

ANIL AGARWAL DIALOGUE 2026

Breaching the Biophysical Ceiling: Navigating Climate Change and Planetary Boundaries in the Anthropocene



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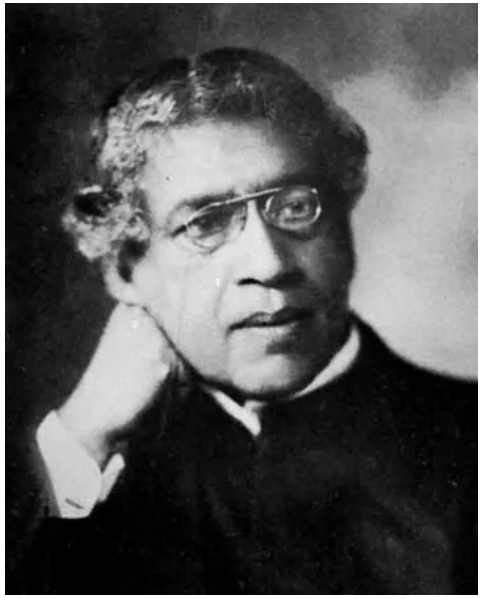
Who really knows, and who can swear,
How creation came, when or where!
Even gods came after creation's day,
Who really knows, who can truly say
When and how did creation start?
Did he will it? Or did he not?
Only 'He', up there, knows, may be;
Or perhaps, not even 'He'.

- Rig Veda 10:129

“The true laboratory is the mind, where behind illusions we uncover the laws of truth”



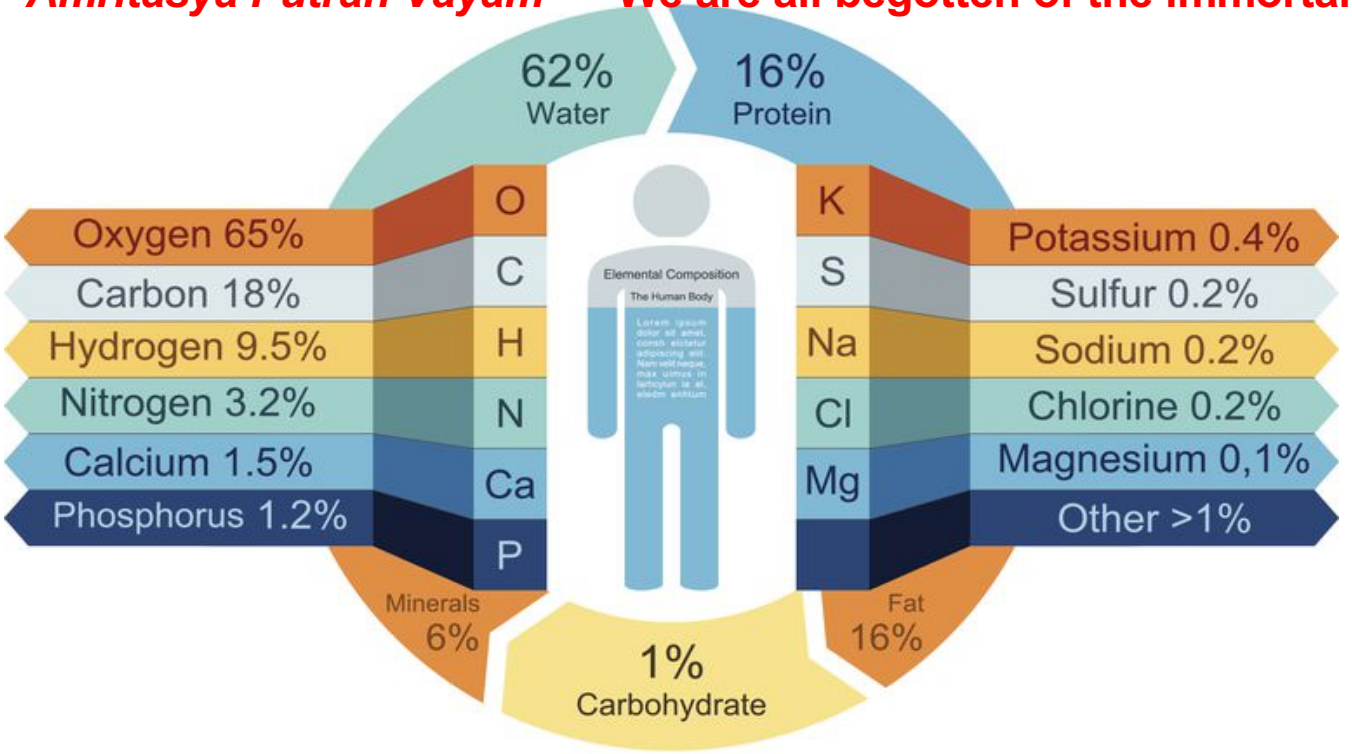
In his letter to Tagore, dated 30th August, 1901, Bose wrote:

There is a great gap between the living and the non-living, and I was experimenting on the responses on plants to make a connection between the two. Just now I got the amazing results; Same, Same, all are the Same!

I am alive with the life force of the mother Earth. J.C. Bose

THE HUMAN BODY

'Amritasya Putrah Vayam' - "We are all begotten of the immortal."



ELEMENTAL COMPOSITION

Getty Images

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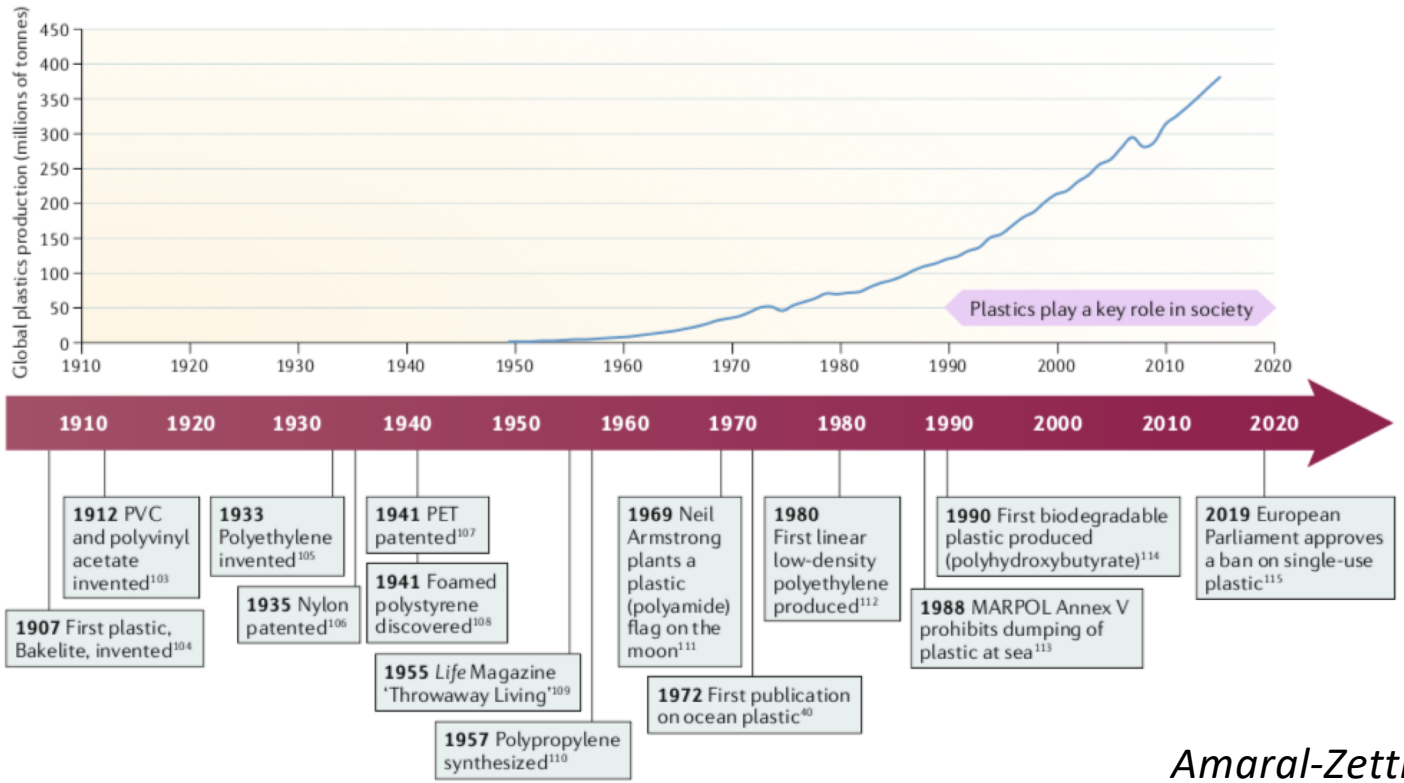
. . . the whole world can be plasticized, and even life itself. —*Roland Barthes*



Amaral-Zettler et al., 2021

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Classifying the Cataclysm

APOCALYPTICISM



The expectation that the world as we know it will end through a cataclysm. A definitive stop.

MILLENNIALISM



The expectation that a divine agent will end the existing world due to human moral failing, specifically to usher in a new, better world.

Millennialism offers **hope**. It assumes the destruction is a cleansing fire.
The question for the modern age: Does science offer this same **hope**?

The Scientific Apocalypse.

Traditional Millennialism	Eco-Apocalypticism
Agent: God	**Agent:** Biology / Physics
Cause: Moral failing	**Cause:** Ecological overshoot
Outcome: Salvation	**Outcome:** Potential collapse

A Timeline of Inaction.

1972 Stockholm (UNCHE)
Introduced "sustainable development".

1987 Brundtland Report
Called for urgent action.

1992 Rio Earth Summit
Agenda 21 adopted. Result: **Anemic action.**

2002 Johannesburg
Failed to secure commitments. Despair among activists.

2012 Rio+20
Popularly known as an "**abject failure**".

SUMMARY:

The UN reports are consensus-driven and conservative ("erring on the side of least drama"), yet even they document a trajectory of **erosion**.

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The Paralysis of Will

Why the species ignores its own science



Religious Fatalism

Belief that a divine being controls the system makes it difficult to believe humans can destroy it.



The Distraction Economy

The pressing demands of survival combined with the distractions of eros and consumer culture.



Active Deception

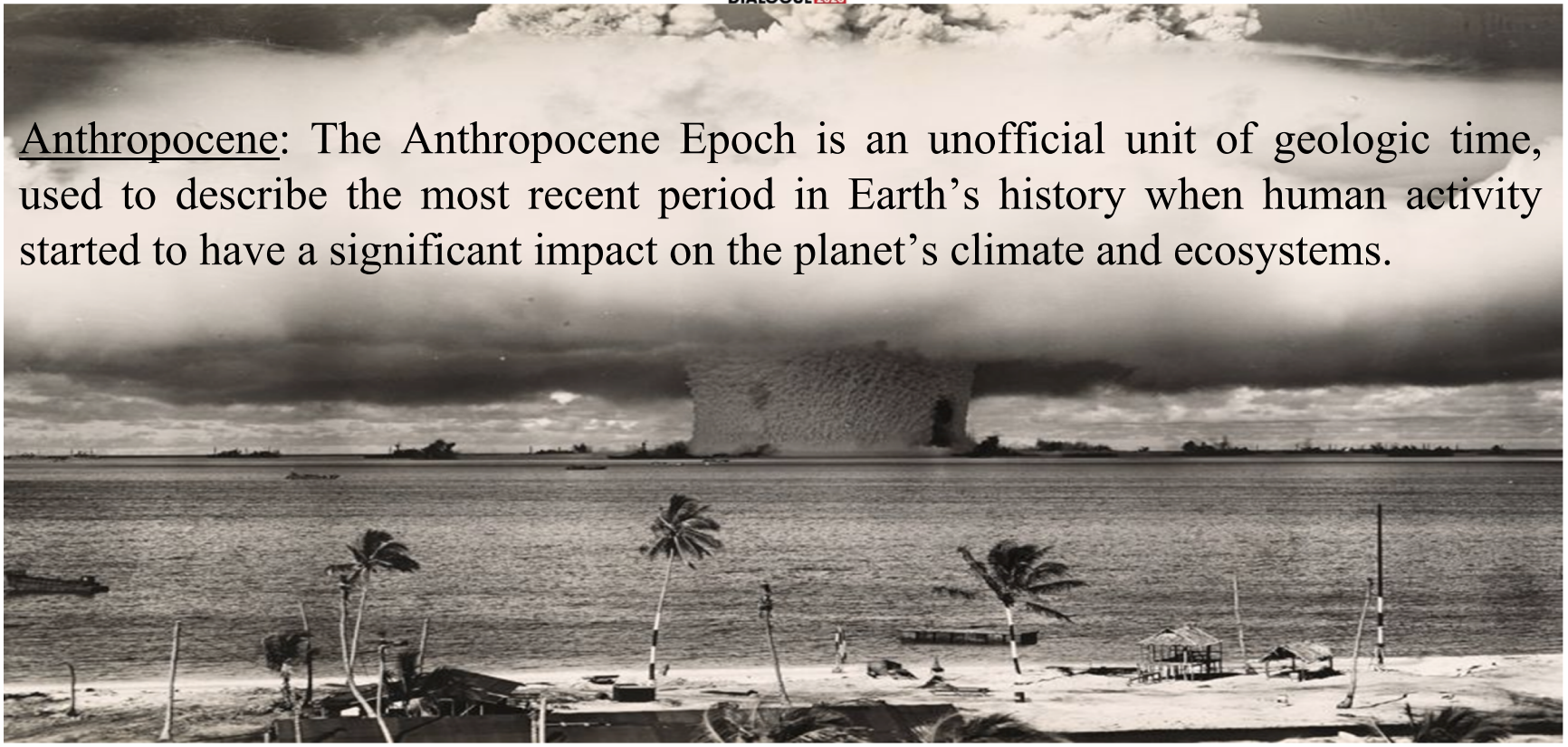
Promulgated by those whose privileges would be reduced by sustainability.



Growth Ideology

The deeply held belief that human well-being depends on increasing economic growth.

Anthropocene: The Anthropocene Epoch is an unofficial unit of geologic time, used to describe the most recent period in Earth's history when human activity started to have a significant impact on the planet's climate and ecosystems.



What is Anthropocene?

Quaternary Period with the Anthropocene Epoch

Eonothem/ Eon	Erathem/ Era	System/ Period	Series/ Epoch	Stage/ Age	millions of years ago
Phanerozoic	Cenozoic	Quaternary	Anthropocene[1]		1950 CE
			Holocene		0.0117
			Pleistocene	Upper	0.126
				Middle	0.781
				Calabrian	1.806
				Gelasian	2.588

[1] In August 2016 the Anthropocene Working Group (AWG), a special body created within the International Commission on Stratigraphy (ICS), recommended that the Anthropocene Epoch be made a formal interval within the International Chronostratigraphic Chart. The AWG recommended that the year 1950 be used as the starting point of the Anthropocene Epoch.

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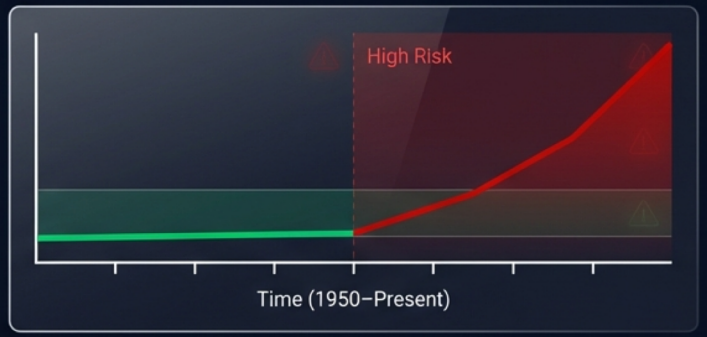
We have left the stability of the Holocene.

The Baseline: Holocene (Last 12,000 Years)



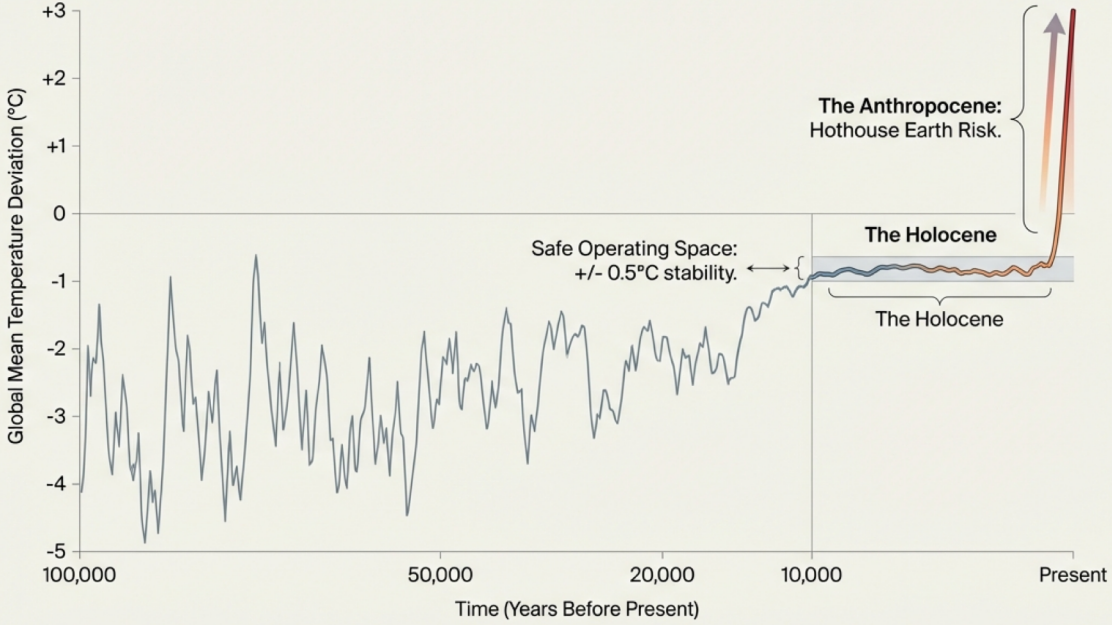
Stable conditions allowed for the rise of agriculture, cities, and civilization. Earth's systems were resilient and self-regulating.

The Shift: Anthropocene (1950–Present)



The Great Acceleration. Human activity is now the dominant force of change, pushing Earth systems into volatility.

The Holocene is the only state we know can support us.



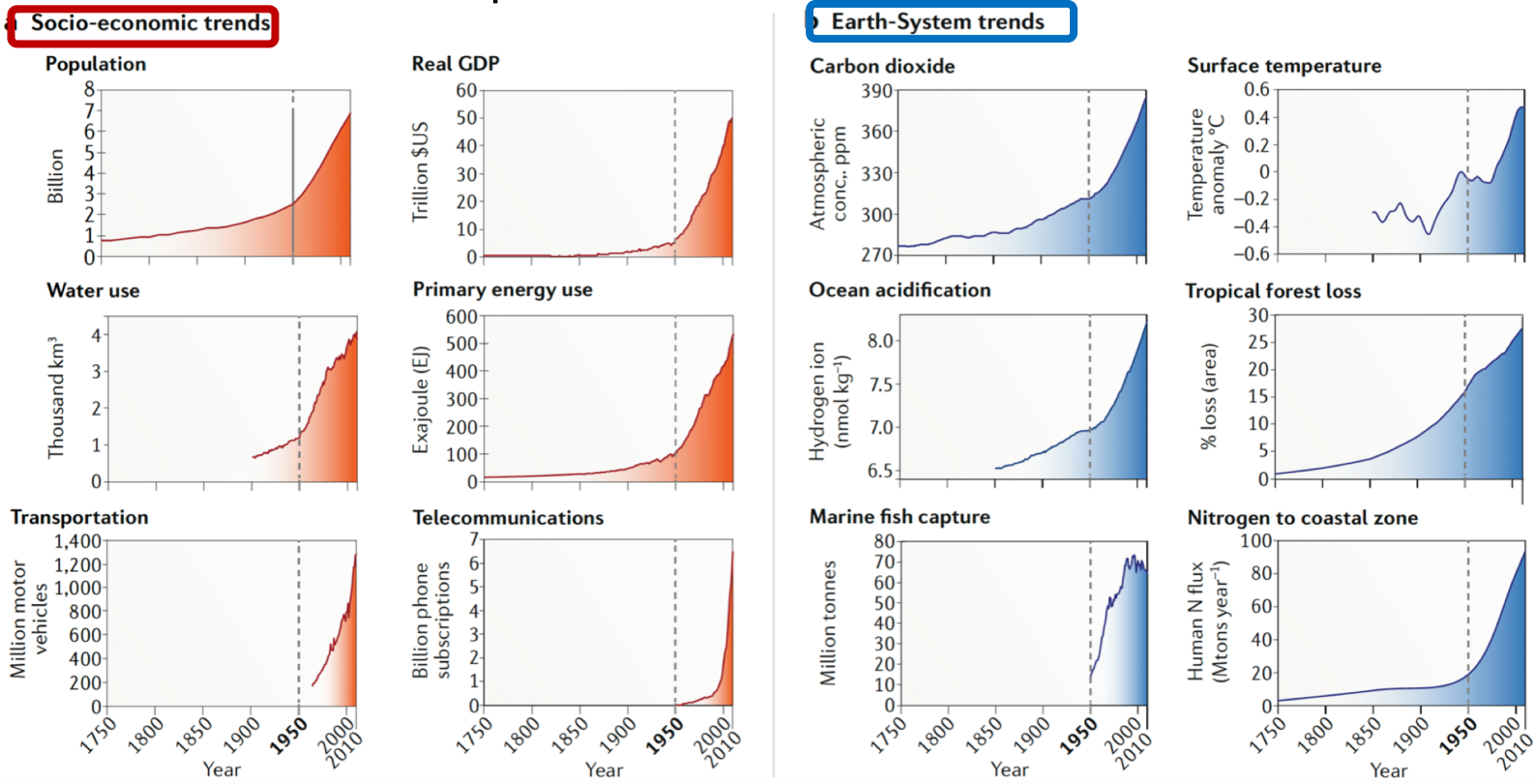
For ~10,000 years, Earth's systems oscillated within narrow limits, allowing agriculture and civilization to emerge.

We have now exited this state.

As Rockström et al. (2024) state: "The reference for a habitable planet is set to the only geological epoch known (for certain) to be able to support civilization establishment... the Holocene."

