynamics, including increasing extraction and processing of resources (fossil fuels, minerals, biomass), production and consumption, and underlying structural inequalities. The impacts of the crisis are cumulative and mutually reinforcing, particularly across food, water, and health systems. Marginalized groups, i.a. Indigenous groups, youth, people in poverty and SIDS, bear disproportionate burdens of while often having the least power to influence outcomes. Despite growing recognition of the need for integration, research and policy remain fragmented.

The intertwined causes of the triple crisis

Planetary boundaries & systemic risks

The transgression of Earth system boundaries and the escalation of the triple planetary crisis reveal deep systemic failures within human societies. Seven of the nine planetary boundaries are currently being transgressed. Ocean acidification breached the safe operating space for the first time in 2025. Crossing boundaries raises the likelihood of ecological and societal tipping points, with local effects propagating globally via social, economic and environmental teleconnections.

Figure 1: The status of the nine Planetary Boundaries as of 2025



Source: Potsdam Institute for Climate Impact Research (Sakschewski et al., 2025)

Direct and indirect drivers of the triple planetary crisis

The triple planetary crisis is propelled by both indirect and direct drivers. **Indirect drivers** encompass broad societal factors - such as economic, demographic, cultural, and technological change - that shape the context for environmental change. Among these, the increasing global interconnectedness of material and informational flows is one important amplifier, accelerating the spread and interaction of environmental risks across sectors and regions. Indirect drivers influence the scale and nature of **direct human activities** like resource extraction, overproduction, overconsumption, land-use change, wildlife exploitation and emissions, which ultimately give rise to pollution, biodiversity loss, and climate change.

Underpinning these trends are **deep-seated structural causes**, including widespread disconnection from and domination over both nature and marginalized people, the concentration of power and wealth, and the prioritization of short-term, individual, and material gains.

Table 1: Multi-level drivers and cascading impacts of the triple planetary crisis

Level	Driver / Sector	Effects	Impacts
Structural	Disconnection from nature, concentration of power/wealth concentration; focus on short-term economic gains, colonial legacies	Perpetuates exploitation and structural inequalities; undermines transformative change	Unequal exposure; MAPA have least influence
Indirect	Economic, demographic, cultural, technological change; global interconnectedness of material/information flows	Shapes scale and nature of direct activities; accelerates spread and interaction of risks	Cross-regional teleconnections; compounding risks and cascading effects
Direct	Land-use change (deforestation, agriculture, mining, infrastructure)	Reduces carbon sinks; fragments habitats	GHG emissions, biodiversity loss.
	Resource extraction (fossil fuels, minerals, biomass)	Fuels emissions; drives land/water pressures	GHG emissions; pollution; habitat fragmentation
	GHG emissions (energy, industry, agriculture)	Primary driver of global warming	Extreme weather events; sea-level rise
	Pollution (chemicals, nutrients, plastics)	Degrades soil quality and ecosystems	About 9 million deaths/yr; soil fertility loss.
	Wildlife exploitation	Increases human–wildlife contact	Zoonotic spillover risk
	Plastic production	Emissions across life-cycle; alters cycles; microplastics in cryosphere and soils	Climate forcing; ecosystem impacts; human exposure

List is not exhaustive. Source: own illustration, Ecologic Institute, based on Knoblauch et al. (2025).

Sectoral amplifiers: the role of energy, agriculture and construction sectors

- **Energy**: Fossil fuel extraction and combustion accounts for about three-quarters of global CO_2 emissions; extraction and use also drive land-use change, habitat fragmentation and chemical pollution.
- **Agriculture & forestry:** Responsible for over 90% of biodiversity loss and water stress caused by land use; about 12.5 million tonnes of plastics were used in agriculture in 2019, with micro- and nanoplastics undermining soil structure, biodiversity, nutrient cycling and carbon sequestration.
- **Construction:** The built environment accounts for almost 40% of global energy and process-related CO_2 emissions and generates significant material and waste flows that intensify biodiversity loss and pollution.