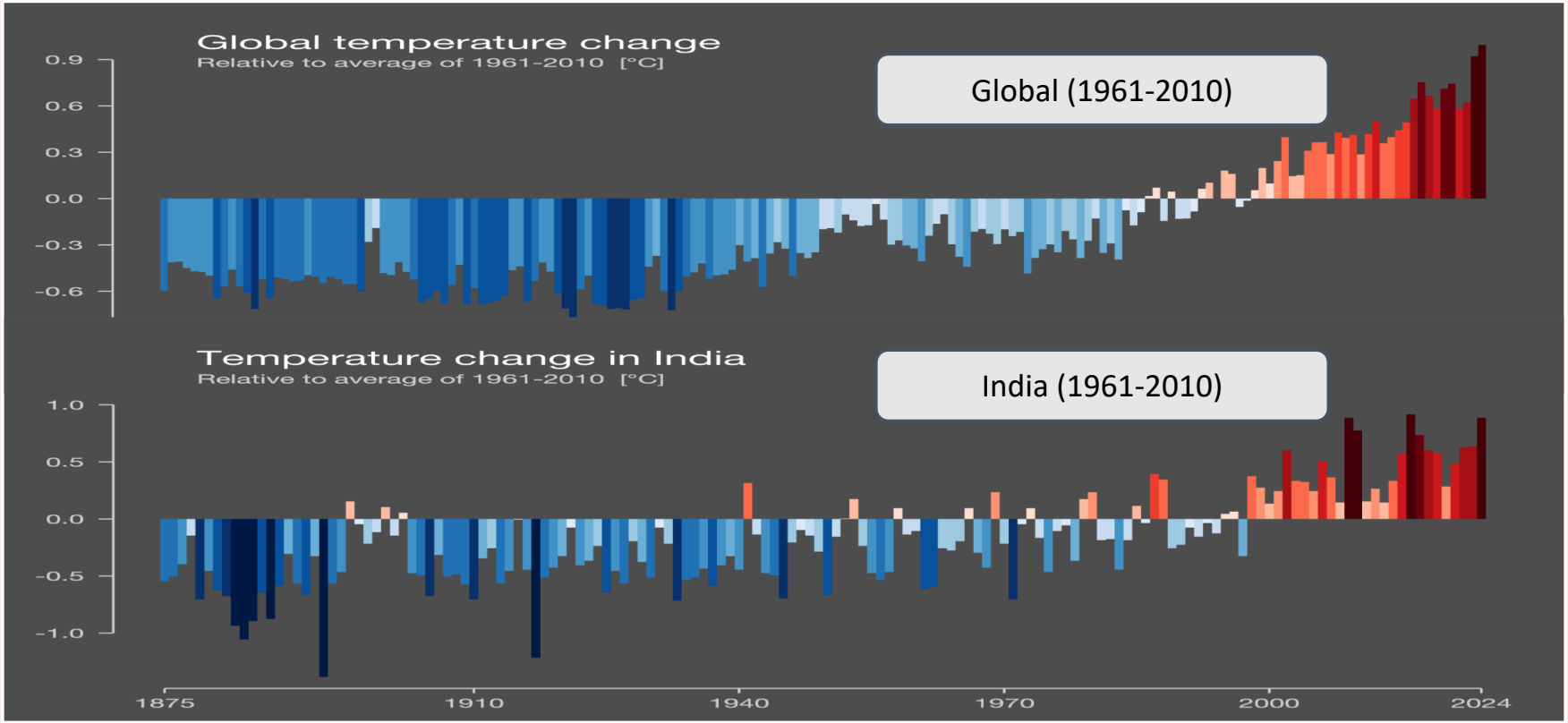
NotebookLM

Characteristics of Anthropocene



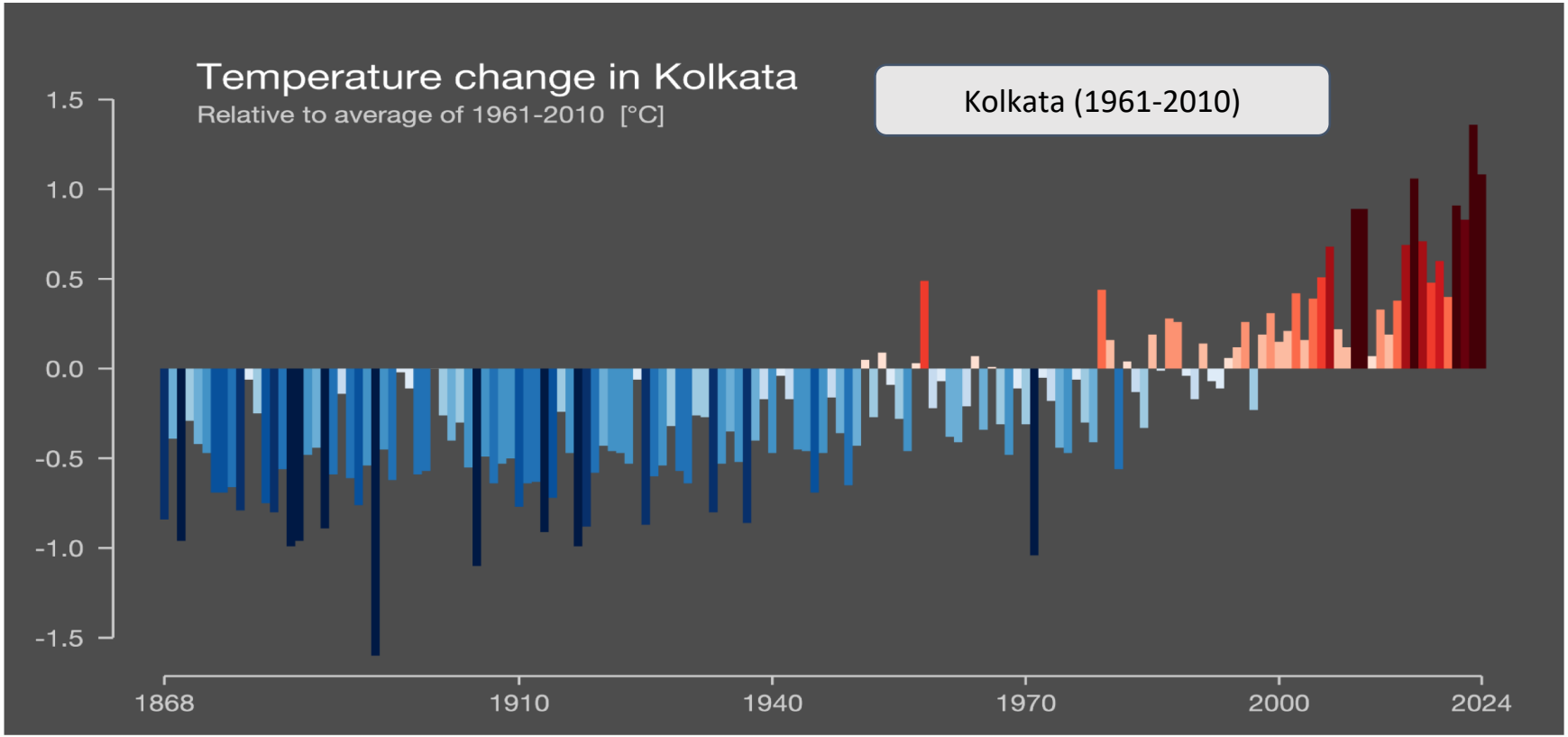
Source: Steffen et al. (2015)

In climate?



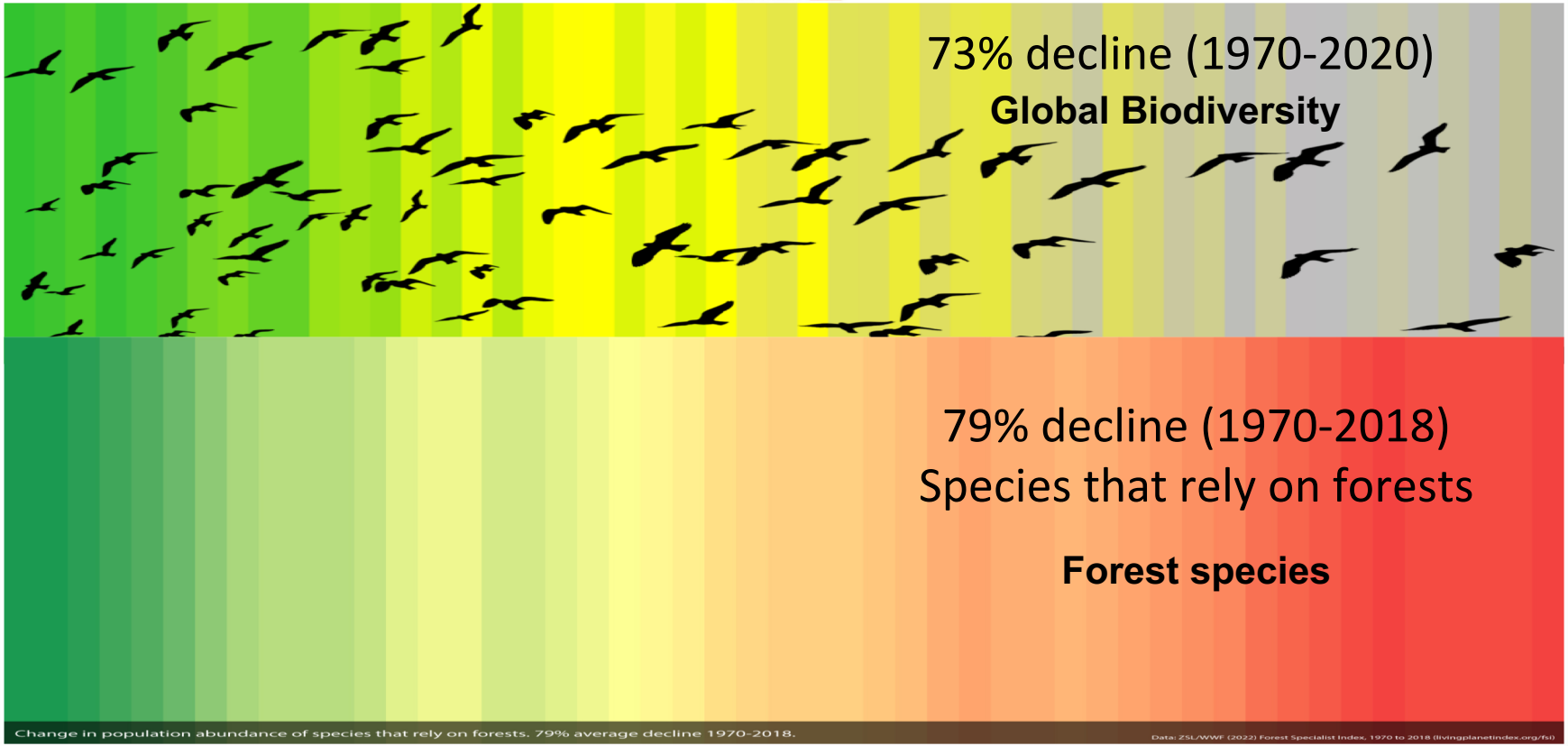
Source: ClimateStripes (2026)

In climate?



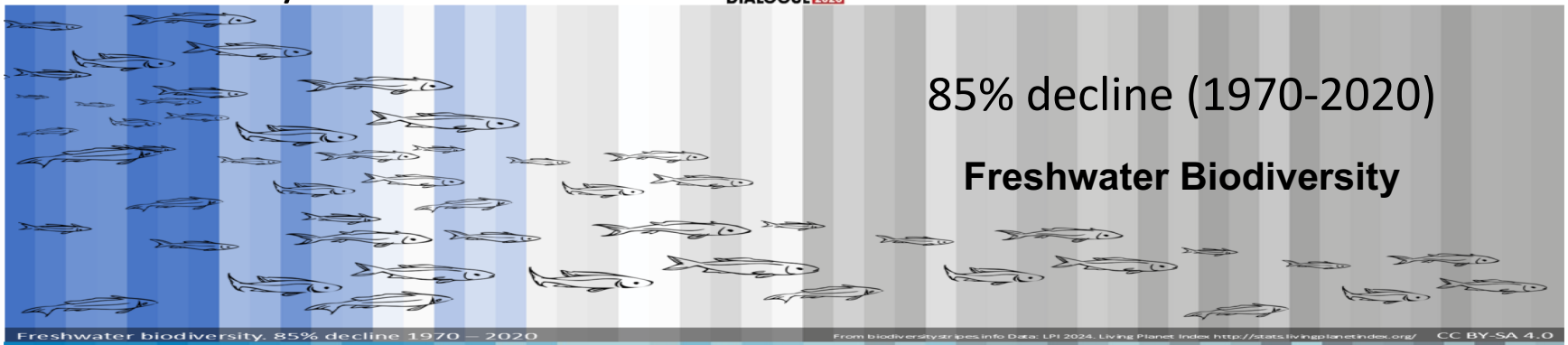
Source: ClimateStripes (2026)

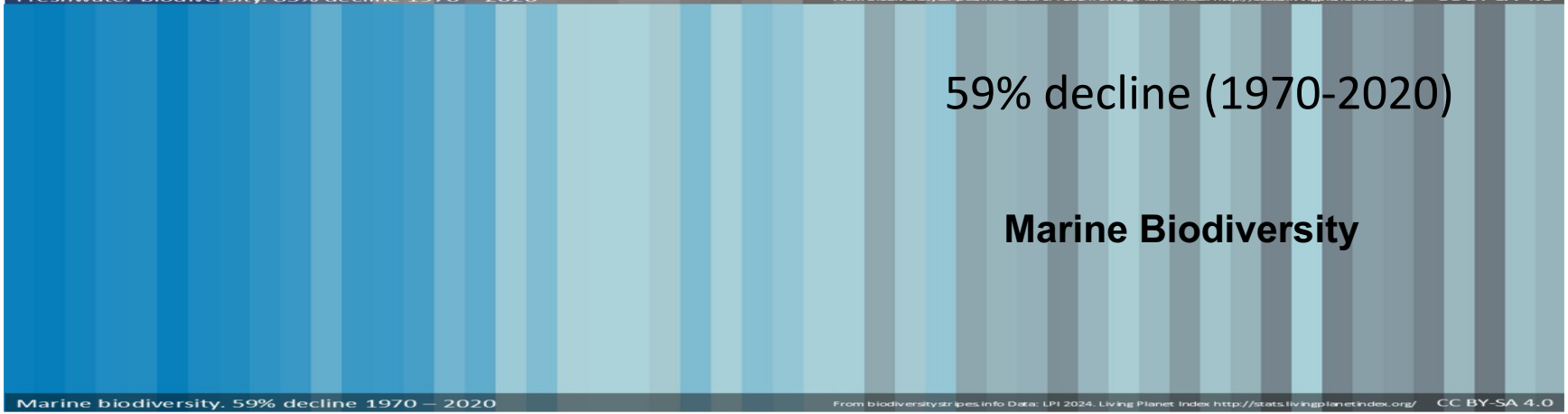
In biodiversity?



Source: BiodiversityStripes (2026)

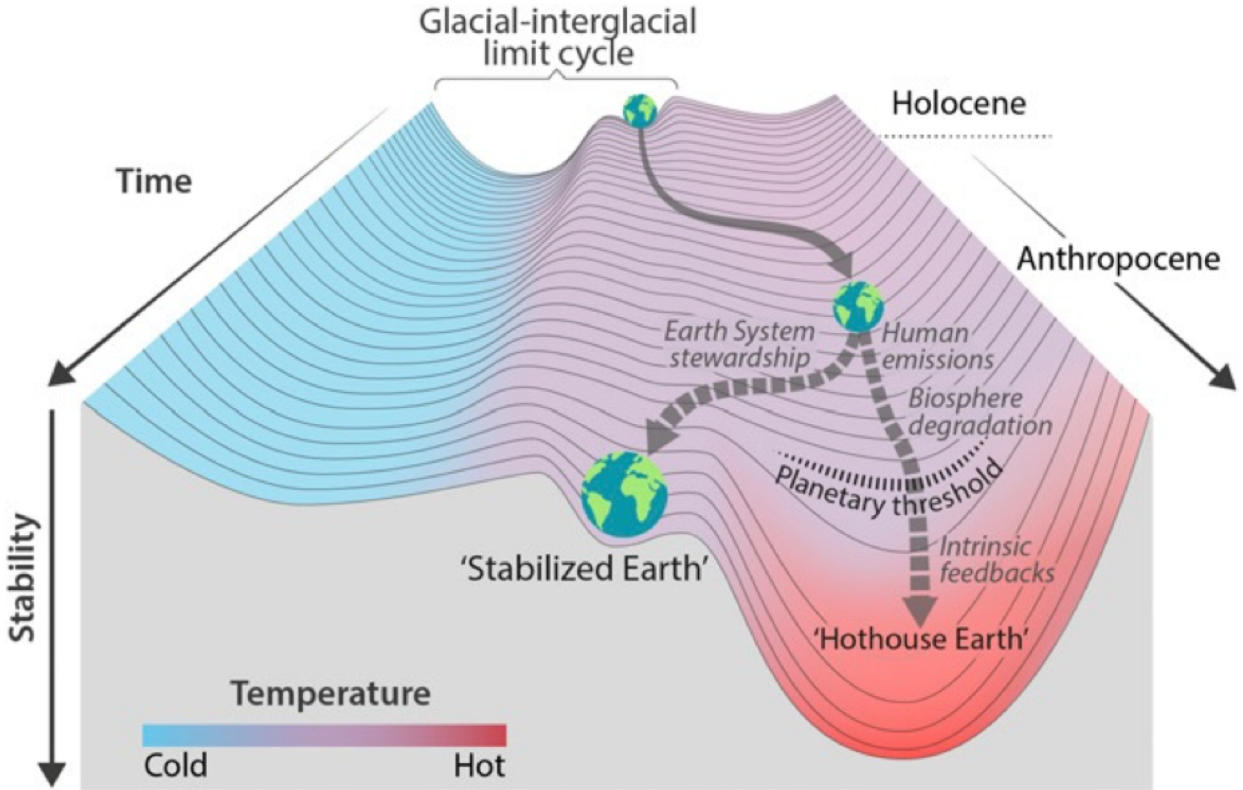
In biodiversity?





Source: BiodiversityStripes (2026)

‘Hothouse’ Earth



Source: Steffen et al. (2018)

What are Planetary Boundaries?

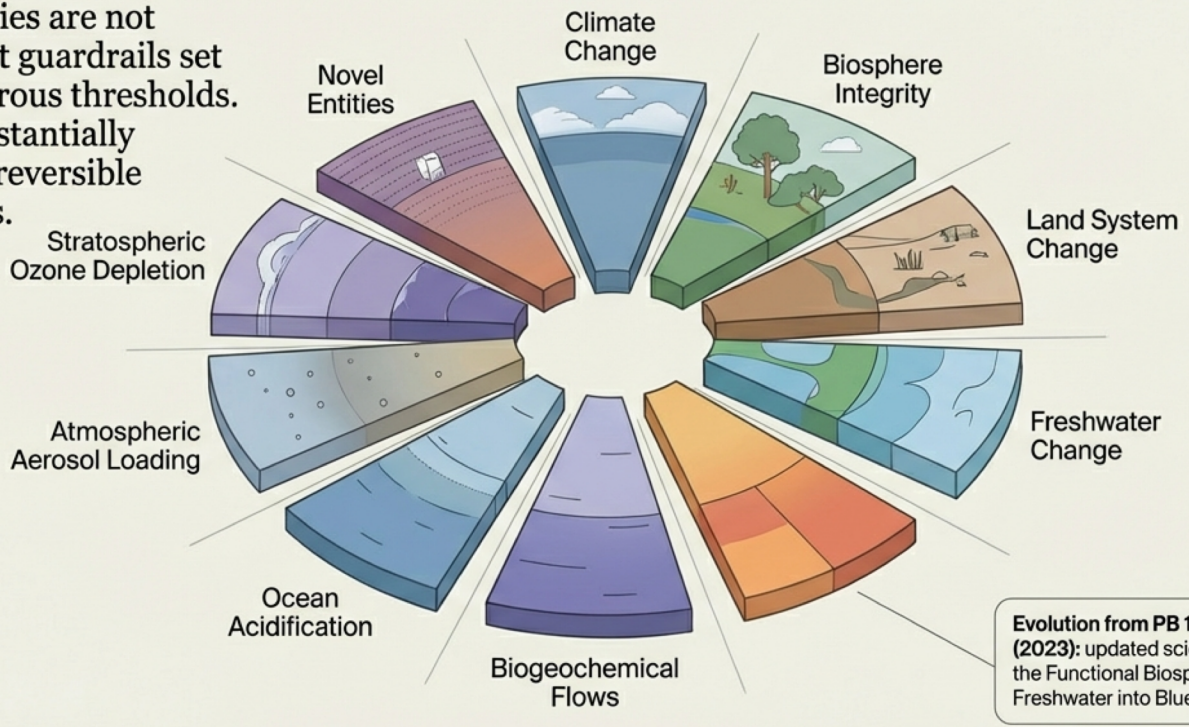


9 Categories of the planetary boundaries

Climate change	CO_2 concentration, energy balance between Earth and space
Atmospheric aerosol loading	The amount of air pollutants
Stratospheric ozone depletion	Stratospheric ozone concentration
Ocean acidification	Carbonate ion concentration in the ocean
Freshwater change	Amount of water available for human and plants
Land use change	Size of forest area
Biosphere integrity	Percentage of functional diversity, speed of extinction
Biogeochemical flows	Outflow of nitrogen and phospherus in synthesized fertilizers
Novel entities	Includes pollution caused by compounds such as plastics

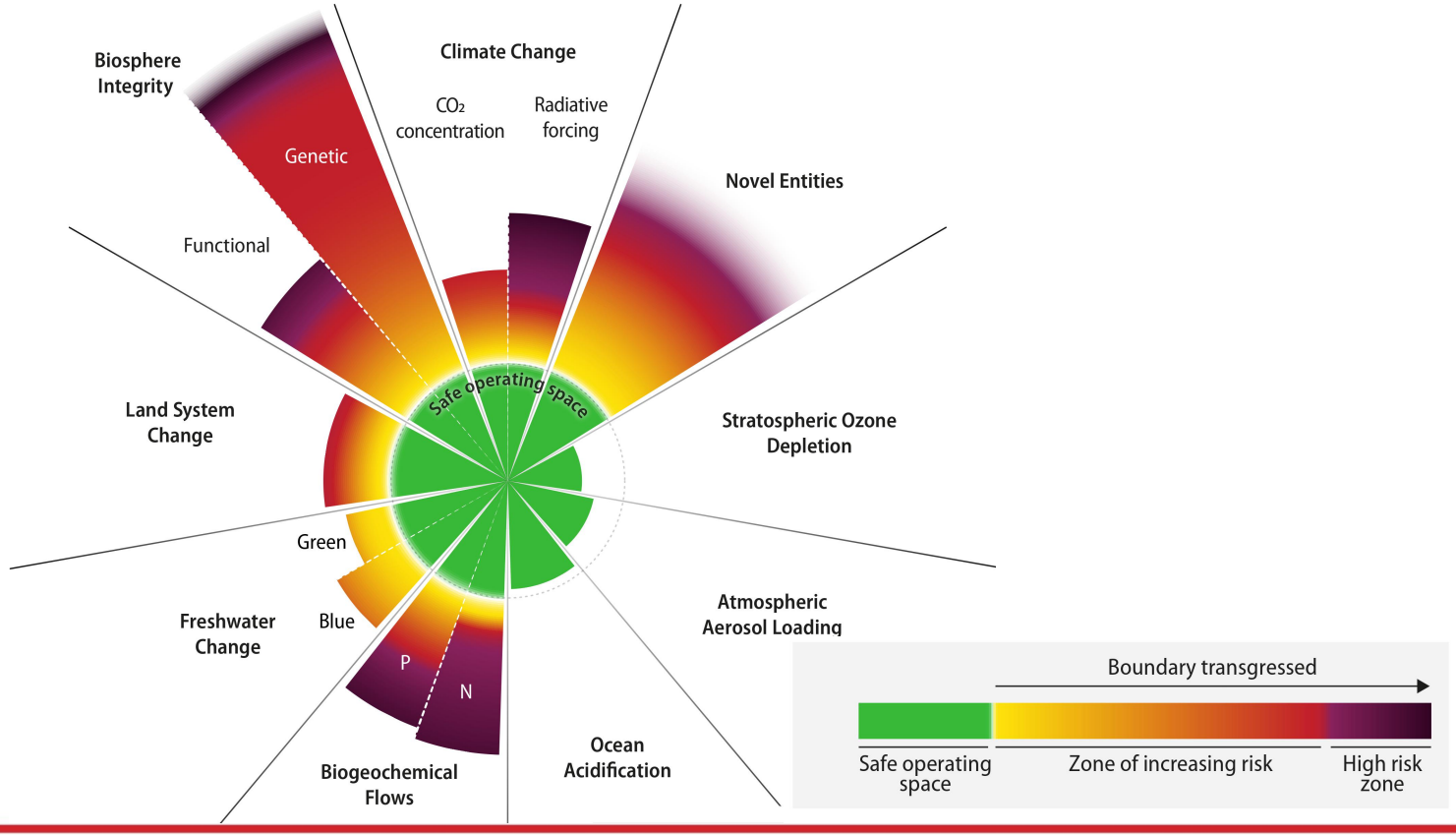
Nine processes regulate the stability of the Earth System.

Planetary Boundaries are not cliffs we fall off, but guardrails set upstream of dangerous thresholds. Crossing them substantially raises the risk of irreversible non-linear changes.



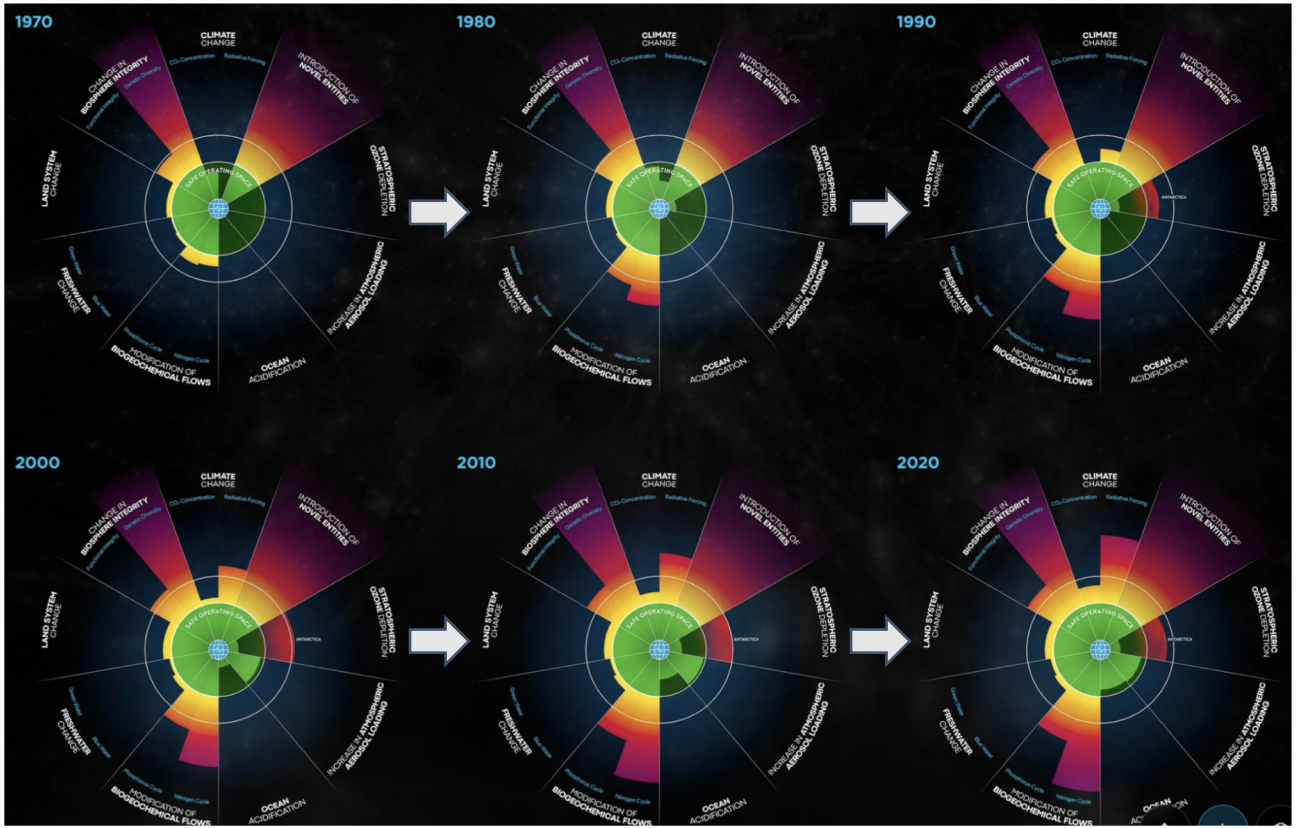
Evolution from PB 1.0 (2009) to PB 3.0 (2023): updated science now quantifies the Functional Biosphere (NPP) and splits Freshwater into Blue and Green water.

Current status of PB?



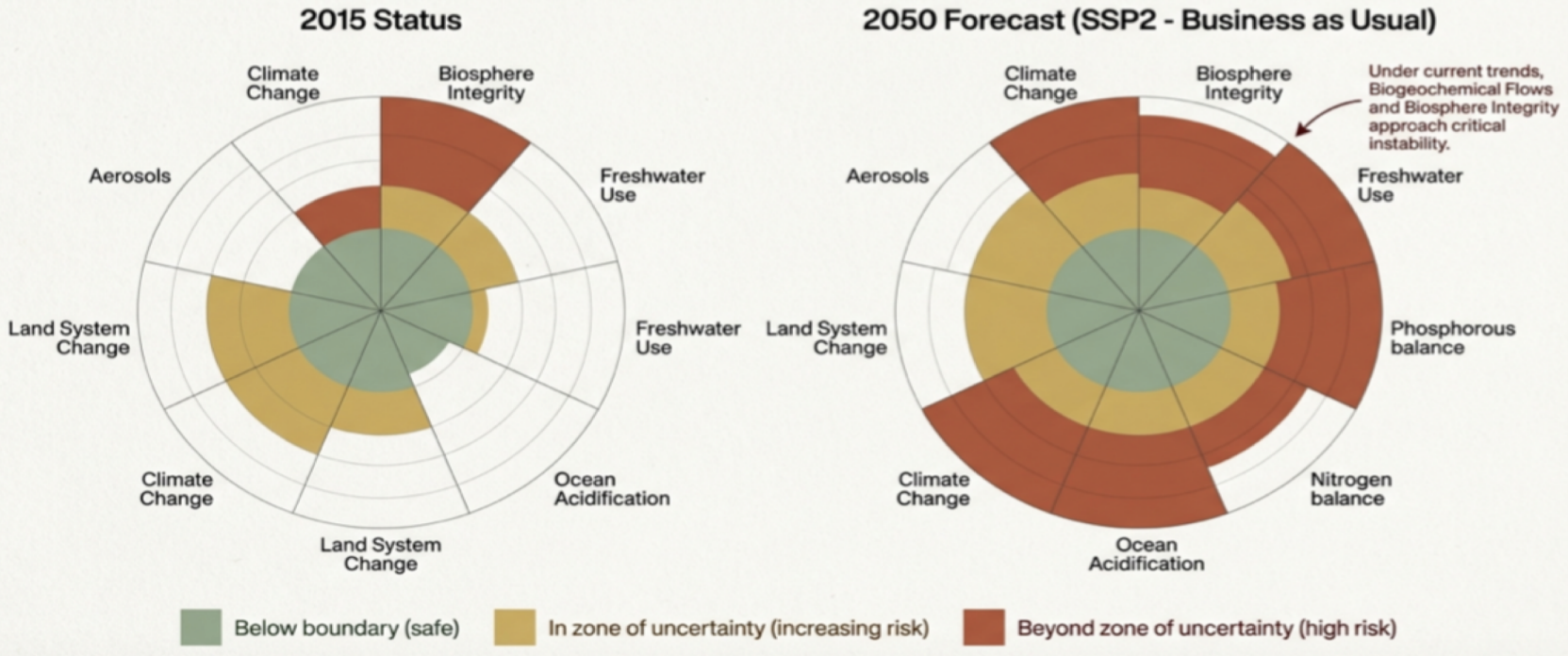
Source: Stockholm Resilience Centre, SRC (2026)

Evolution of Planetary Boundaries

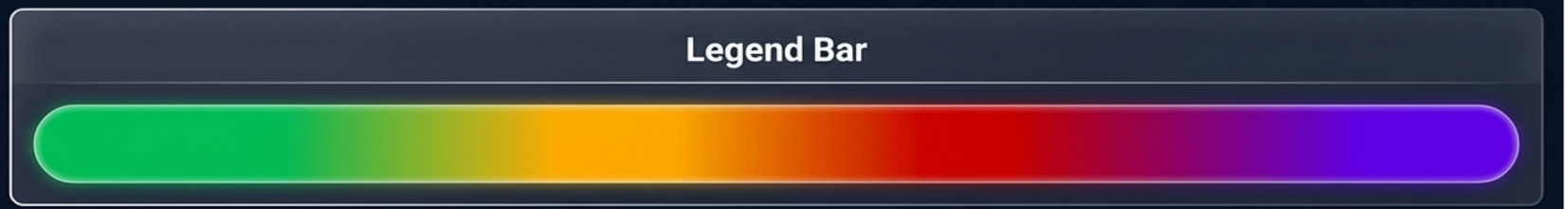


Source: Stockholm Resilience Centre, SRC (2026)

Forecasting 2050: The High Cost of Inaction



Reading the Chart: Understanding Planetary Risk.



Safe Operating Space
Conditions resemble the Holocene. High resilience.

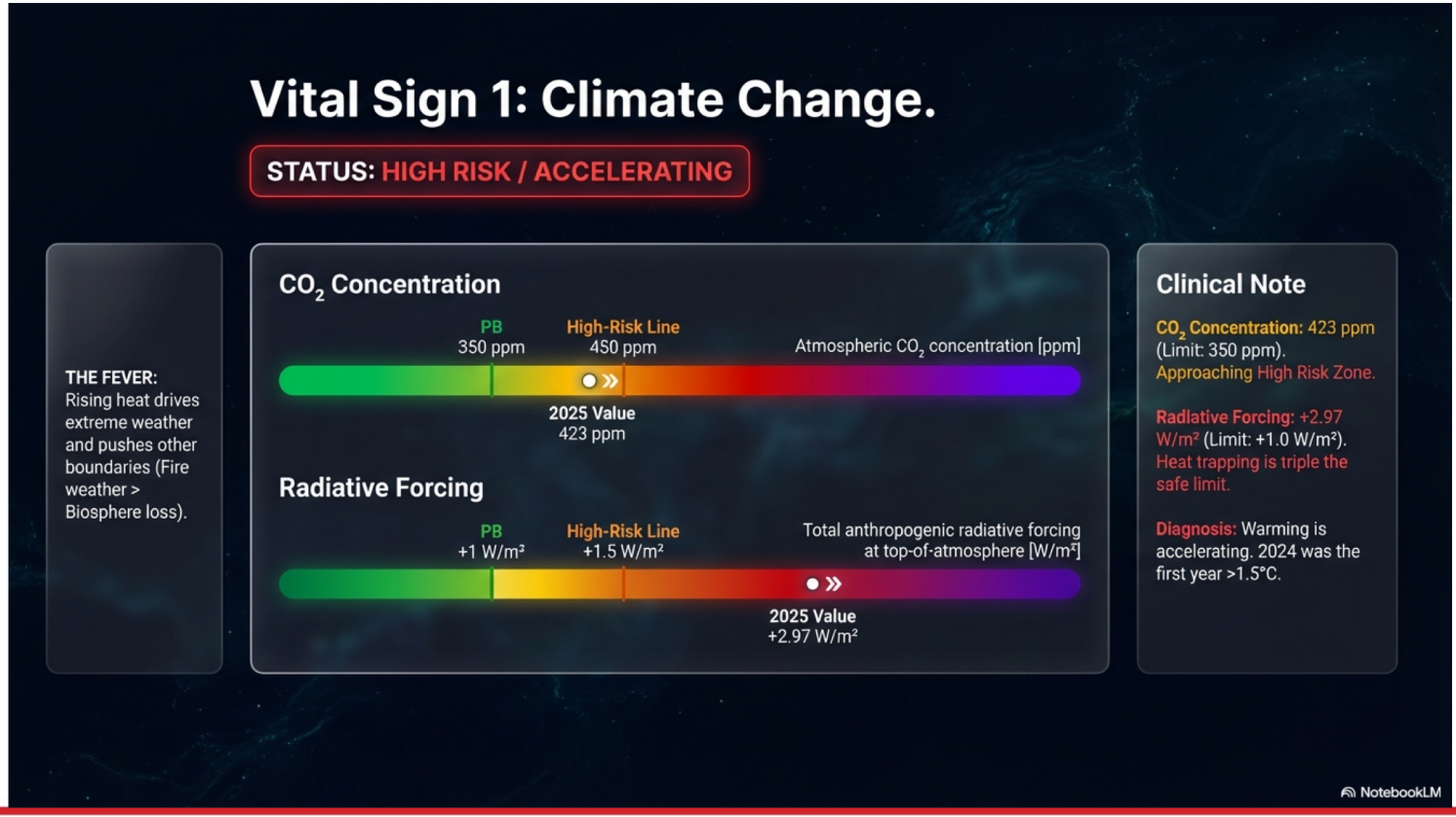
Zone of Increasing Risk
Resilience weakens. Feedback loops may trigger.

High-Risk Zone
High probability of severe, irreversible damage.

Trend Direction
Indicates the pressure is accelerating.

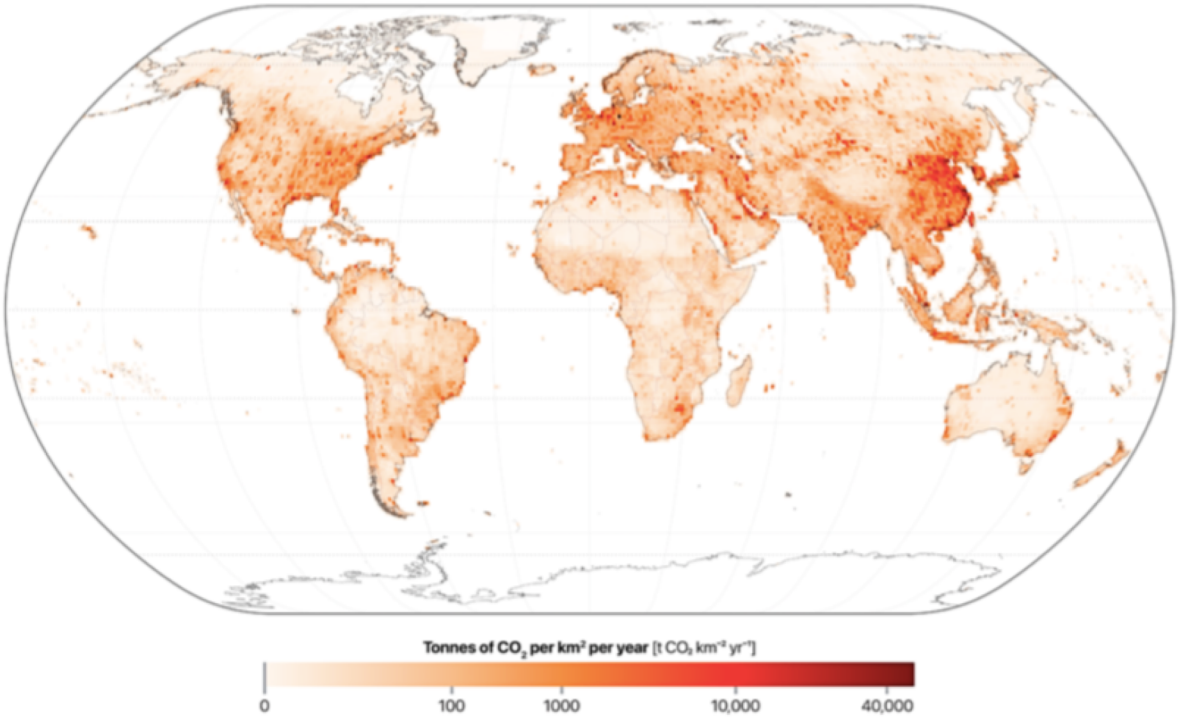
Tipping Points: A threshold where small changes trigger self-reinforcing, irreversible shifts (e.g., ice sheet collapse).

Source: Stockholm Resilience Centre, SRC (2026)



Source: Stockholm Resilience Centre, SRC (2026)

Where climate change begins – Global patterns of fossil CO2 emissions

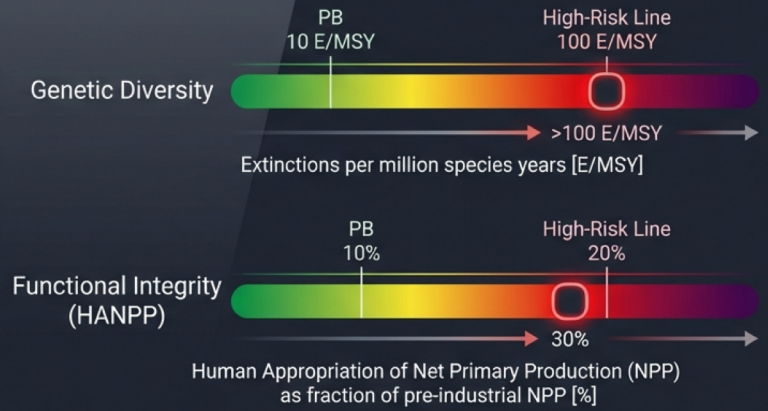


Vital Sign 2: Biosphere Integrity.

STATUS: CRITICAL / UNRAVELING

IMMUNE FAILURE:
Loss of biosphere integrity weakens the planet's ability to absorb carbon, worsening Climate Change.

Biosphere Integrity



Clinical Note

Extinction Rate: >100 E/MSY vs Limit 10. Rate is 10x-100x higher than background.

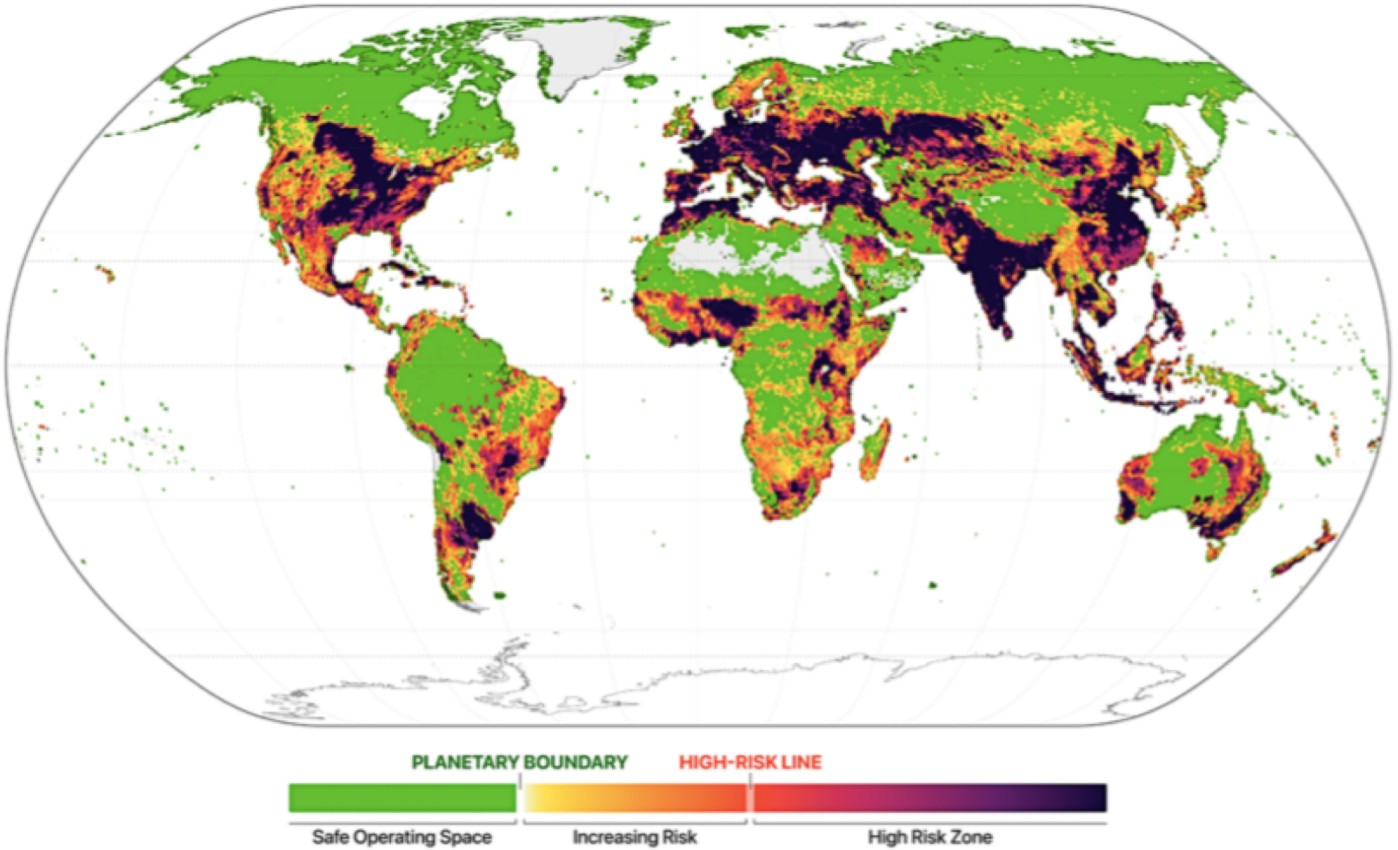
Energy Appropriation (HANPP): 30% vs Limit 10%. Humans consume 3x the safe amount of nature's energy.

Diagnosis: Nature's safety net is breaking. We are losing the genetic library needed for future resilience.

NotebookLM

Source: Stockholm Resilience Centre, SRC (2026)

Global risk map of Change in Biosphere Integrity



Planetary Health Check 2025

Clinical High-Fidelity

The Physical Body: Land & Water Systems

STATUS: BREACHED (Increasing Risk)

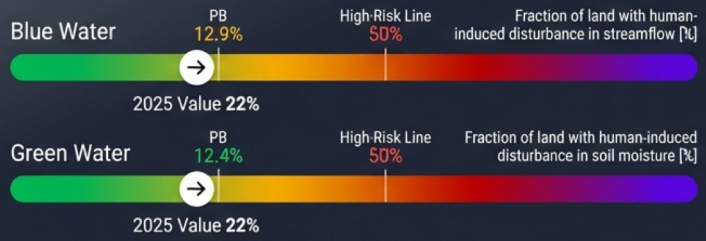
ORGAN FAILURE:

Deforestation in the Amazon (Land) leads to reduced rainfall (Freshwater), threatening the entire rainforest.

Land System Change



Water Cycle Disturbance



Clinical Note

Forest Cover: 59% (Limit: 75%). We have cleared too much of the Earth's surface.