Table 2: Cross-sectoral drivers of the triple planetary crisis

Driver	Climate Change	Biodiversity Loss	Pollution
Agriculture & land-use change	CO_2, CH_4 (Methane) emissions from deforestation, livestock production and N_2O from fertilisation	Habitat conversion, species loss, e.g. through overfishing	Fertilizer run-off, pesticides
Fossil fuel extraction & combustion	Responsible for ¾ of global CO_2 emissions and resulting global warming	Infrastructure expansion leads to habitat fragmentation and loss	Air pollution, heavy metals
Industrial production	High energy demand leads to significant GHG emissions	Habitat degradation through land conversion, industrial expansion, and unsustainable extraction reduces ecosystem capacity	Chemical waste

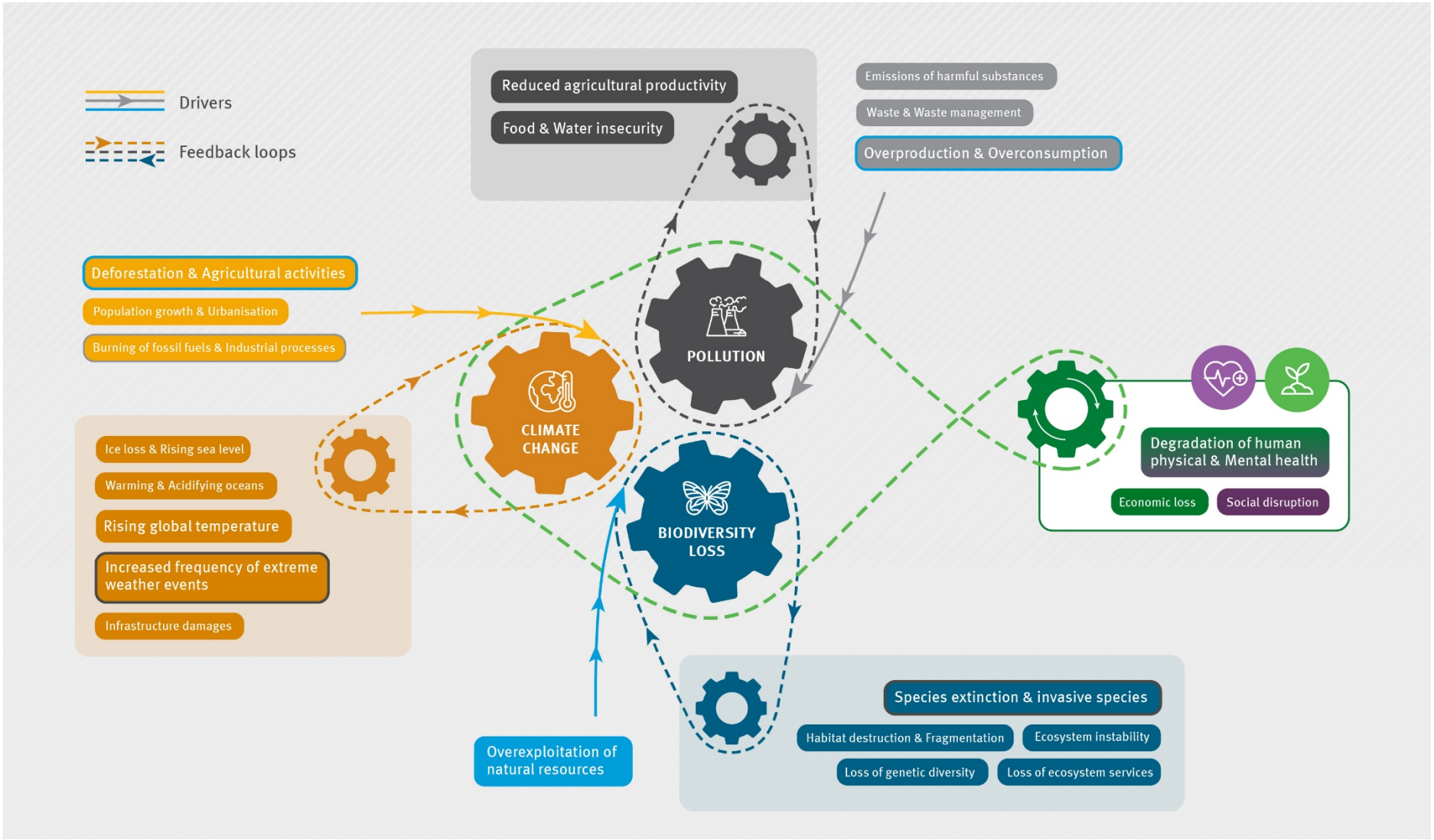
List is not exhaustive. Source: own illustration, Ecologic Institute, based on Knoblauch et al. (2025).