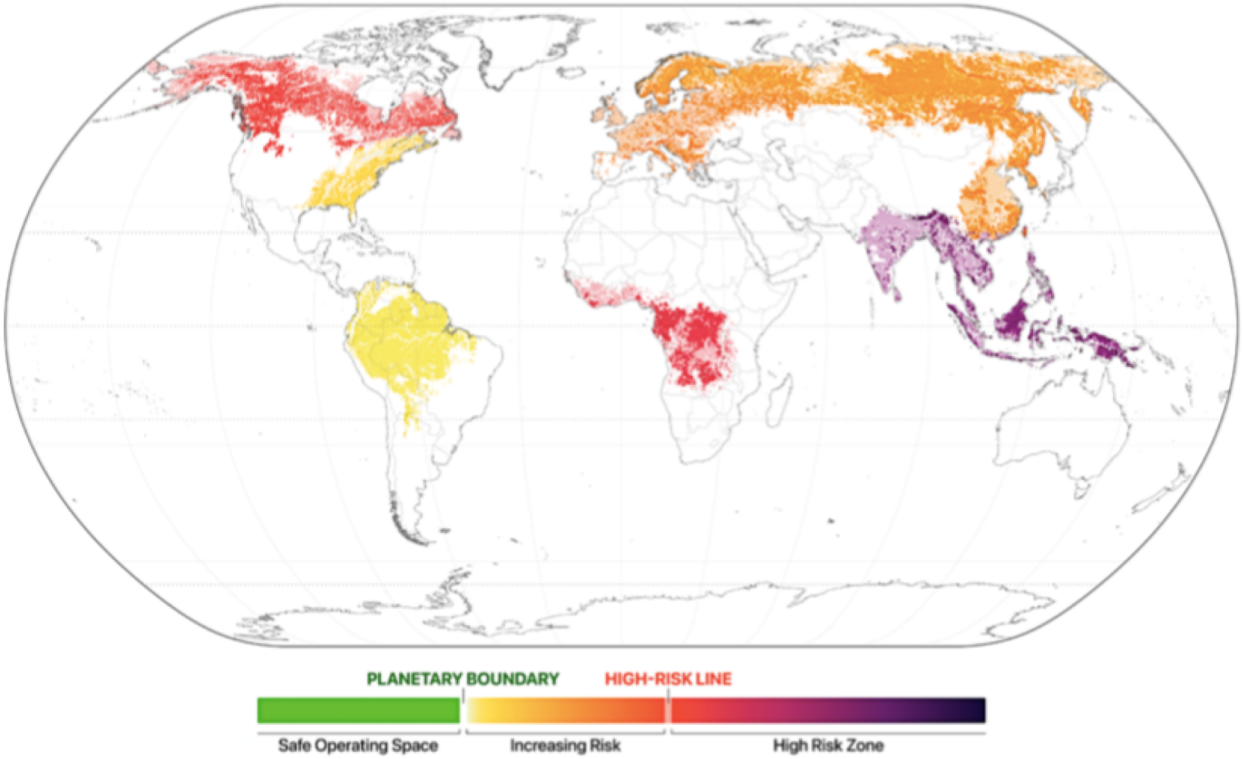
Freshwater Disturbance: **>20%** (Limit: ~13%). Rainfall and soil moisture cycles are deviating from the norm.

Diagnosis: The physical regulation of the planet is failing due to extraction.

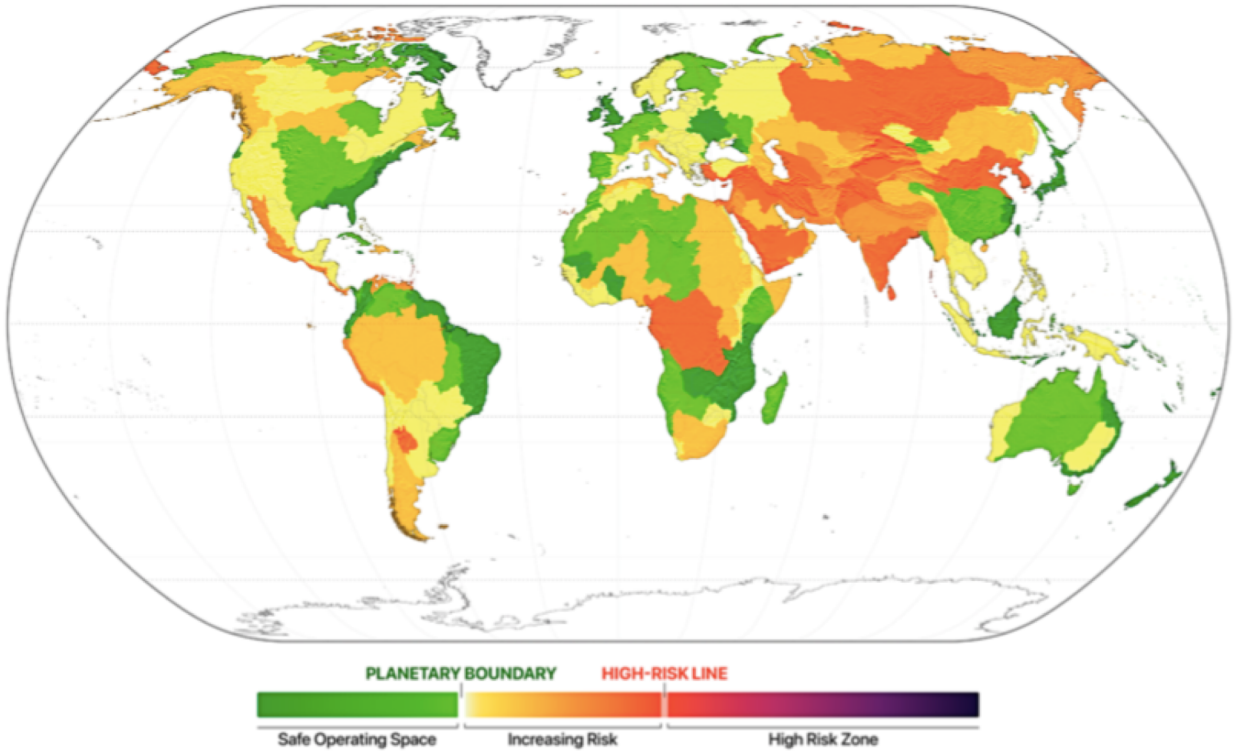
NotebookLM

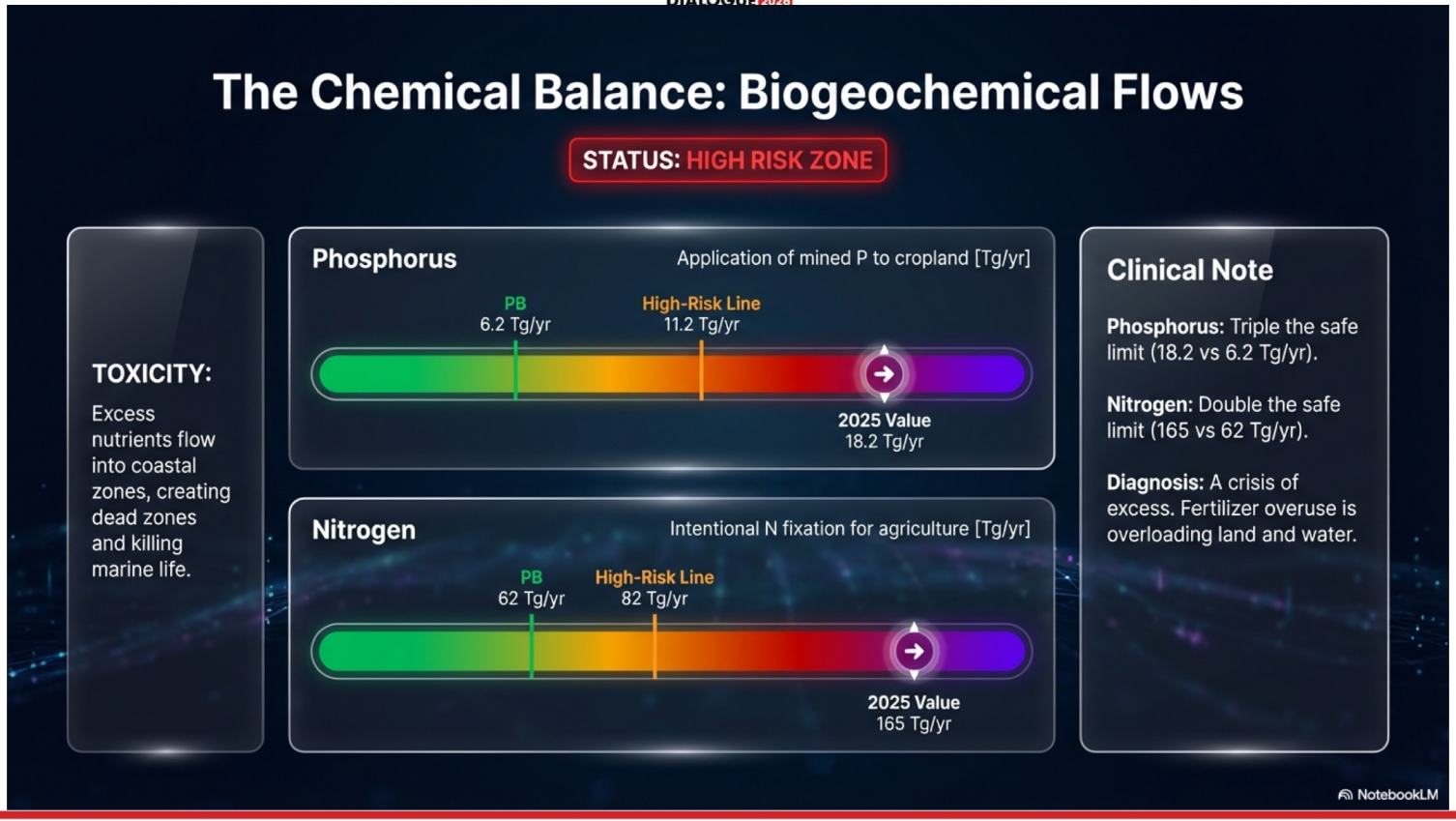
Source: Stockholm Resilience Centre, SRC (2026)

Global risk map of the Land System Change boundary transgression – Forest area.



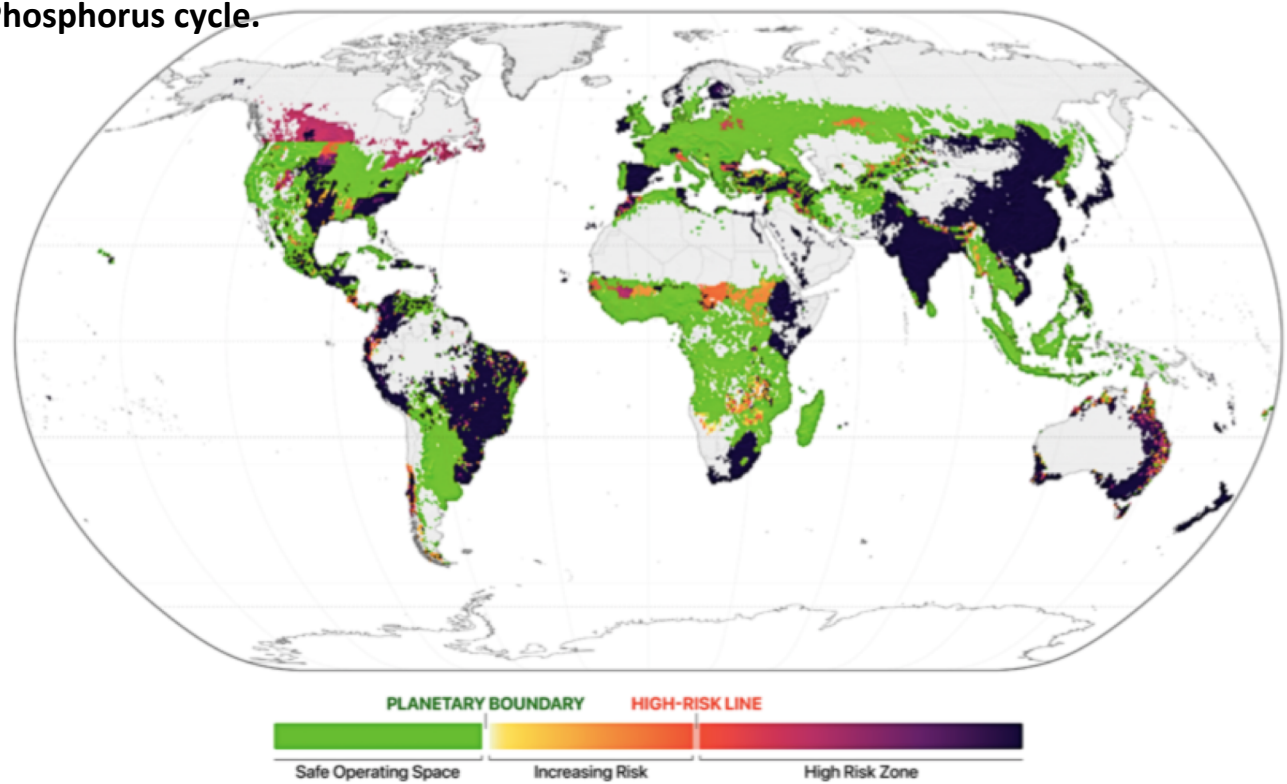
Global risk map of Earth's freshwater systems (I) – Blue water





Source: Stockholm Resilience Centre, SRC (2026)

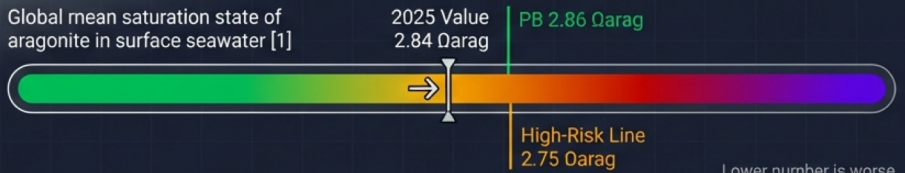
Global risk map for the transgression of the Modification of Biogeochemical Flows boundary – Phosphorus cycle.



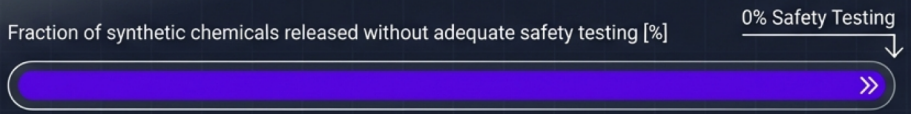
The Toxic Load: Chemicals & Acidification

STATUS: BREACHED

Ocean Acidification



Novel Entities



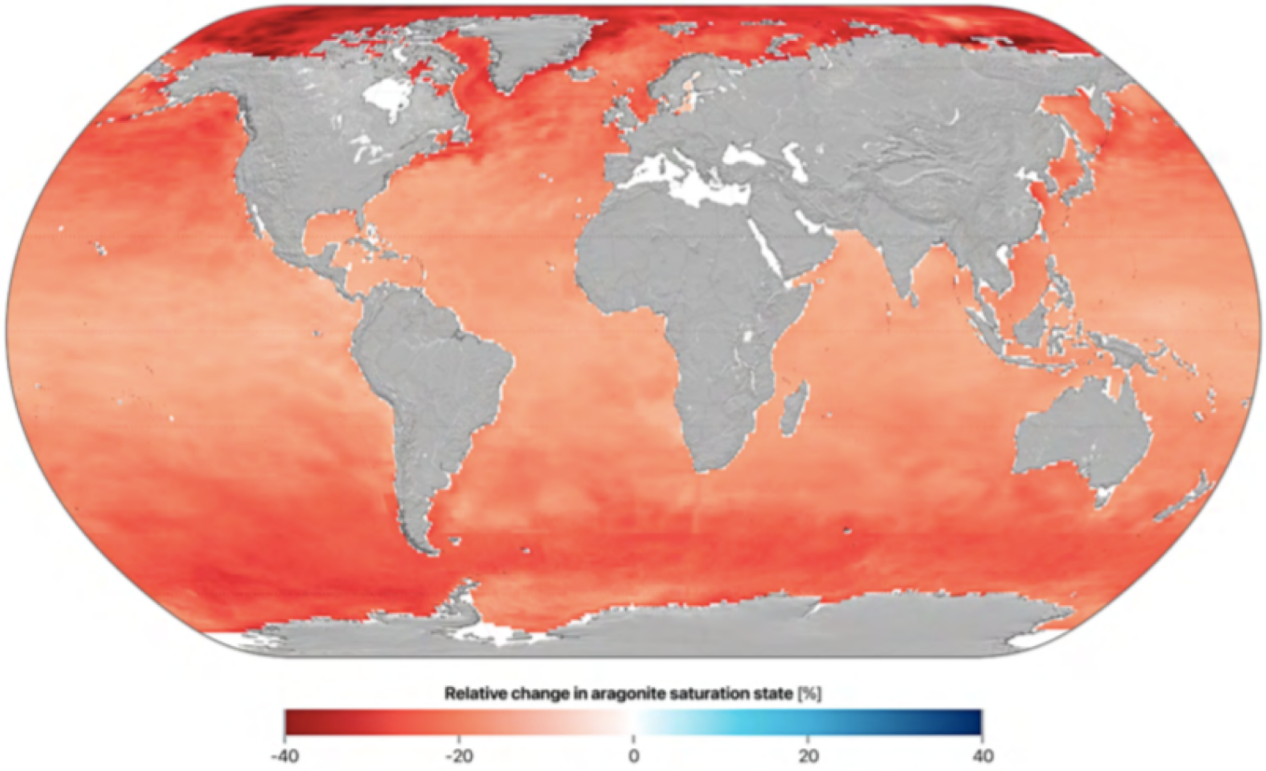
Clinical Note

- **Ocean Acidification:** Newly transgressed in 2025. The ocean is turning acidic.
- **Novel Entities:** 0% safe testing. We are releasing synthetic chemicals faster than we can test them.
- **Diagnosis:** We are conducting an uncontrolled chemical experiment on the patient.

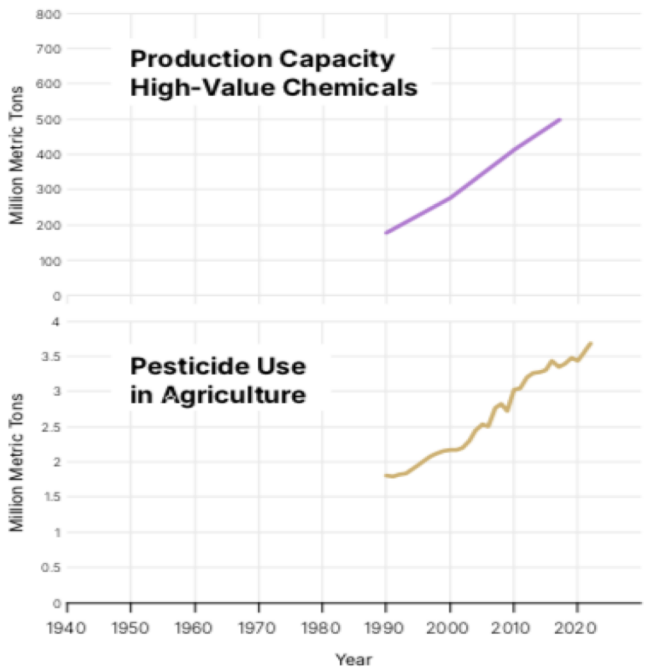
NotebookLM

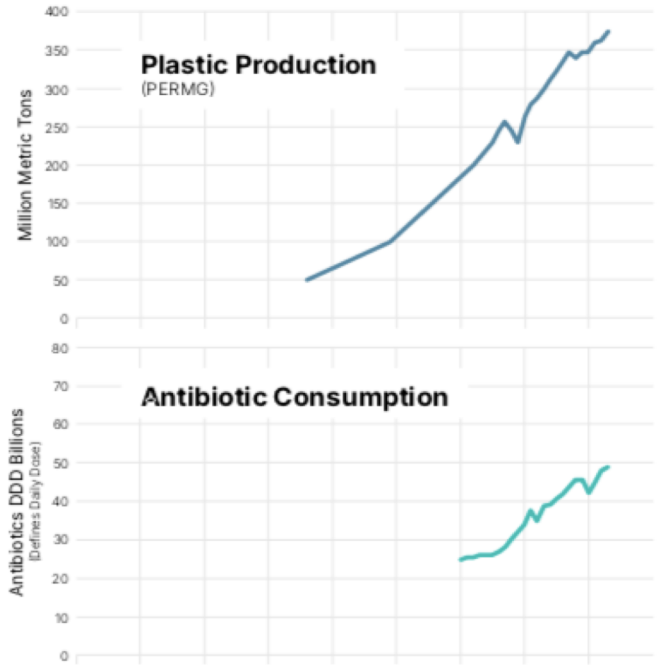
Source: Stockholm Resilience Centre, SRC (2026)

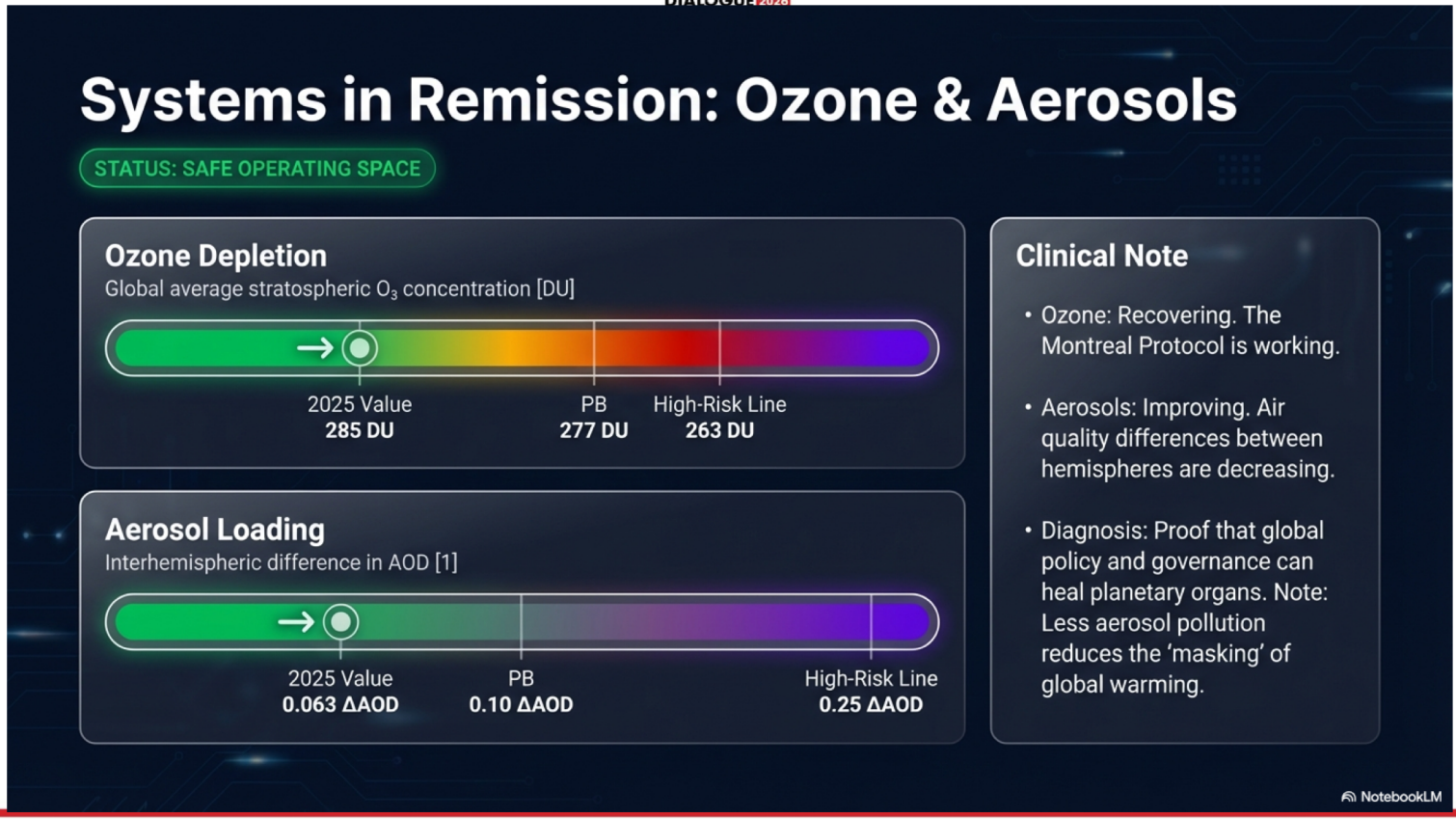
Global map of Ocean Acidification



The rise of novel entities.

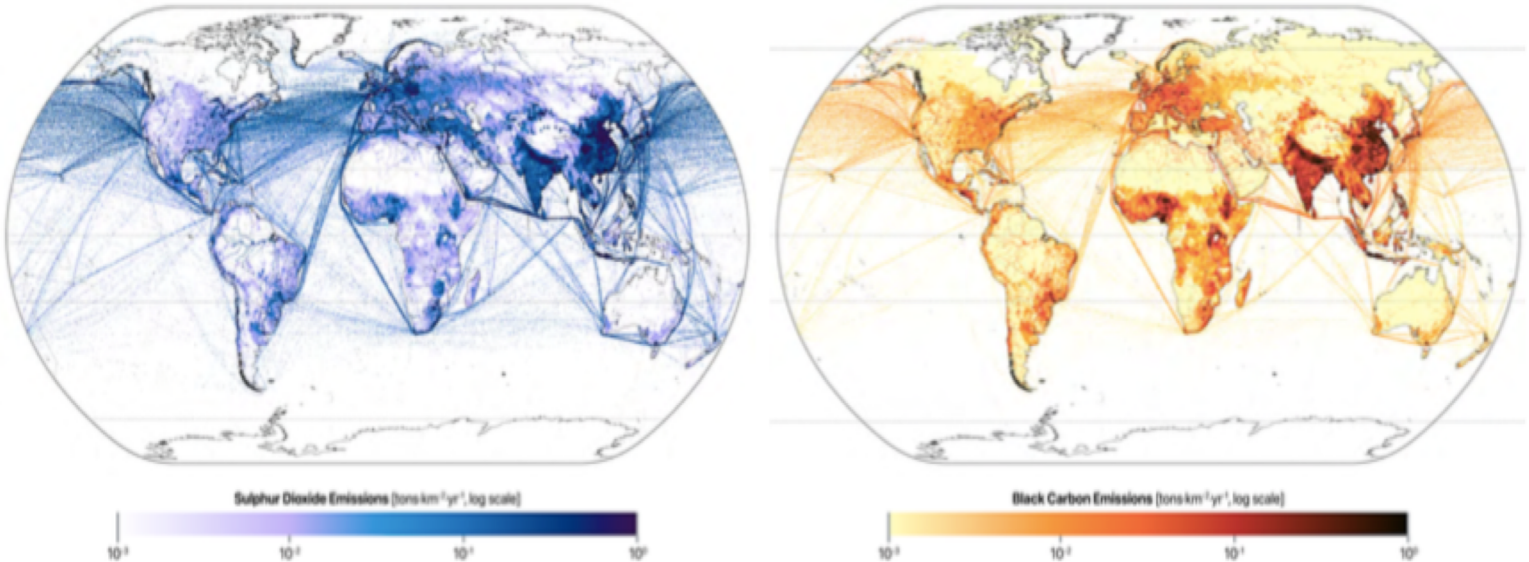






Source: Stockholm Resilience Centre, SRC (2026)

Global aerosol emissions, averaged annually over 2010–2020



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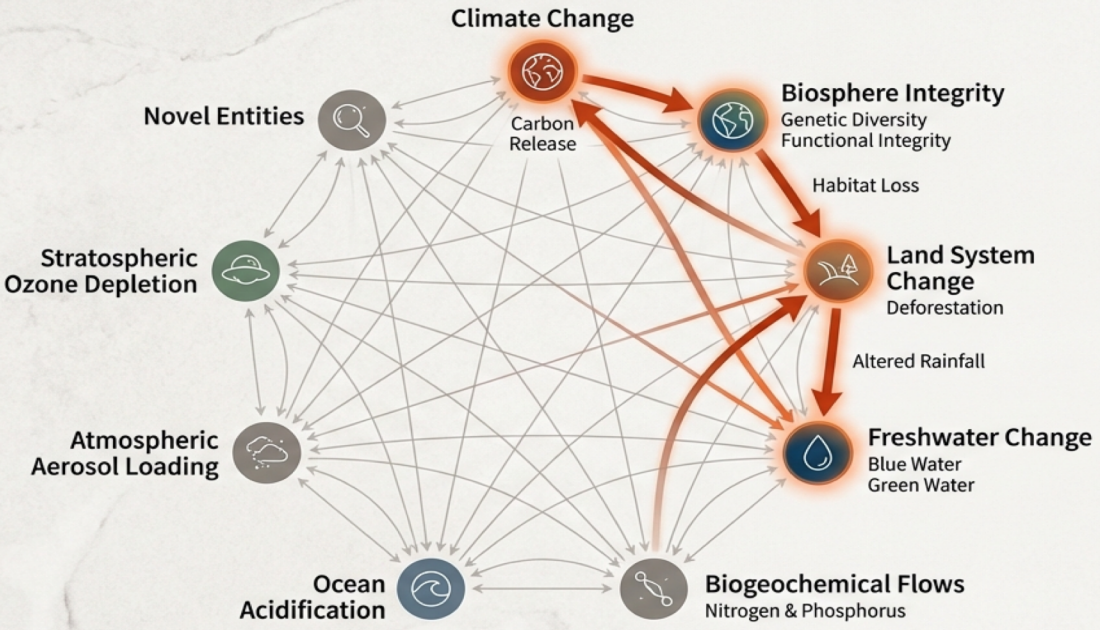
Transgressing one boundary shrinks the safe space for others



Interactions amplify instability.

A domino effect occurs where 'safe' boundaries are breached solely due to pressure from Core boundaries.

As the Safe Operating Space shrinks, the risk of tipping points increases.

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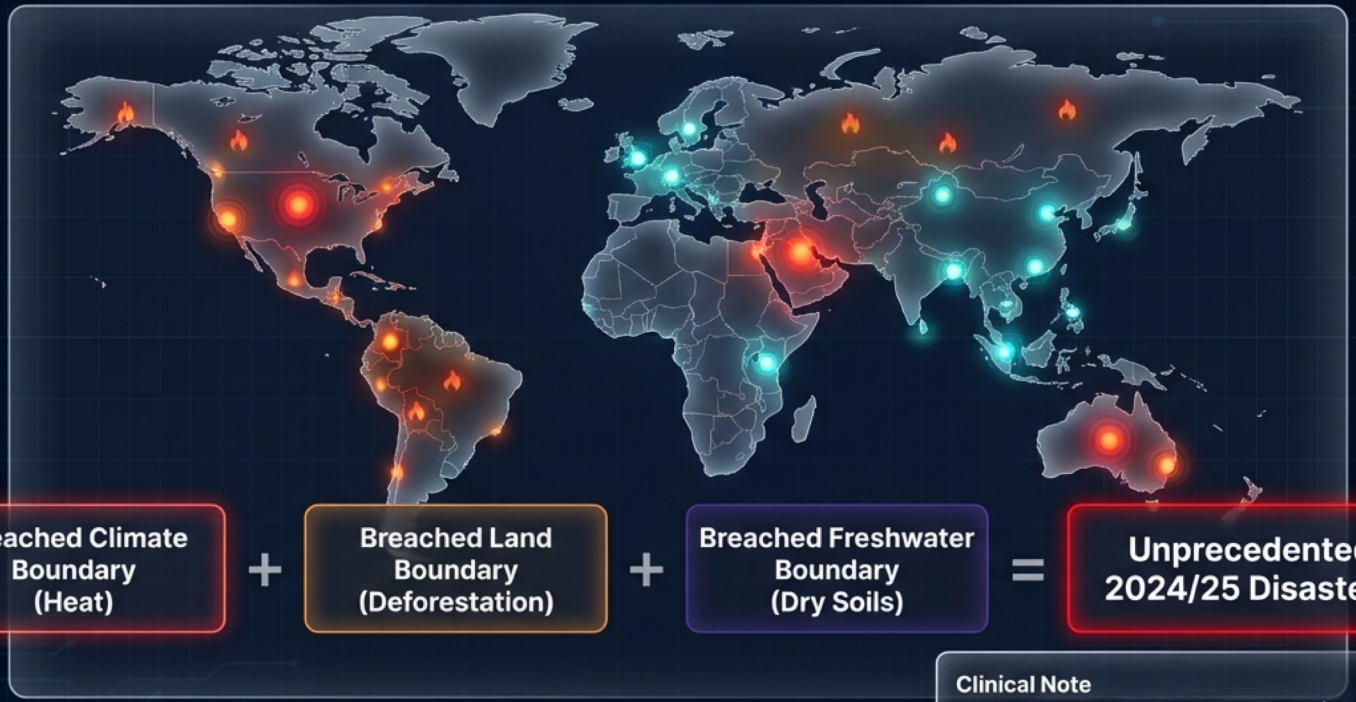
Complication: The Era of Compound Disasters



Breached Climate Boundary (Heat) + Breached Land Boundary (Deforestation) + Breached Freshwater Boundary (Dry Soils) = Unprecedented 2024/25 Disasters

Clinical Note
Attribution: The extreme weather of 2024 (the first year >1.5°C) is not natural variability. It is the result of interacting organ failures.

Treatment Plan: The Planetary Boundaries Initiative

Planetary Boundaries INITIATIVE



DIAGNOSTICS

Continuous monitoring via the Planetary Mission Control Centre.

Real-time tracking of all planetary boundaries and early warning systems for tipping points.

SOLUTIONS

Connecting science to leverage points for cities and businesses.

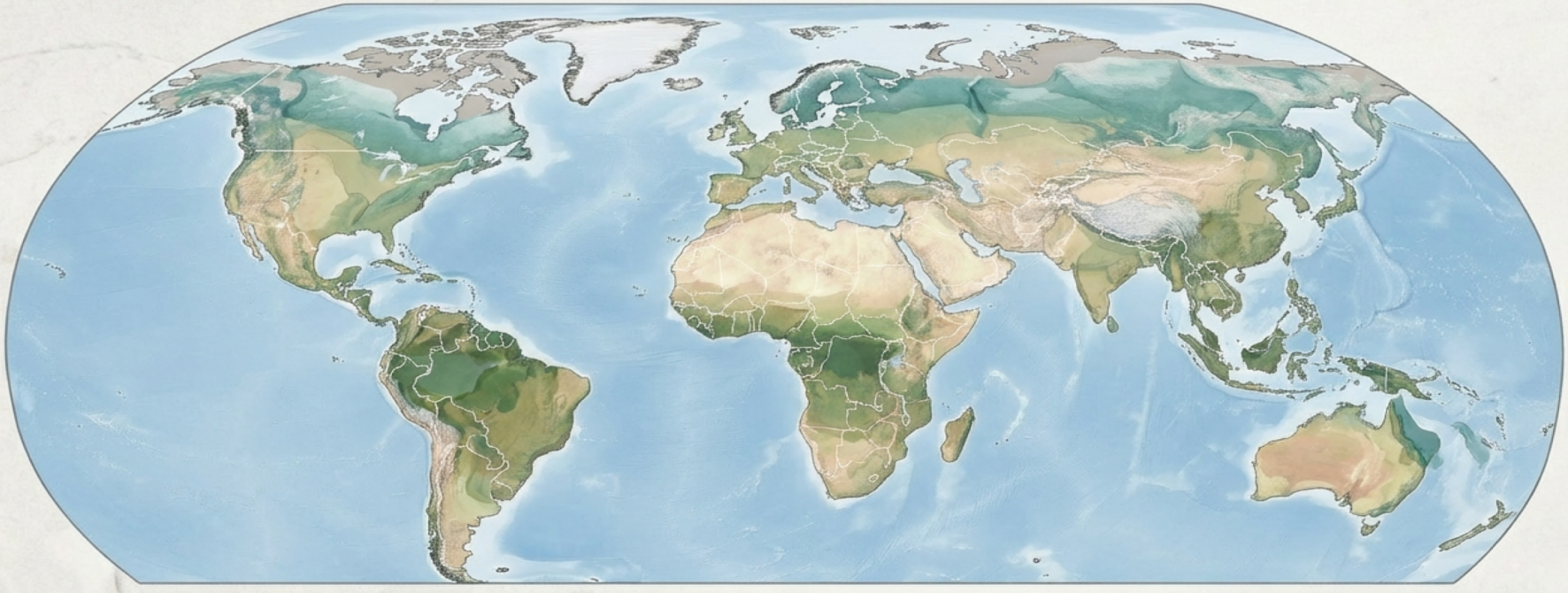
Translating planetary data into actionable insights for sustainable development and risk mitigation.

TOOLS

The PBAnalyzer—Using AI to link Earth system data with socio-economic decisions.

A dynamic platform for simulating policy impacts and optimizing resource management.

The Scale Mismatch: Earth Systems ignore political borders.



The Trap: Planetary Boundaries are global biophysical thresholds, but policymaking is national. Simply dividing the global budget **per capita** ignores regional ecological reality. A rainforest nation has different **responsibilities** than a **desert nation**.

Mainstreaming: From Academic Science to Corporate Strategy.

PB 1.0 Published — 2009

SDGs & Paris Agreement — 2015

Doughnut Economics Action Lab — 2019

SBTN (Science Based Targets Network) Launch — 2023



Circular Economy

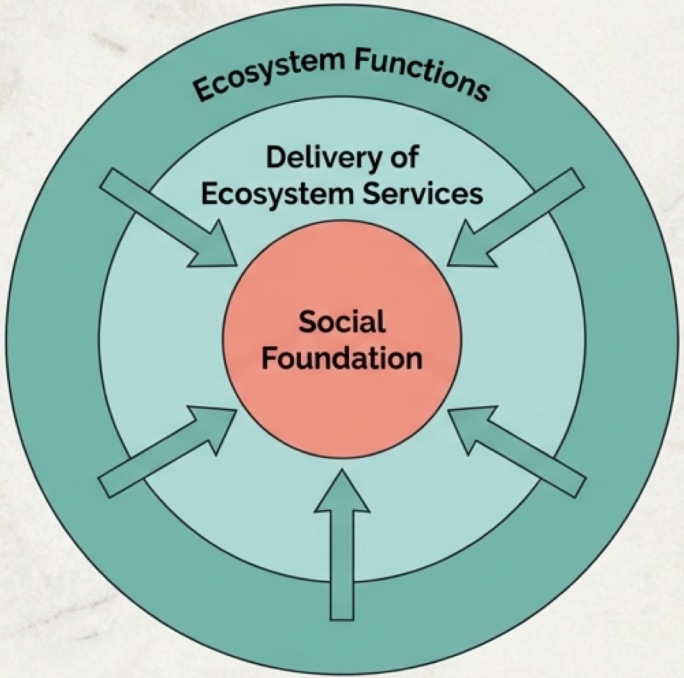


Planetary Health Diet



Science Based Targets

Ecosystem Services are the currency of the Safe and Just Space



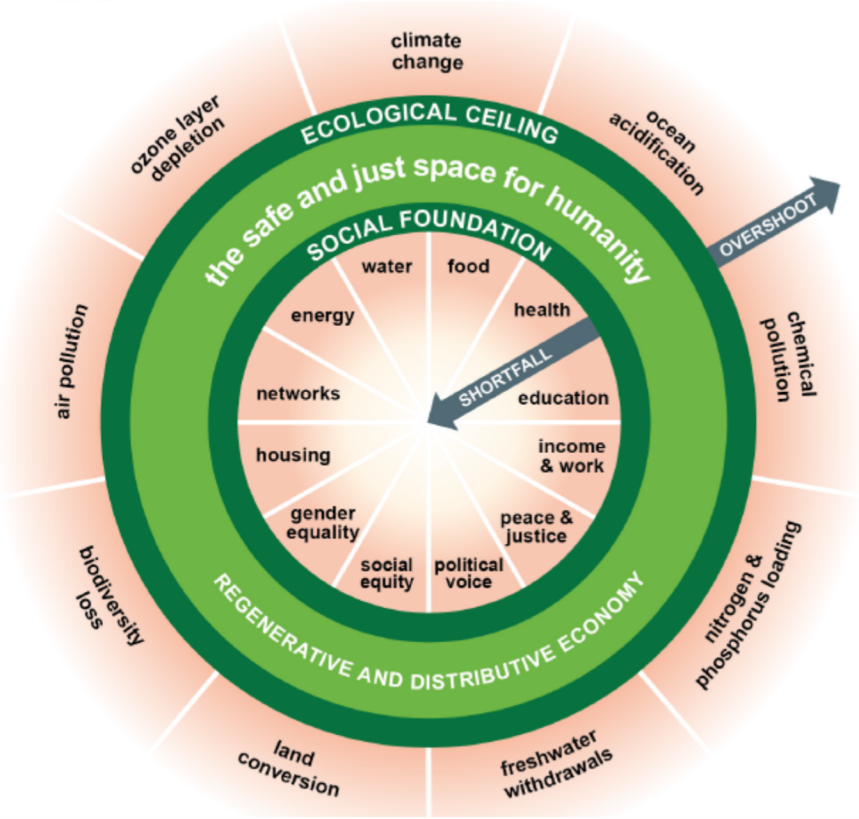
The Mechanism: Healthy Ecosystems (within PBs) provide Services (Pollination, Clean Water) which fulfill Social Needs. When PBs are crossed, services decline, causing us to fall below the Social Foundation.

Doughnut Economy =

Planetary boundaries
(ecological ceiling / safe operating space)

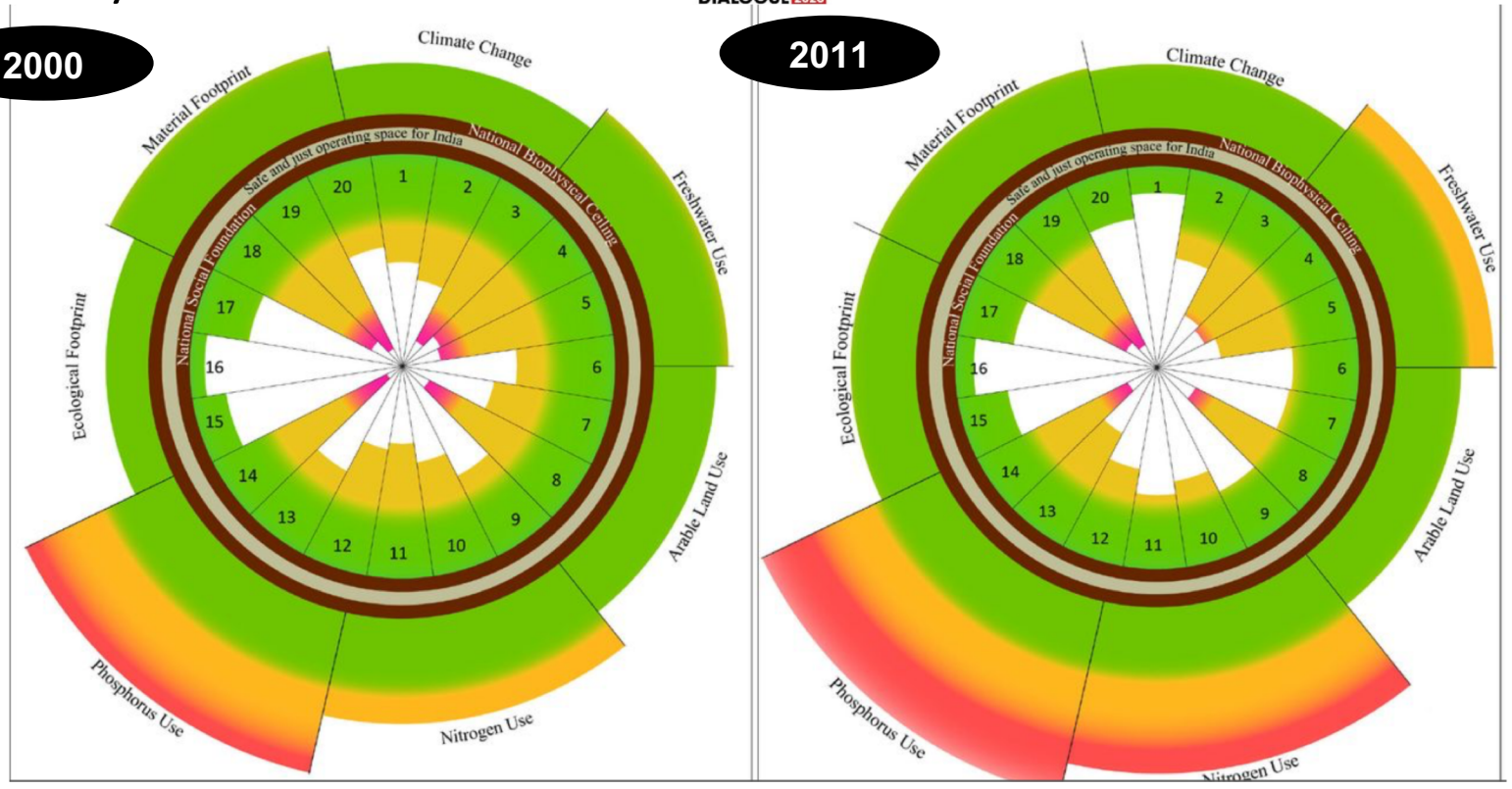
✚

Socio-economy
(social foundation / just operating space)



Source: Raworth (2017)

Planetary boundaries of India?



Source: Roy & Pramanick (2020)

Insights: PB of India

- India overshot per capita limits for freshwater (2007-08), nitrogen (2002), and phosphorus (pre-2002). These ‘ceiling’ violations jeopardize long-term ecological stability.
- Phosphorus and nitrogen use exceed safe limits by 85.1% and 40.3%, respectively. This massive biogeochemical imbalance threatens national ecosystem health.
- Under ‘Business-as-Usual’ (BAU), India will surpass per capita GHG limits by 2045–2047. This narrow window mandates rapid decarbonization to prevent global tipping points.
- By 2045, India is projected to breach all remaining biophysical boundaries, including arable land (2035), ecological footprint (2020–25), and material footprint (2025–30). This trajectory signals an impending national ecological crisis.

Source: Roy & Pramanick (2020)

Insights: PB of India

- Despite lower black carbon, fossil emissions like SO_2 (63.38% increase) and $PM_{2.5}$ (61.51% increase) are soaring. These trends heighten Anthropocene pressures on health and climate.
- Despite economic growth, 15 of 20 social indicators fail ‘just’ foundation thresholds. Deprivation remains highest in gender equality, political voice, and social equity.
- Reverting to 1990 per capita water use rates would cut 2050 withdrawals by 16.83% compared to BAU. This highlights structural reform as a viable path to resource sufficiency.
- Capping per capita GHGs at 1990 levels would reduce 2050 total emissions by 31.98%. This offers a ‘safe’ path that balances development with biophysical limits.