Feedback loops between the three crises

The triple planetary crisis is shaped by powerful feedback loops, where one disturbance fuels further disruptions across natural and human systems. These interactions can create cascading effects, in which climate change, biodiversity loss, and pollution trigger chains of secondary impacts that amplify the original problem. When multiple stressors interact simultaneously, they lead to compounding risks, making the combined impacts on ecosystems and societies more severe and complex than each crisis alone.

Rising temperatures, shifting rainfall, and extreme weather events destabilize access to **water, energy, and food**, intensifying scarcity and competition. At the same time, meeting growing demand through fossil fuel extraction, intensive farming, or desalination increases emissions and environmental damage, further driving climate change, biodiversity loss and pollution. Air and water pollutants from energy systems add further pressure by harming species, degrading ecosystems, and undermining food security.

Figure 2: Drivers and feedback loops of the triple planetary crisis



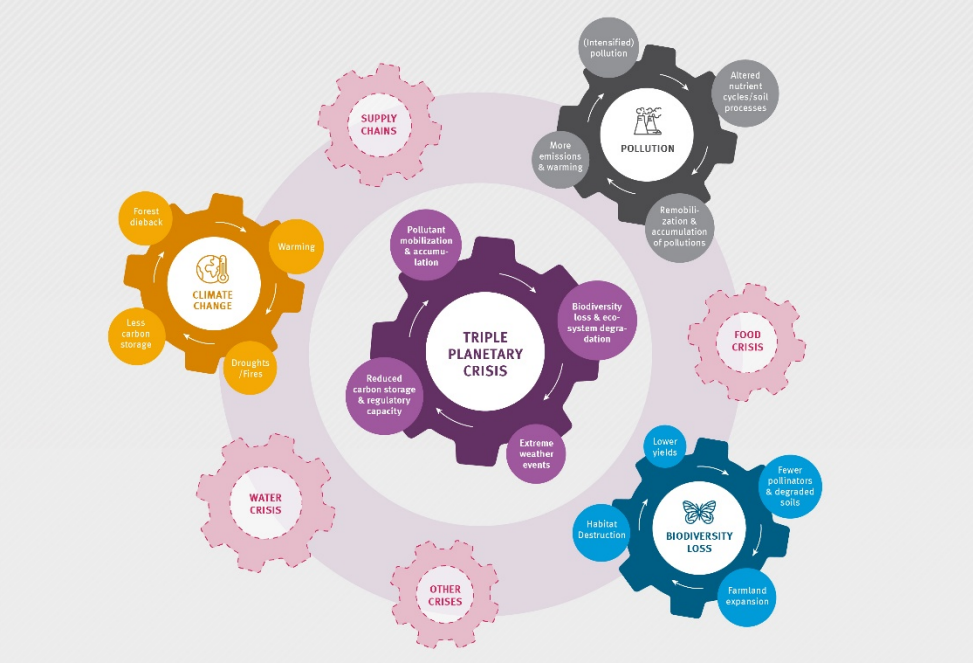
This infographic is illustrative and does not capture the full complexity and interconnectedness of the crises and their impacts. Source: Own illustration, Ecologic Institute.