Source: Roy & Pramanick (2020)

Safe and Just Operating Space for India

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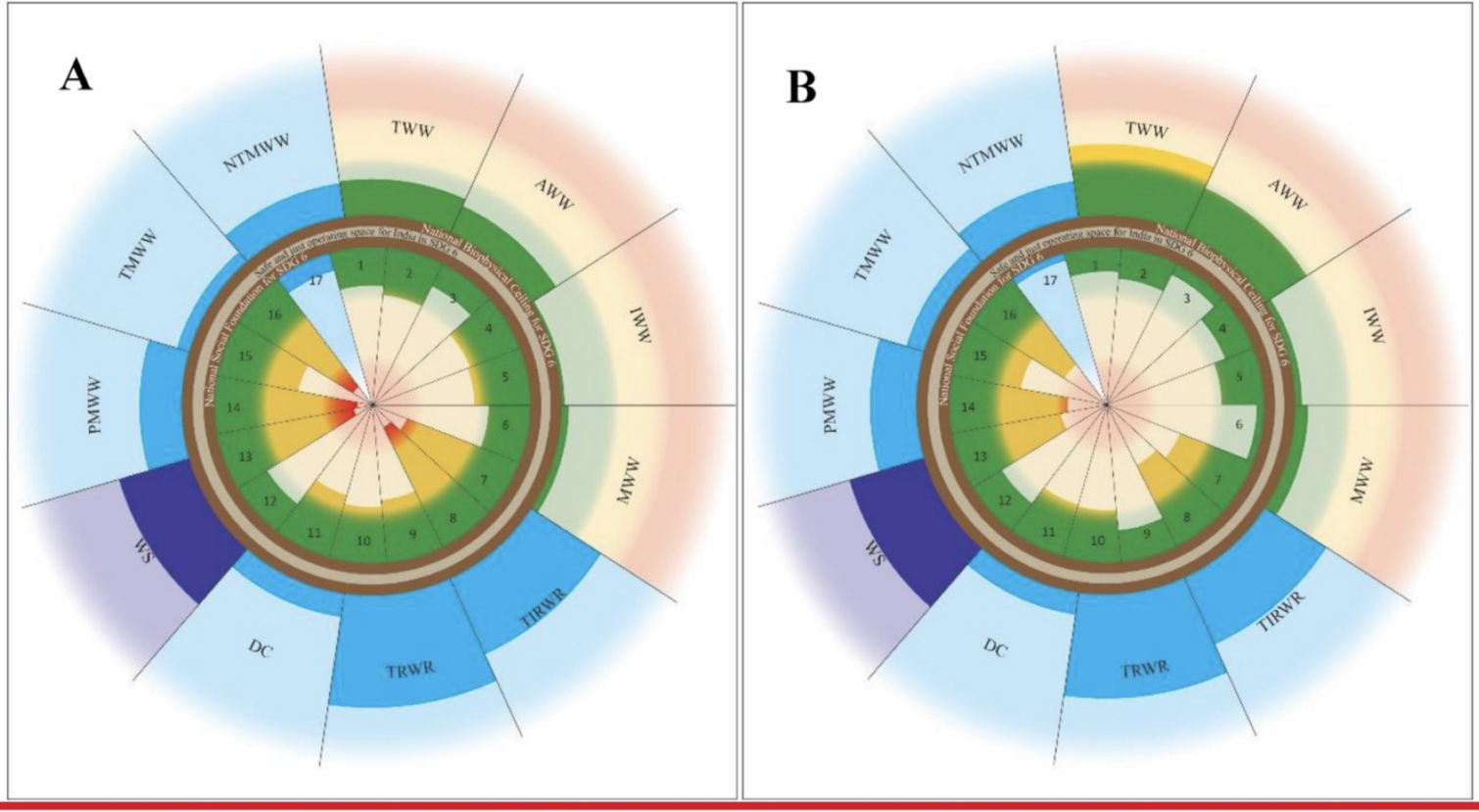
C. M. Hussain (ed.), *Handbook of Environmental Materials Management*,
https://doi.org/10.1007/978-3-319-58538-3_210-1

WaSH in India as PB?



Source: Roy & Pramanick (2020)

Insights: PB of WaSH of India

- Per capita water withdrawal has overshot the ‘safe’ global boundary of 576.96 m3 per year. India is now operating beyond its biophysical ceiling for freshwater use.
- Between 1962 and 2014, per capita renewable water resources plummeted by 64.29%. Rapid population growth is driving this acute biophysical stress.
- India’s water stress level (44.53%) is nearly four times the global average (12.82%). This disparity underscores extreme vulnerability to scarcity.
- By 2050, India’s water requirement will nearly triple 1990 levels. Overwhelming biophysical limits is imminent without radical efficiency gains.
- Untreated municipal wastewater surged 67.58%, far outpacing treatment growth. This failure threatens regional soil health and biodiversity.

Source: Roy & Pramanick (2020)

Insights: PB of WaSH of India

- 2050 domestic needs will hit 111 billion m3 alongside surging power generation demand. These competing priorities necessitate a total restructure of national planning.
- Agricultural water use efficiency is lagging; per capita withdrawal fell by only 0.76%. Improving agricultural productivity is a top priority to prevent biophysical overshoot.
- Improved water/sanitation access cut child mortality by 78.1 per 1,000 births and stunting by 27.5%. Resource management directly impacts the most vulnerable age groups.
- Under business-as-usual, basic sanitation will miss 2030 UN targets, only meeting thresholds between 2040 and 2055. This ‘social floor’ deficit requires immediate policy intervention.
- Urban open defecation hit target levels in 2013, but rural areas lag until 2035–2045. This inequality complicates an inclusive, safe, and just operating space.
- ‘Soft measures’, like population control and irrigation efficiency, could cut 2050 withdrawals by 7.5%. Behavioral and structural shifts are essential to stay within safe limits.

Source: Roy & Pramanick (2020)

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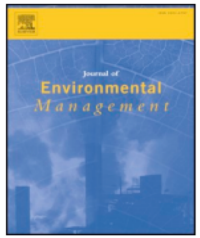

Research article

Analysing progress of sustainable development goal 6 in India: Past, present, and future

Check for updates

Ajishnu Roy, Kousik Pramanick*

Integrative Biology Research Unit (IBRU), Department of Life Sciences, Presidency University, 86/1 College Street, 700073, Kolkata, India

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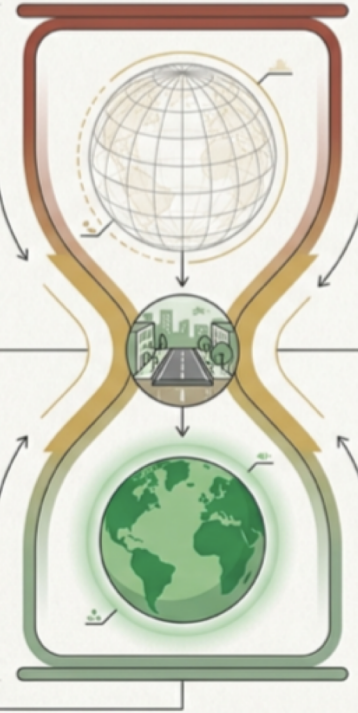
The Logic of Recovery

Global Diagnosis

Local Cure

Planetary Recovery



The Diagnosis: Current global trends (IMAGE modeling) show us transgressing critical limits by 2050.

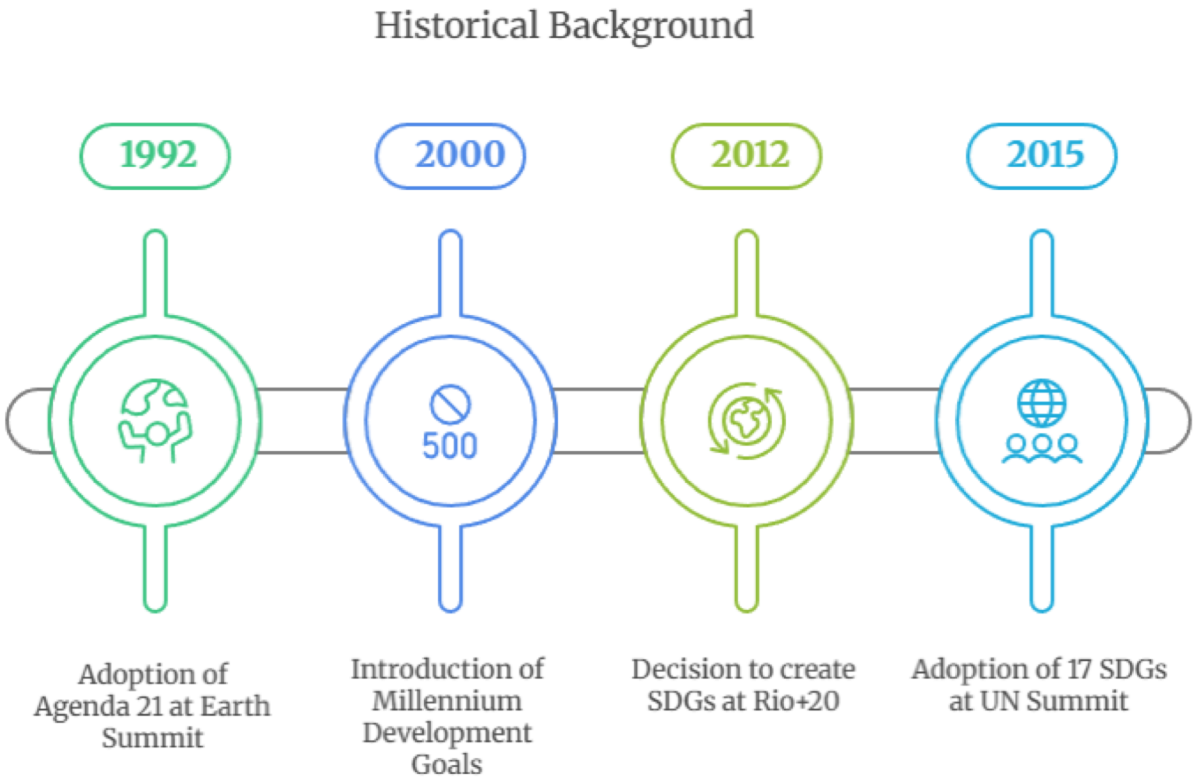
The Intervention: The battle for sustainability is physical and local. We use the MuNaP index to audit urban Nature-Based Solutions.

The Prognosis: Scaling local functionality to reverse global pressure.

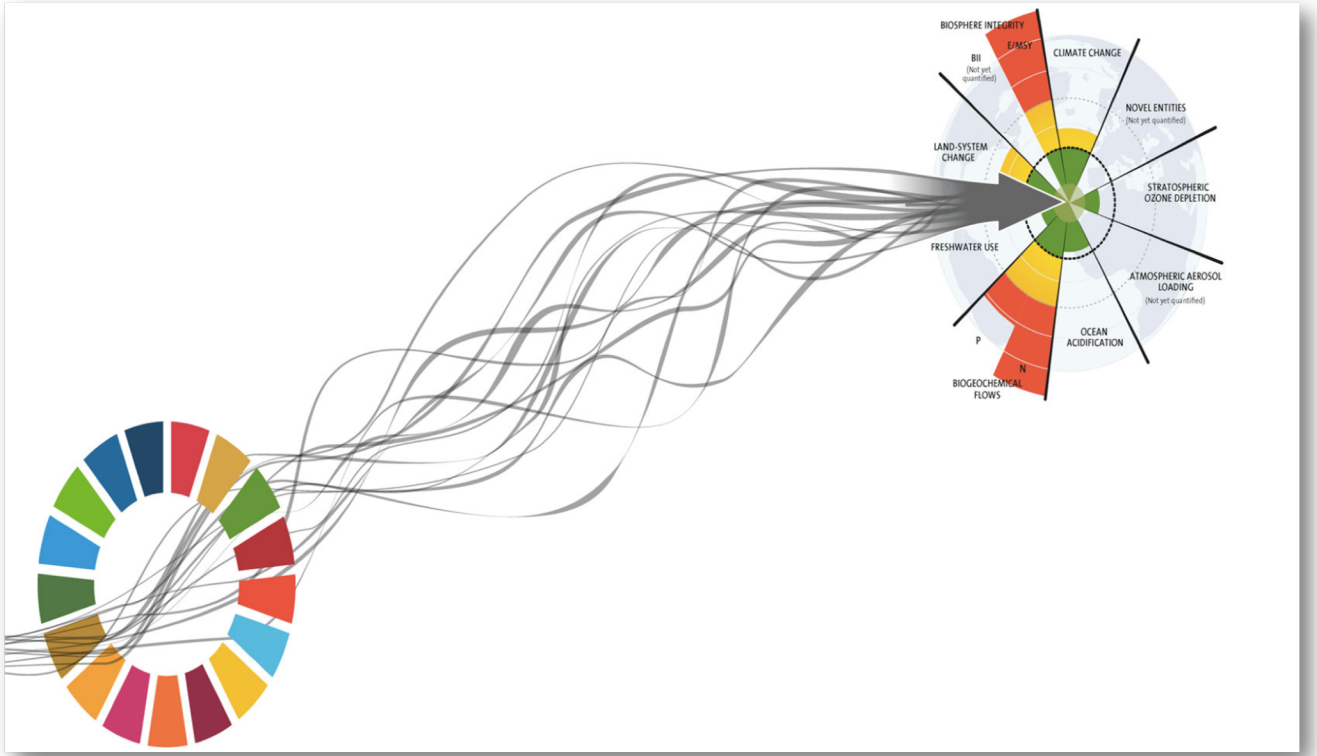
What are MDGs of UN (2000-2015)?



MDG to SDG

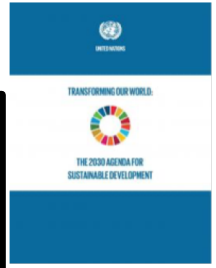

Historical Background
1992
2000
2012
2015
500
Adoption of Agenda 21 at Earth Summit
Introduction of Millennium Development Goals
Decision to create SDGs at Rio+20
Adoption of 17 SDGs at UN Summit

From PB to SDG?

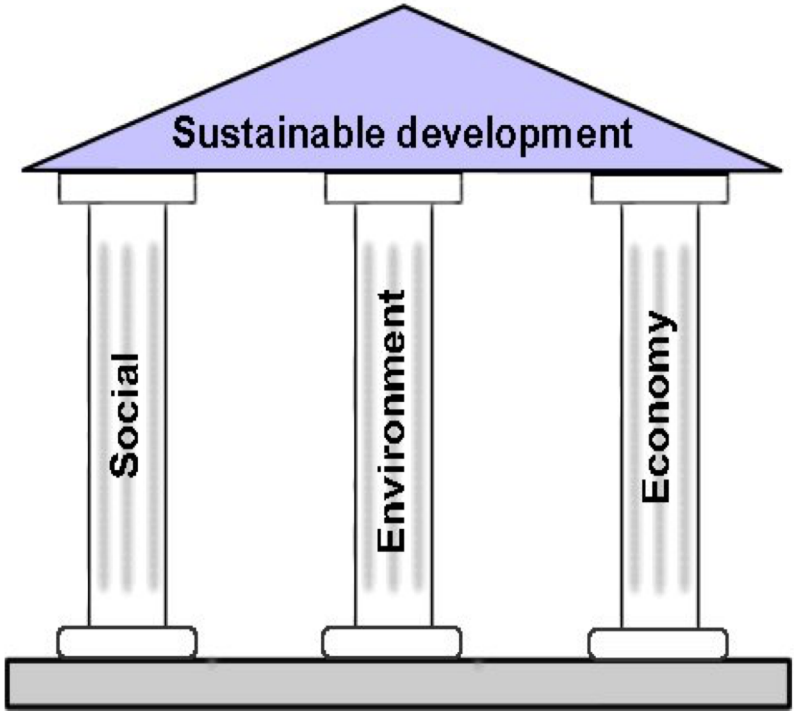


What are SDGs of UN (2015-2030)?





Three Pillars



Triple Bottom Line (TBL)



‘Wedding cake’ representation



World's SDG performance (2025)





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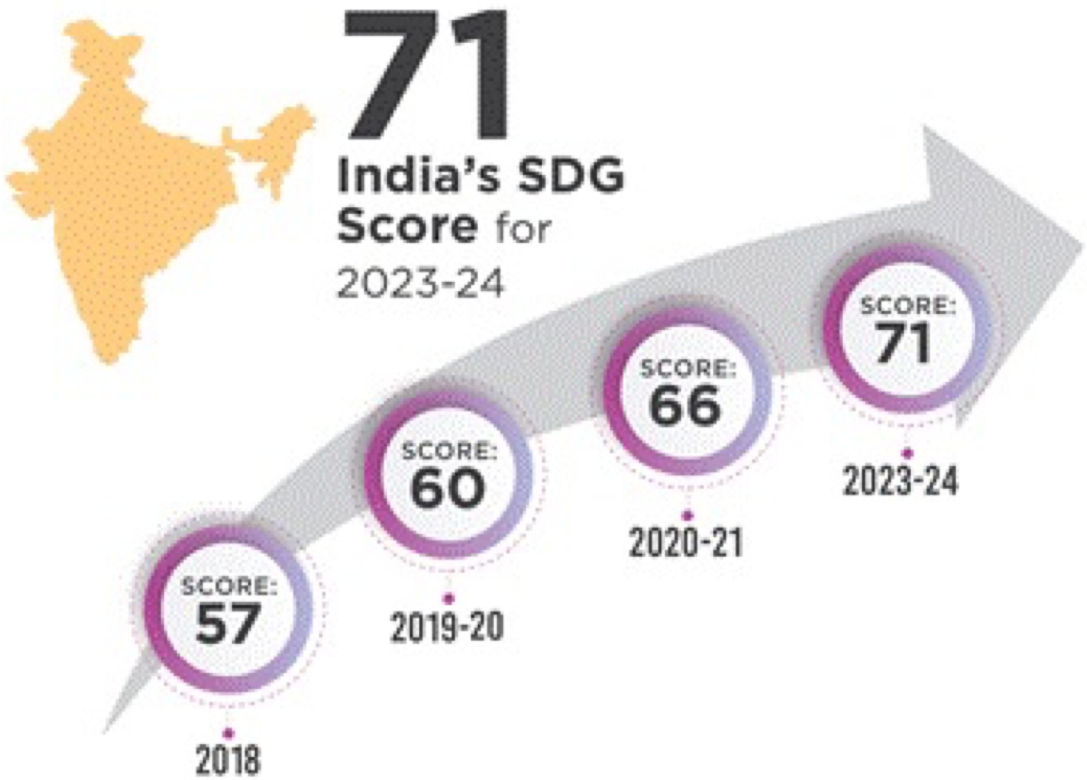
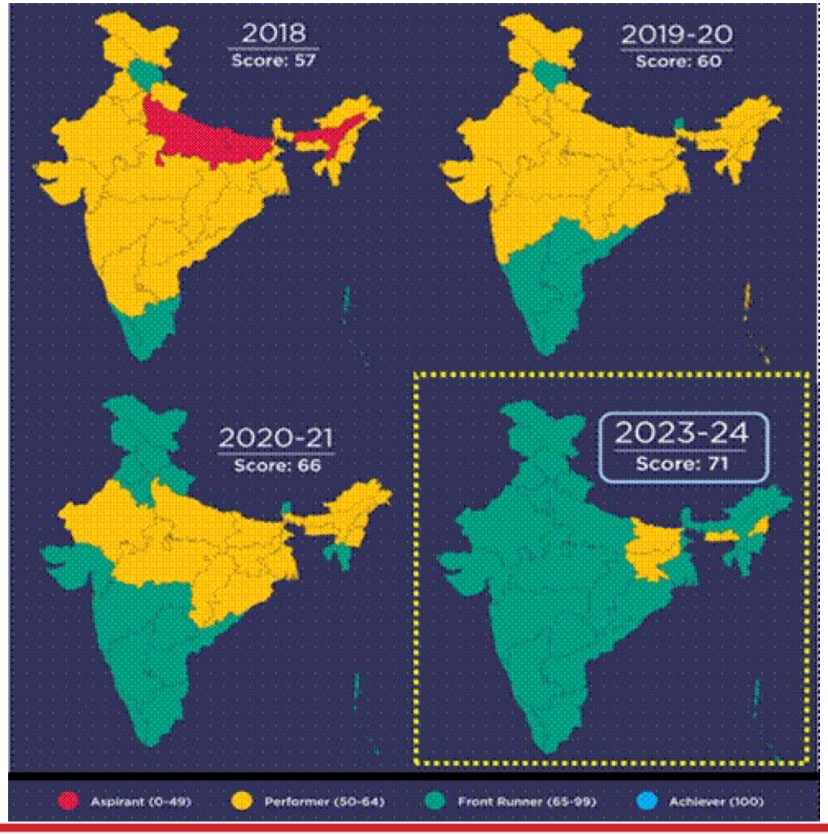


India’s SDG performance (2023-24)

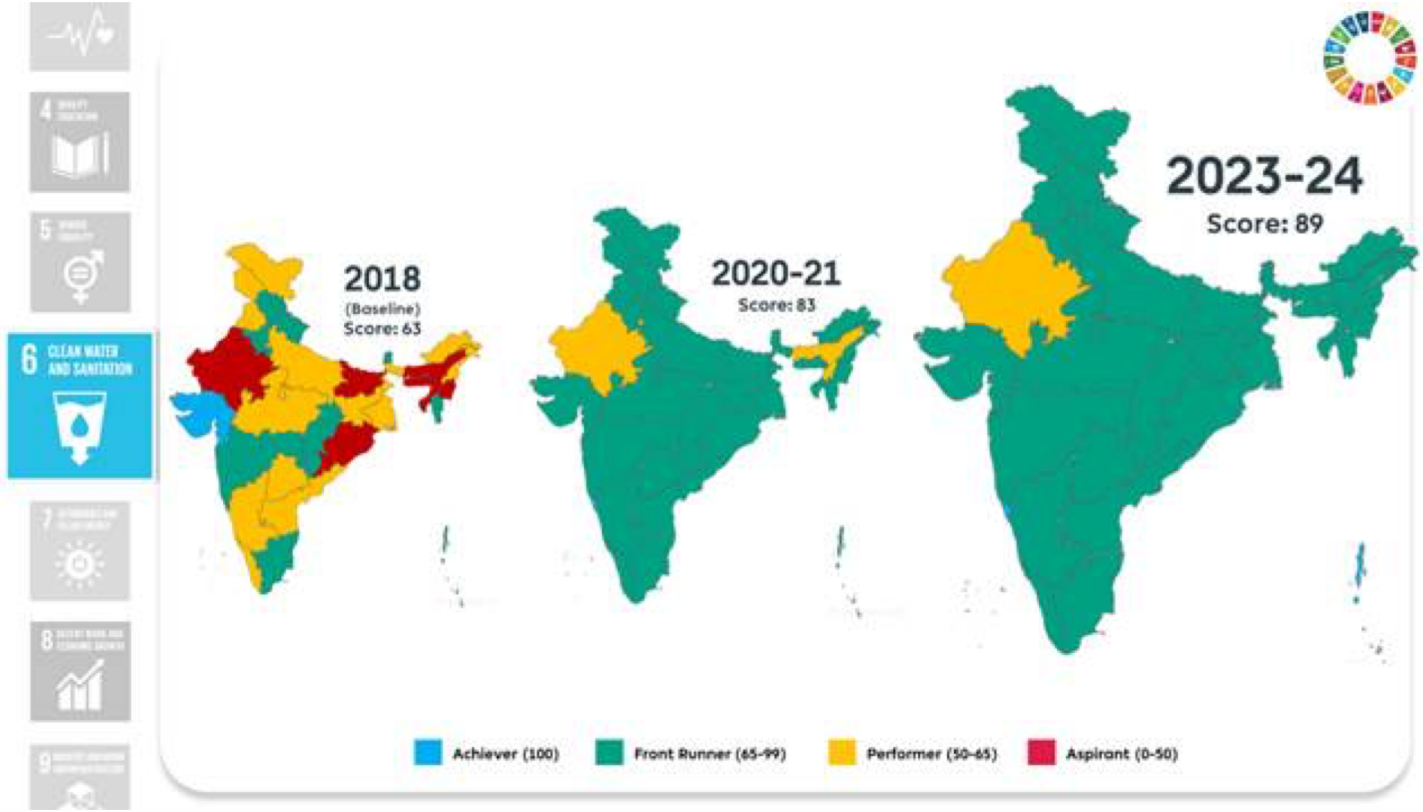


Source: Sustainability Development Report 2023

India’s SDG progress (2018-2023)



SDG 6 in India



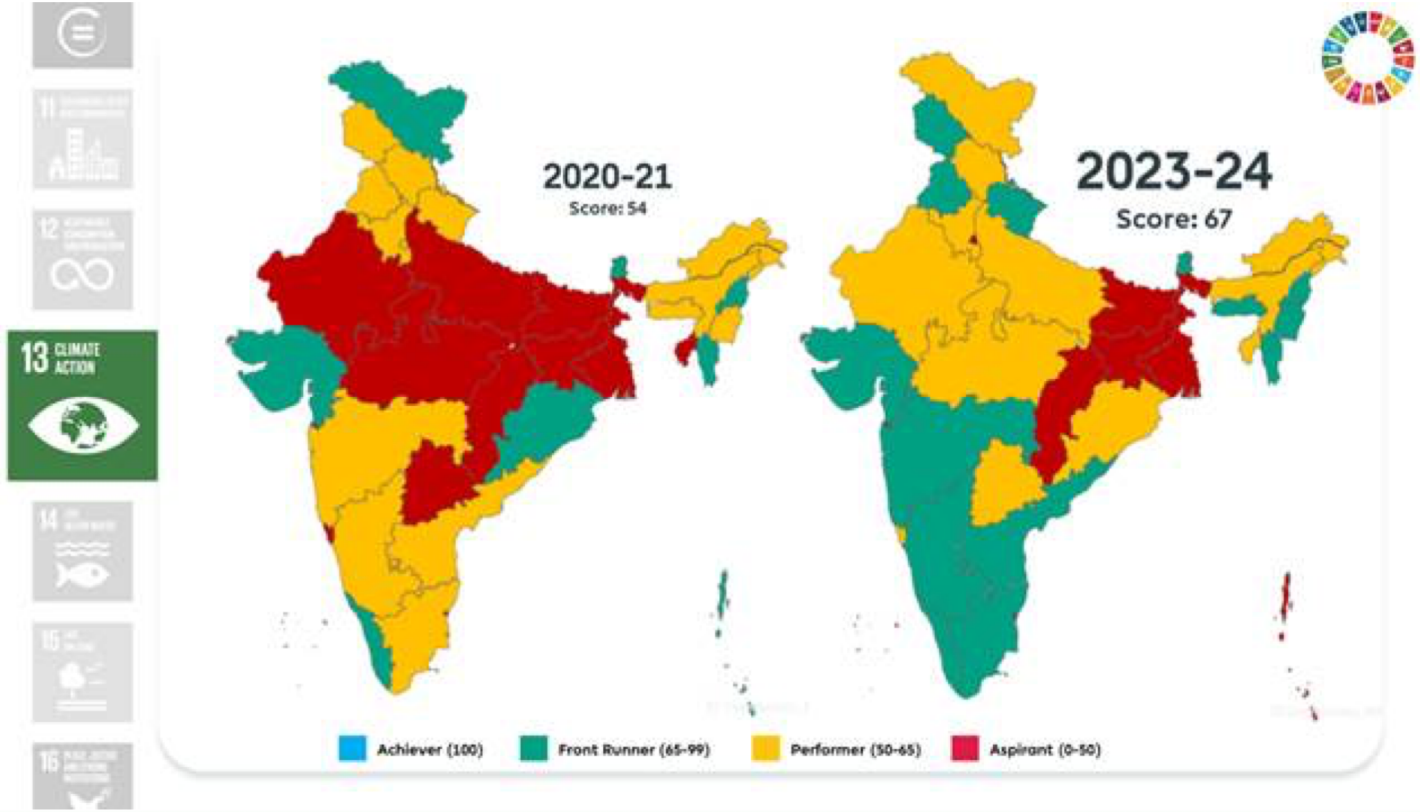
SDG 6: gap with UN SDG 2030





Source: Garai, Roy & Pramanick (2025)

SDG 13 in India



SDG 13: gap with UN SDG 2030

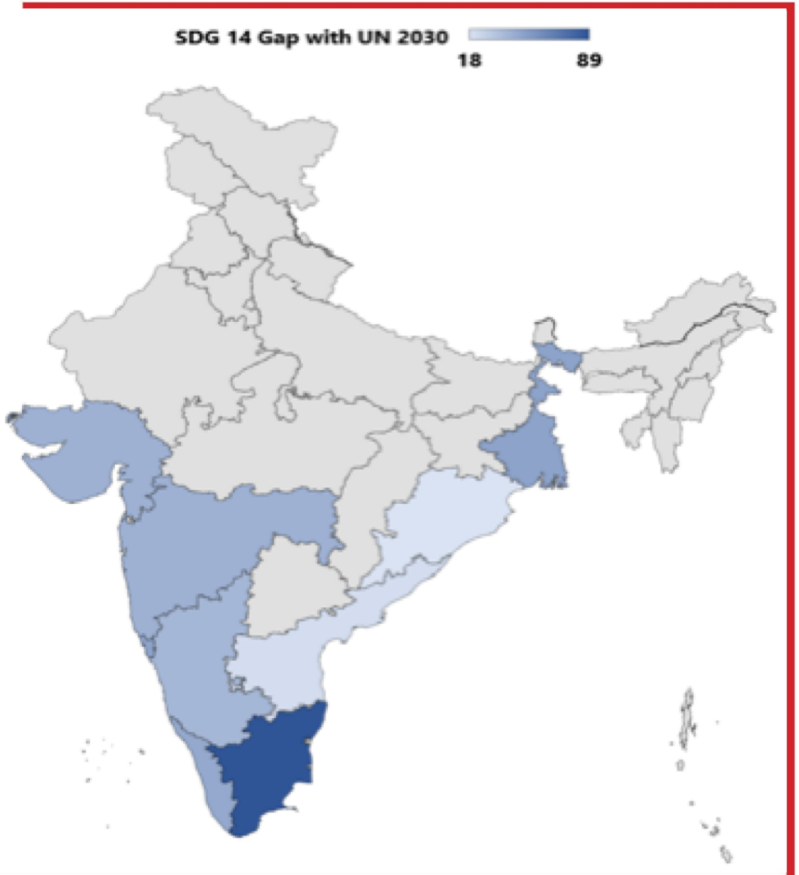




Source: Garai, Roy & Pramanick (2025)

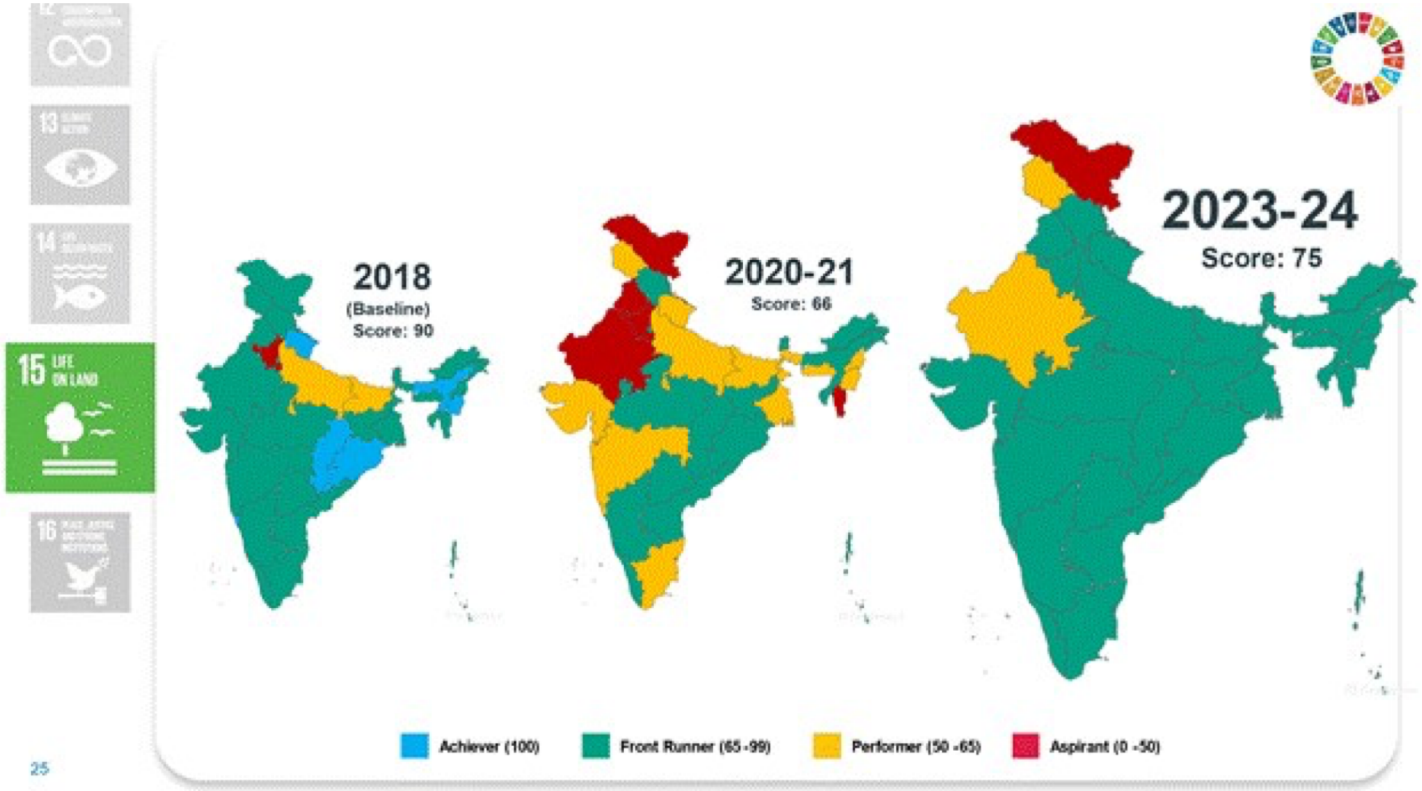
SDG 14: gap with UN SDG 2030





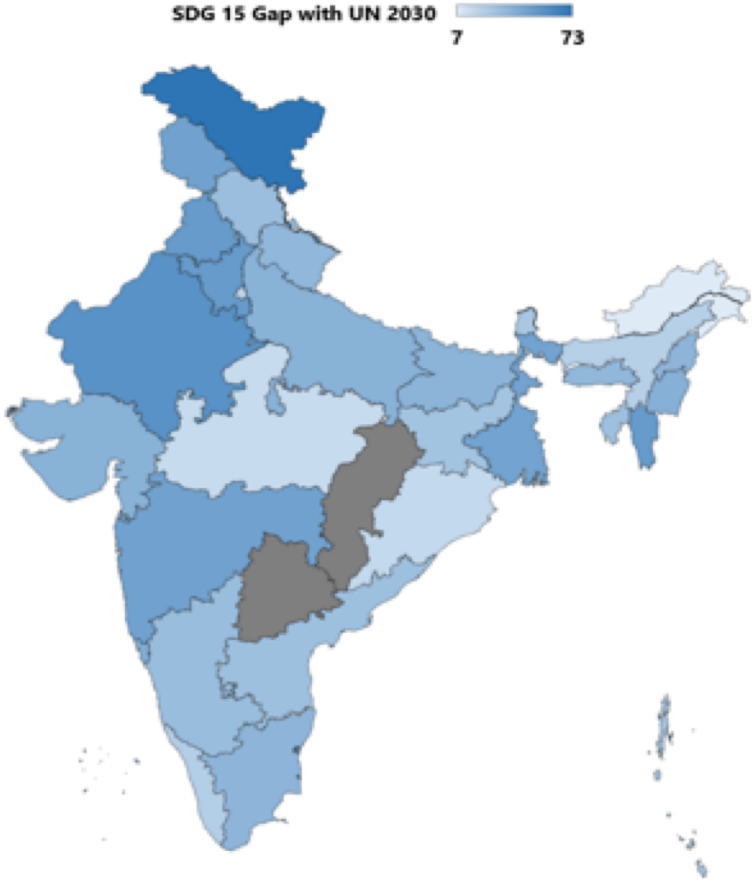
Source: Garai, Roy & Pramanick (2025)

SDG 15 in India



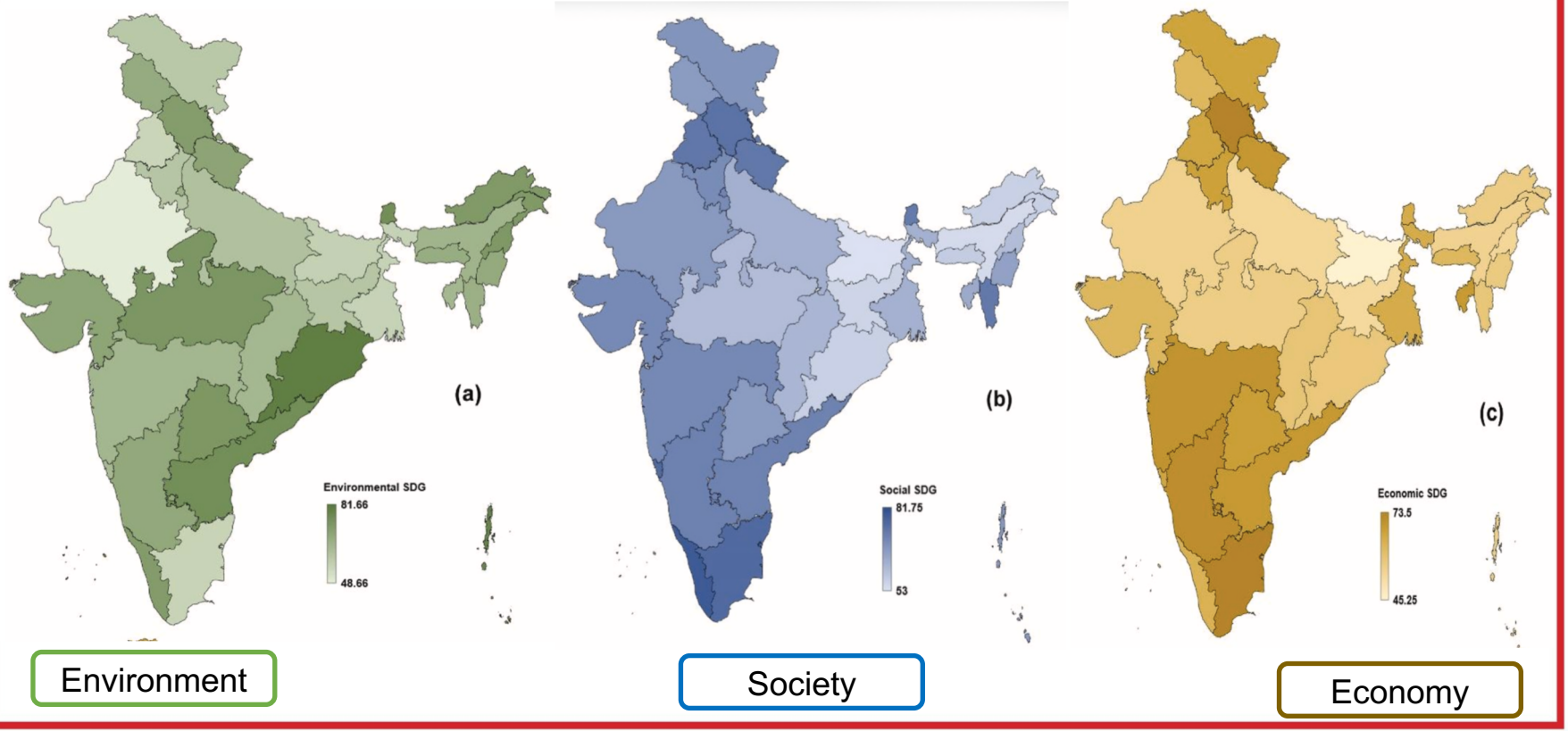
SDG 15: gap with UN SDG 2030





Source: Garai, Roy & Pramanick (2025)

India's SDG performance



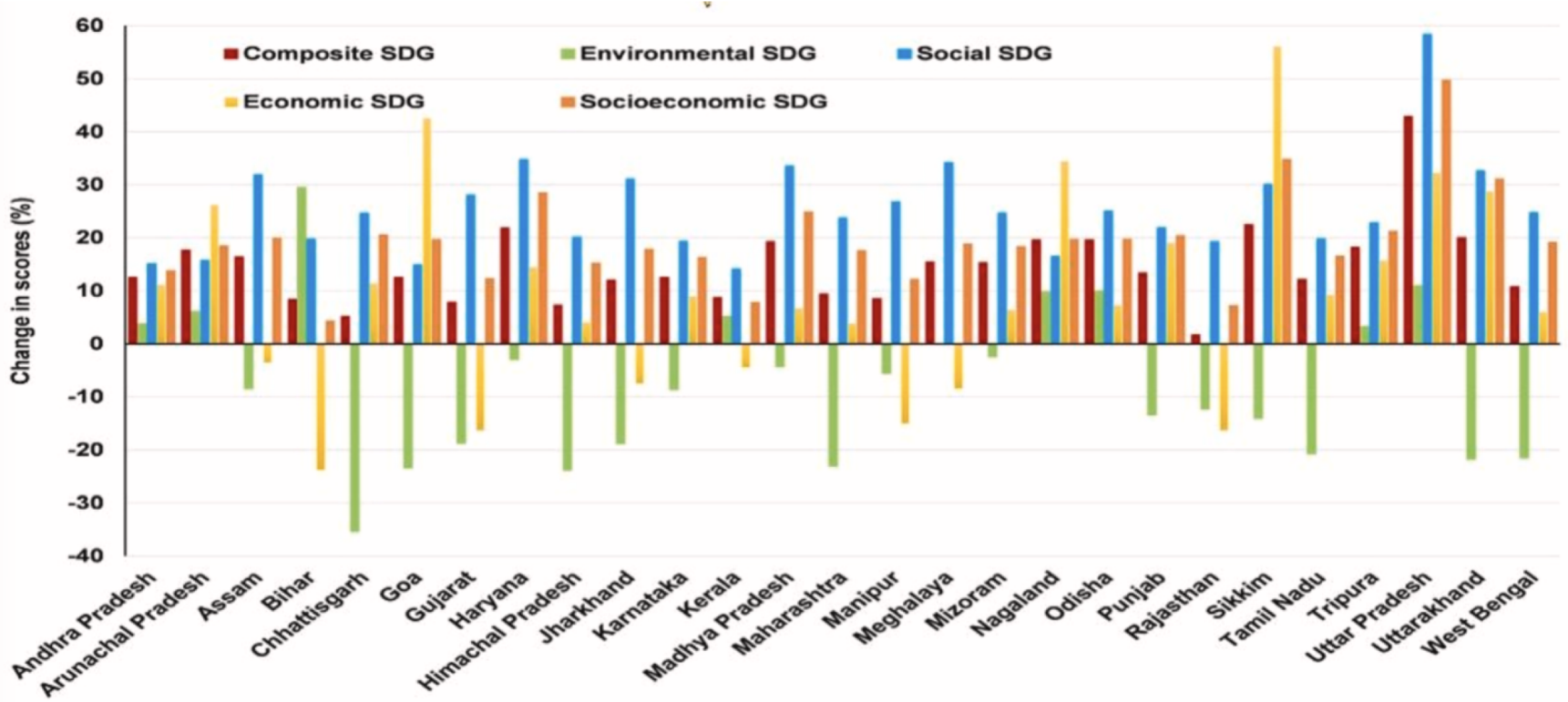
Environment

Society

Economy

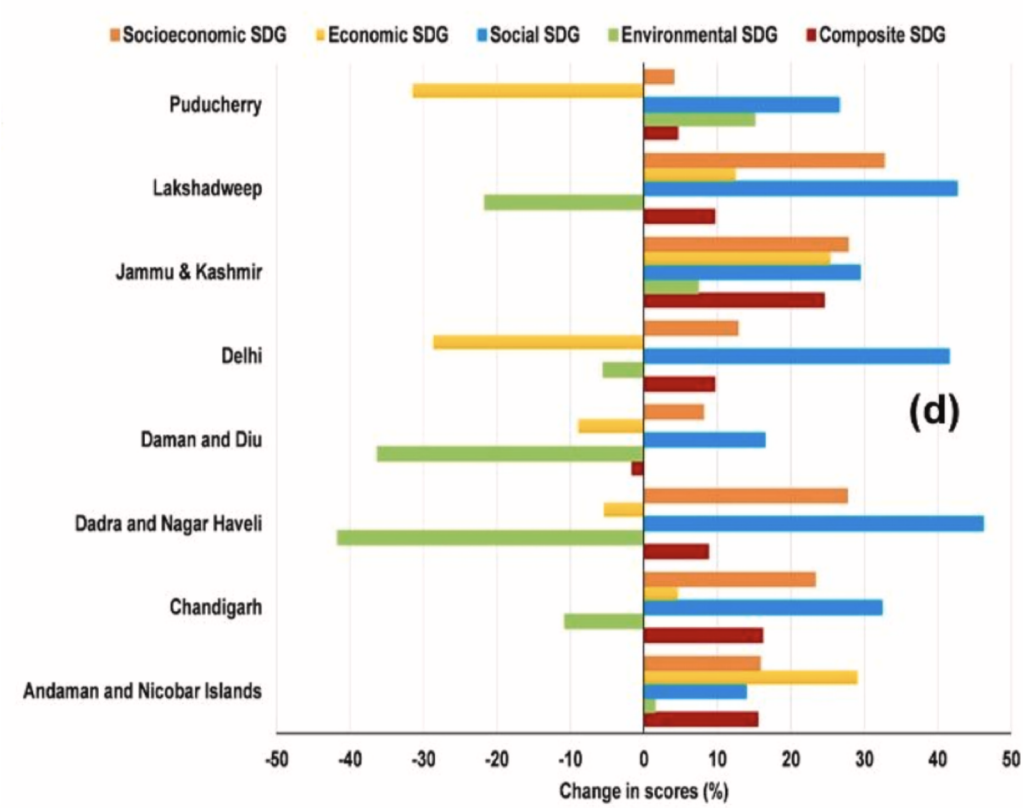
Source: Garai, Roy & Pramanick (2025)