Table 3: Cross-sectoral impacts of the triple planetary crisis

	Impacts			
Sector	**Climate**	**Biodiversity**	**Pollution**	**Compound risk**
Agrifood	Droughts, yield loss	Pollinator decline, soil degradation	Run-off, plastics	Food insecurity
Water	Scarcity, floods	Wetland loss	Contamination, eutrophication	Unsafe supplies
Health	Heatwaves, disease spread	Loss of regulation	Air & water pollution	Chronic disease & antimicrobial resistance
Ecosystems	Forest dieback, bleaching	Species extinction	Persistent pollutants	Collapse of services

Source: Own illustration, Ecologic Institute, based on Knoblauch et al. (2025).

Figure 3: Feedback loops reinforcing the triple planetary crisis



Source: Own illustration, based on Knoblauch et al. (2025).

Impacts on human health and ecosystem health

Ecosystem health

Pollution and co-stressors are degrading soils and undermining microbial diversity, carbon/nitrogen/phosphorus cycling and water movement, reducing fertility and plant productivity, intensifying biodiversity loss and increasing GHG emissions. As contaminants accumulate, self-regulation declines, heightening vulnerability to additional pressures.

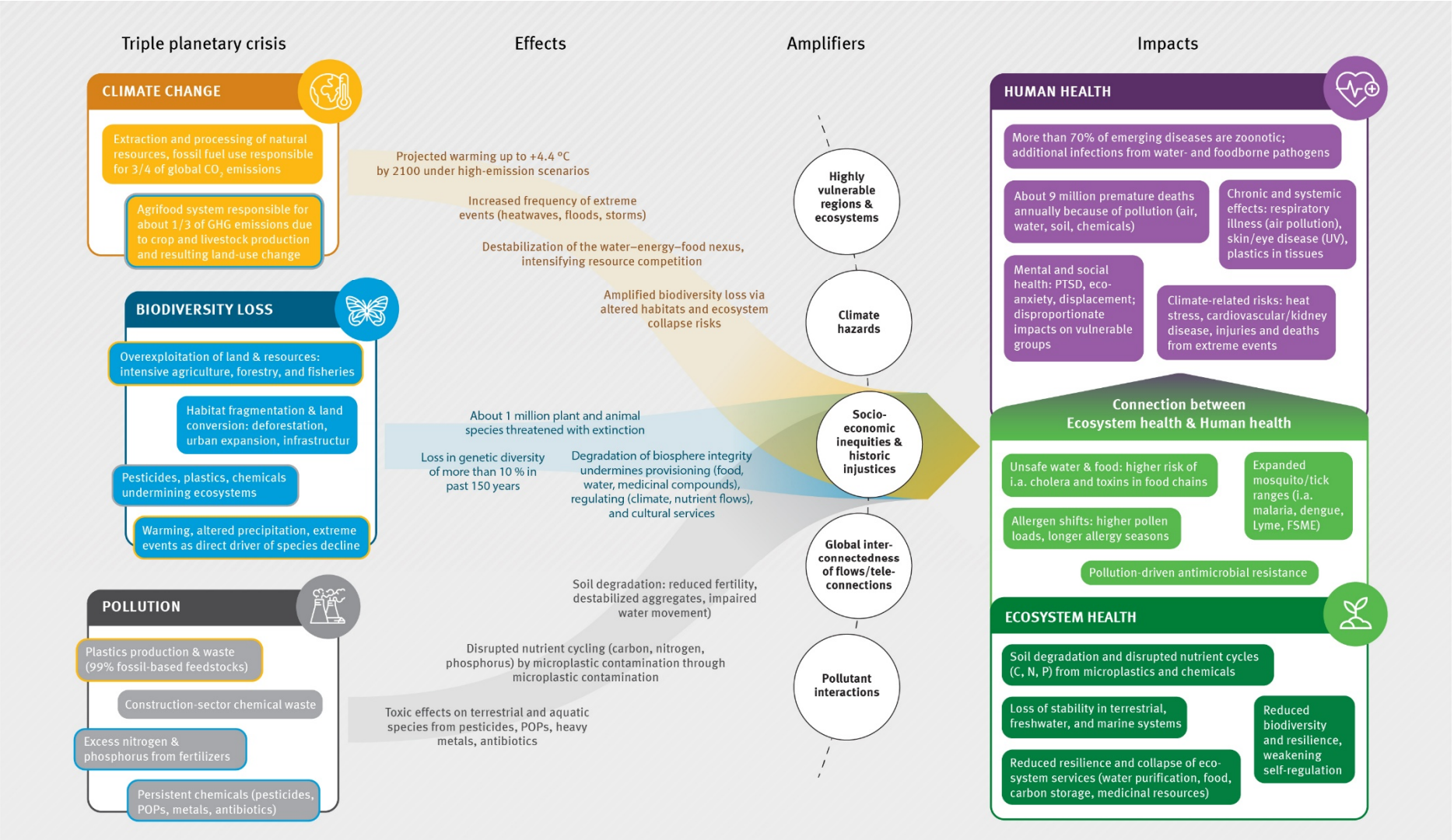
- Microplastics change C/N/P cycling and soil structure; microbes decline.
- Self-regulation drops; soils filter less; plants produce less.
- GHG emissions rise from degraded soils; biodiversity loss accelerates.

Human health

Disrupted ecosystem services and exposure to contaminants elevate disease risk. Climate change and pollution raise disease burdens. Biodiversity loss increases spillover risks of diseases with animal origin.

- Climate hazards (heatwaves, floods, storms) increase mortality, damage health infrastructure and disrupt care. WHO estimates around 250,000 additional deaths per year (2030–2050) from malnutrition, malaria, diarrhoeal disease and heat stress, mostly on the African continent, wider climate-sensitive deaths are not included in that figure.
- Pollution (air, water, soil) is linked to about 9 million premature deaths annually. Plastics are detected across food webs, drinking water and human tissues, such as breast milk, placenta, lungs and blood. Climate change expands vector ranges and intensifies water-/food-borne diseases and air-quality impacts; mental health burdens also rise.
- Over 70% of emerging diseases, and almost all pandemics, originate in microbes of animal origin, often linked to intensified human–wildlife contact caused by land use change and ecosystem disturbance.
- Climate change expands the range and activity of vectors such as mosquitoes and ticks, while biodiversity loss weakens natural disease regulation, increasing spillover risks.
- Extreme weather and rising temperatures heighten water- and food-borne illness and worsen air quality, while pollutants accelerate pathogen resistance and alter immune responses, compounding infectious disease threats.

Figure 4: Impacts of the triple planetary crisis on human and ecosystem health



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Inequalities compound risks of the triple crisis

Disparities in exposure, adaptive capacity and access to infrastructure/healthcare leads to Most Affected People and Areas (MAPA) shouldering disproportionate burdens, often in contexts of under-resourced systems and historic marginalization. Intersecting vulnerabilities, such as gender, ethnicity, income, disability, age and colonial legacies amplify impacts of the triple crisis.

MAPA in scientific literature

Indigenous Peoples are the most frequently mentioned MAPA group and are highlighted both as vulnerable and as holders of crucial knowledge. Other MAPA groups (youth, racialized communities, people living in urban informal settlements, disabled persons, people in poverty) are much less visible; MAPA regions referenced most often include arid/semi-arid areas, coastal regions and SIDS, with the Global South frequently noted. This visibility gap raises questions about whose vulnerability is considered in research and governance.

Lessons learnt

- **The triple planetary crisis requires systemic, integrated and cross-sectoral responses:** Climate change, biodiversity loss, and pollution interact and reinforce each other, so siloed approaches risk inefficiency and unintended negative consequences. Cross-sectoral coordination and anticipatory governance are crucial to address the complexity of these interconnections,
- **Impacts and vulnerabilities are deeply unequal and layered:** Policy blind spots persist when marginalized groups are not adequately included in research and governance.
- **Equity and justice must guide solutions:** Technological, sectoral, and policy innovations must be explicitly aligned with distributive justice and inclusion; otherwise, they risk reinforcing marginalization and losing legitimacy and effectiveness.
- **Integrated responses must be managed well:** The most effective responses are those that remain understandable, garner political support, and are feasible to implement at reasonable cost.

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