Indian states' SDG performance



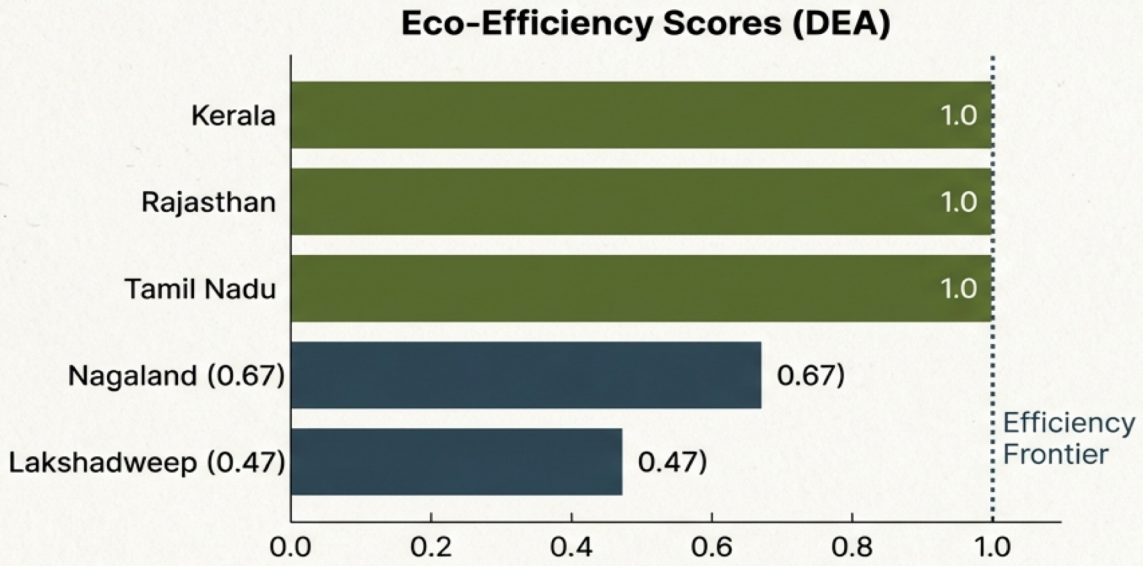
Source: Garai, Roy & Pramanick (2025)

Indian UTs' SDG performance



Source: Garai, Roy & Pramanick (2025)

The Efficiency Frontier: Converting Resources to Well-being

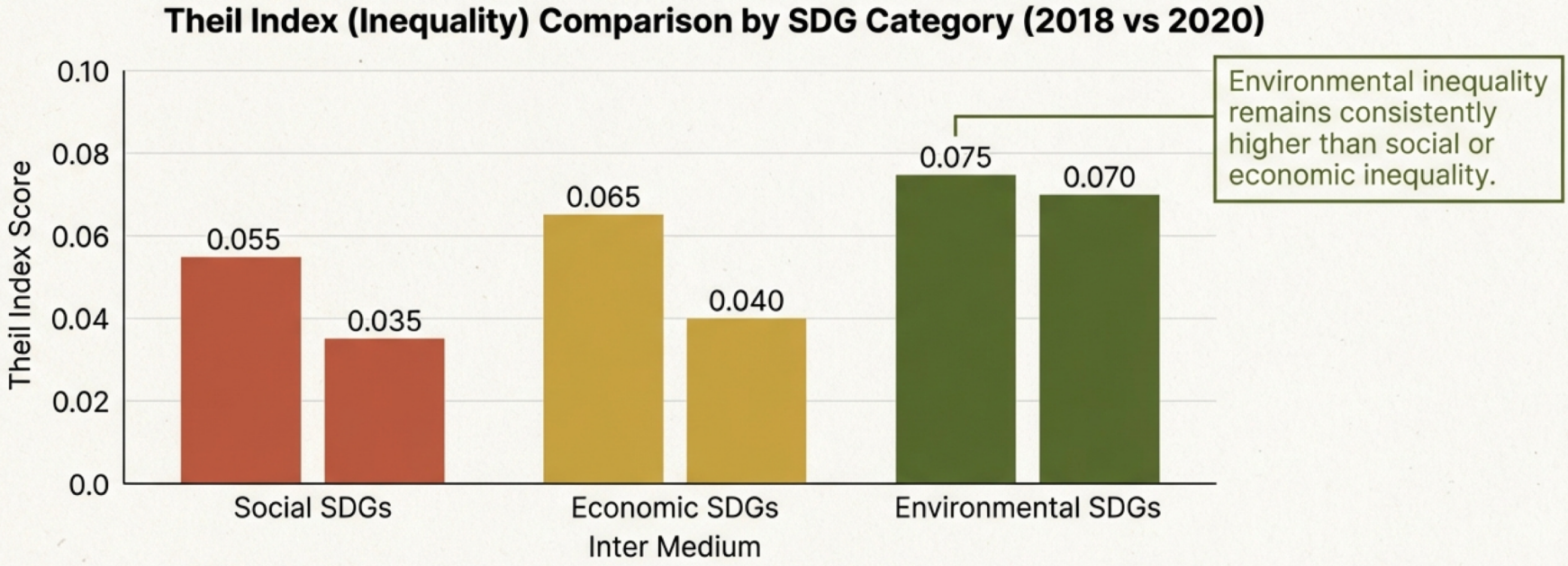


The Metric: How much social well-being is generated per unit of environmental impact?

Insight: **High-income states like Gujarat show high 'environmental slack'—they could reduce environmental inputs by ~30% while maintaining the same economic output.**

Source: Garai, Roy & Pramanick (2025)

The Inequality Trap: Diverging Environmental Burdens



While social gaps (Health, Water) are closing, the burden of environmental degradation is concentrating in specific regions.

Source: Garai, Roy & Pramanick (2025)

Benchmarking: Global and National Standards

	Environment	Social	Economic
Kerala	Lagging Global Avg	Exceeding Global Avg	On Par
Gujarat	Lagging Global Avg	Lagging Global Avg	Exceeding Global Avg
Bihar	Lagging Global Avg	Lagging Global Avg	Lagging Global Avg
Himachal	Lagging Global Avg	Exceeding Global Avg	On Par
Islands	Exceeding Global Avg	On Par	On Par

Environment: Most states lag behind global benchmarks.
Social: Select states outperform the world.
Economy: Industrial hubs exceed averages, but the core lags.

Source: Garai, Roy & Pramanick (2025)



- A pronounced North-South divide exists; southern and northern states significantly outpace central and eastern regions in overall SDG progress.
- Kerala, Himachal Pradesh, and Tamil Nadu are consistent top performers, while Bihar, Uttar Pradesh, and Jharkhand continue to lag.
- Rapidly industrializing states like Gujarat and Maharashtra excel in economic goals but show declining environmental scores.
- Despite being national priorities, state-level inequality in addressing poverty (SDG 1) and hunger (SDG 2) increased during the study period.
- Environmental disparities remain significantly higher and more persistent than social or economic gaps across all states and UTs.
- SDG 3 (Health) showed dramatic evenness improvements (2018–2020), reflecting intensified health system focus during the pandemic.
- Air pollution-related DALYs (Disability-Adjusted Life Years) show high network centrality, linking environmental quality directly to public health outcomes.



- States like Rajasthan and Kerala are "perfectly efficient" at converting environmental inputs into socio-economic benefits.
- Sustainable development gains are primarily driven by technological innovation and improved practices rather than simple scale adjustments.
- Hierarchical clustering identified five distinct state profiles, providing a framework for cluster-specific governance and peer learning.
- While Chandigarh leads UTs, island territories like Lakshadweep face sharp trade-offs between marine conservation and development.
- Only a few regions, such as Kerala and Chandigarh, consistently exceed global benchmarks across environmental, social, and economic dimensions.
- India must shift from siloed approaches to integrated state-level actions and mandatory technology transfers from leading to lagging states.

Executive Summary:

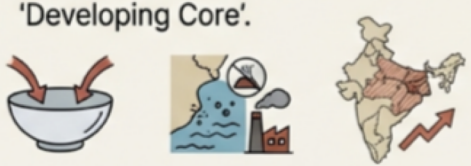
THE DIAGNOSIS (GOOD)

- **North-South Dominance:** Southern and Northern states consistently outperform Central/Eastern regions.
- **Health Surge:** Significant improvement in Good Health (SDG 3), driven by pandemic-era focus.
- **Social Convergence:** Inequalities in social and economic sectors are shrinking across most states.



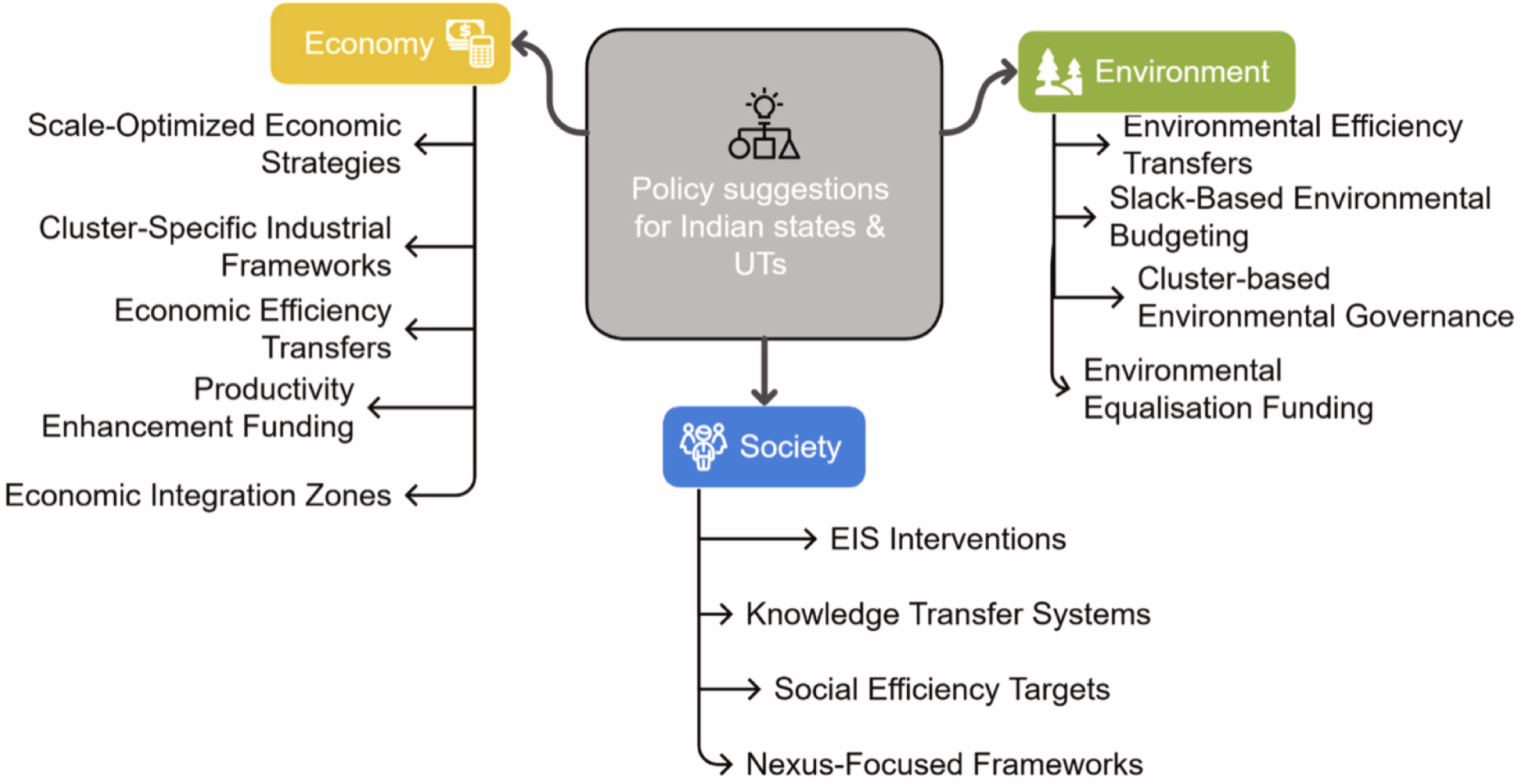
THE SYMPTOMS (BAD)

- **The Hunger Gap:** Unlike other metrics, disparities in 'Zero Hunger' (SDG 2) are widening.
- **Environmental Trade-offs:** Coastal Union Territories show strong negative correlation between economic growth and marine ecosystems.
- **Persistent Laggards:** Central and Eastern states (e.g., Bihar, Jharkhand) remain stuck in the 'Developing Core'.



Source: Garai, Roy & Pramanick (2025)

Policy suggestions for SDG



Source: Garai, Roy & Pramanick (2025)

Policy Pathways: Optimizing the Economic Engine



Scale-Optimization

Capital expansion for increasing-return states (Haryana).

Efficiency Transfers

Mandatory knowledge exchange from Benchmark states (Rajasthan) to Laggards

Cluster-Specific Industry

Differentiated policies for Northeast vs. Industrial West.

Source: Garai, Roy & Pramanick (2025)

Policy Pathways: Integrating the Doughnut



Slack-Based Budgeting

Binding targets to reduce environmental waste in high-output states (Gujarat).

Equalization Funding

Direct funds to regions with high Environmental Inequality indices.

Nexus Frameworks

Cross-ministry planning for the Poverty-Hunger-Education nexus.

Source: Garai, Roy & Pramanick (2025)

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Unravelling sustainable development at the sub-national scale in India

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In local Bengali newspaper (Ei Samay)

ANIL AGARWAL DIALOGUE 2026

অর্থনীতিতে এগোলেও উন্নত হয়নি পরিবেশ

শ্যামগোপাল রায়

দেশের একাধিক রাজ্য উন্নয়ন অর্জনের পথে এগোলেও সেই উন্নয়ন সব রাজ্যের ক্ষেত্রে সমান নয়। কিছু রাজ্য ও কেন্দ্রশাসিত অঞ্চল অনেকাংশে এগিয়ে থাকলেও বাকি রাজ্যগুলির অবস্থান ২০৩০-এর লক্ষ্যমাত্রা থেকে অনেকটাই দূরে। নীতি আয়োগ ২০৩০-এর মধ্যে দেশের সার্বিক উন্নয়নের যে লক্ষ্যমাত্রা রেখেছে, তাকে সামনে রেখেই করা হয়েছে এই সমীক্ষা। এর পাশাপাশি সমীক্ষায় জানানো হয়েছে, অর্থনৈতিক সমৃদ্ধি হচ্ছে পরিবেশকে যথেচ্ছ ভাবে ধ্বংস করে। সম্প্রতি 'এনভায়রনমেন্টাল ডেভেলপমেন্ট' নামক আন্তর্জাতিক জার্নালে প্রকাশিত একটি সমীক্ষা রিপোর্টে এমনই তথ্য উঠে এসেছে। ওই সমীক্ষায় আরও জানানো হয়েছে, অর্থনৈতিক অগ্রগতির ক্ষেত্রে যে টার্গেট রয়েছে—সেই টার্গেট পূরণে কয়েকটি রাজ্য ও কেন্দ্রশাসিত অঞ্চল বেশ কিছুটা এগিয়ে থাকলেও বাকি রাজ্যগুলির অবস্থান ২০৩০-এর নির্ধারিত লক্ষ্যমাত্রার চেয়ে অনেকটাই দূরে। পশ্চিমবঙ্গের অবস্থান এই সূচকে ২৩তম। গবেষকদের মতে, বাংলায় স্বাস্থ্য ও শিক্ষার সূচক তুলনামূলক ভাবে উন্নত হলেও পরিবেশ সংরক্ষণ, বর্জ্য ব্যবস্থাপনা ও টেকসই শহর নির্মাণের পরিকল্পনায় ঘাটতি রয়েছে। বাংলার অর্থনৈতিক উন্নয়ন তুলনামূলক ভাবে প্রতিবেশী উত্তর-পূর্ব ভারতের রাজ্যগুলির তুলনায় উন্নত। গবেষকদের সুপারিশ, বাকি ভারতের উন্নয়নের দৌড়ে সামিল হতে বাংলাকে বেশ কিছু ভারসাম্যমূলক পদক্ষেপ করতে হবে।

কী বলছে সমীক্ষা

সামগ্রিক উন্নয়নে সেরা
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- তামিলনাড়ু
- গোয়া
- চণ্ডীগড়

পরিবেশগত ক্ষেত্রে সেরা
- ওড়িশা
- অন্ধ্রপ্রদেশ
- সিকিম
- কেরালা
- লক্ষদ্বীপ

পিছিয়ে
- কেরালা
- হিমাচলপ্রদেশ
- তামিলনাড়ু
- গোয়া
- চণ্ডীগড়

পিছিয়ে
- পশ্চিমবঙ্গ
- তামিলনাড়ু
- গুজরাট
- মহারাষ্ট্র
- ছত্তিসগড়

এই সমীক্ষাটি করেছেন প্রেসিডেন্সি বিশ্ববিদ্যালয়ের অধ্যাপক কৌশিক প্রামাণিক এবং দুই গবেষক নন্দিনী গড়াই ও অভিজ্ঞ রায়। রাষ্ট্রপুঞ্জ নির্ধারিত ১৭টি উন্নয়ন লক্ষ্যমাত্রার উপরে ভিত্তি করে দেশের ২৮টি রাজ্য ও ৯টি কেন্দ্রশাসিত অঞ্চলের মধ্যে ১১২টি সূচক বিশ্লেষণ করে করা হয়েছে সমীক্ষাটি। এর মধ্যে রয়েছে দারিদ্র, ক্ষুধা, শিক্ষা, স্বাস্থ্য, সামাজিক বৈষম্য, পানীয় জল, প্রচলিত ও অপ্রচলিত শক্তি, শিল্প, পরিকাঠামো, দূষণ, টেকসই শহর, জলবায়ু কর্মকাণ্ড থেকে জীববৈচিত্র সংক্রান্ত তথ্য। সমীক্ষায় উঠে এসেছে, কেরালা, তামিলনাড়ু, হিমাচলপ্রদেশ, চণ্ডীগড় এবং পুদুচেরি স্বাস্থ্যের উন্নতি ও অর্থনৈতিক উন্নয়নের মধ্যে ভারসাম্য বজায় রেখে এগোচ্ছে। অন্য দিকে, বিহার, ঝাড়খণ্ড ও মধ্যপ্রদেশ দারিদ্র ও ক্ষুধার সঙ্কটের নিরিখে দৌড়ে পিছিয়ে পড়ছে। পরিবেশগত সূচকে আরও উদ্বেগজনক তথ্য উঠে এসেছে সমীক্ষায়। তামিলনাড়ু, মহারাষ্ট্র ও গুজরাট অর্থনৈতিক ভাবে উন্নত হলেও পরিবেশগত অবক্ষয় সেখানে তীব্র।



সমীক্ষায় জানানো হয়েছে, জাতীয় গড় দিয়ে দেশের প্রকৃত চিত্রটা বোঝানো যায় না। রাজ্যভিত্তিক বৈষম্য না মেটালে ২০৩০ সালের মধ্যে লক্ষ্যমাত্রা পূরণ শুধুমাত্র কাগজ-কলমেই সীমাবদ্ধ থেকে যাবে। তাই অঞ্চলভিত্তিক তথ্যনির্ভর নীতি গ্রহণ, পরিবেশ-অর্থনীতির ভারসাম্য এবং সামাজিক বিনিয়োগ বাড়ানোর পরামর্শ দিয়েছেন গবেষকরা। কৌশিকের কথায়, 'টেকসই উন্নয়নের মাপকাঠিতে ভারত এগোচ্ছে, কিন্তু সব রাজ্যকে নিয়েই এগোতে হবে। না হলে সার্বিক উন্নয়ন অসম্পূর্ণই থেকে যাবে।'

Link: https://eisamay.com/nation/india-grew-in-economic-sectors-but-environmental-condition-is-very-poor/200408244.cms

ANIL AGARWAL DIALOGUE 2026

Existing Indian Policies for SDG 6

Goal 6: Clean Water and Sanitation

- Swachh Bharat Mission
- Jal Jeevan Mission (JJM)
- AMRUT 2.0 Scheme
- PM Krishi Sinchayee Yojna (PMKSY)
- Mission Amrit Sarovar
- Jal Shakti Abhiyan: Catch the Rain
- Atal Bhujal Yojana
- Pradhan Mantri Krishi Sinchayee Yojana
- National River Conservation Programme (NRCP)
- Namami Gange - Integrated Ganga Conservation Mission
- National Perspective Plan (NPP)

Existing Indian Policies for SDG 13

Goal 13: Climate Action

- National Action Plan on Climate Change
- National Mission for Sustaining the Himalayan Ecosystem
- National Clean Air Programme
- National Mission for a Green India
- National Solar Mission
- National Mission for Enhanced Energy Efficiency
- National Water Mission
- Compensatory Afforestation Fund Management and Planning Authority (CAMPA)
- National Mission for Sustainable Agriculture
- National Cyclone Risk Mitigation Project

Source: SDG India Index 2023-24 (NITI Aayog)

Existing Indian Policies for SDG 14

Goal 14: Life Below Water

- Neel Kranti Mission (Blue Revolution)
- National Plan for conservation of Aquatic Ecosystems (NPCA)
- Pradhan Mantri Matsya Sampada Yojana
- Sagarmala Project
- Interlinking of Rivers
- National Coastal Mission
- Ocean Services, Technology, Observation, Resources, Modelling and Science (OSTORMS)
- Mangrove Initiative for Shoreline Habitats & Tangible Incomes

Existing Indian Policies for SDG 15

Goal 15: Life on Land

- National Afforestation Programme (National Mission for a Green India)
- Integrated Development of Wild Life Habitats
- Project Tiger
- Project Elephant
- Nagar Van Yojana
- National Action Programme to Combat Desertification
- National Agroforestry Policy

Source: SDG India Index 2023-24 (NITI Aayog)

Impacts of plastics on SDG

- **SDG 3: Good Health and well-being – Plastics** can disrupt the hormone systems of humans and animals can cause local inflammation and all sorts of physiological effects.
- **SDG 6: Clean drinking water and good sanitation**
- **SDG 11: Sustainable cities & communities**
- **SDG 12: Sustainable consumption and production**
- **SDG 13: Stop climate change**
- **SDG 14: Life Below Water**
- **SDG 15: Life on Land**

NanoImpact
Volume 34, April 2024, 100507

Evaluating the potential of daily intake of polystyrene microplastics *via* drinking water in inducing PCOS and its ovarian fibrosis progression using female zebrafish

Madhuchhanda Adhikari [a], Chayan Biswas [a], Piyali Mazumdar [b], Shampa Sarkar (Biswas) [b], Kousik Pramanick [a]



মহিলাদের পিসিওএসের নেপথ্যে প্লাস্টিকও, ইঙ্গিত মিলল গবেষণায়

শ্যামগোপাল রায়

বংশবৃদ্ধি রোধ এবং অনিচ্ছিত জীবনযাপনের কারণেই শুধু নয়। মাইক্রো-প্লাস্টিকের ছোবড়ে মহিলাদের মধ্যে পলি-সিস্টিক ওভারিয়ান সিন্ড্রোম (পিসিওএস) নামক রোগে আক্রান্তের সংখ্যা বাড়ছে। কলকাতায় হওয়া সাম্প্রতিক একটি গবেষণায় উঠেএসেই ইঙ্গিত মিলেছে। গবেষণাটি হয়েছে প্রেসিডেন্সি বিশ্ববিদ্যালয়ে। দেশে এই মুহূর্তে পিসিওএস রোগের শিকার প্রায় ১০ শতাংশ মহিলা। ক্লিনিক্যাল পরীক্ষা হলে এই অনুপাত অনেক বেশি হবে বলে গবেষকদের ধারণা। বাইরে থেকে দেখে এই রোগ চিহ্নিত করা কঠিন বলেও মত তাঁদের। অনিয়মিত ঋতুচক্র, অপরিণত ডিম্বাণু, স্টেটোস্টেরনের আধিক্য, ডায়াবিটিস ও মোটা হওয়ার প্রবণতা এই রোগের প্রধান লক্ষণ।

গবেষণাপত্রটি সম্প্রতি প্রকাশিত হয়েছে একটি আন্তর্জাতিক মানের বিজ্ঞানপত্রিকা 'ন্যানো ইমপ্যাক্ট' জার্নালে। দাবির সপক্ষে সাতকের গবেষকরা পরীক্ষা-নিরীক্ষা করেছেন জেব্রাফিশ নিয়ে। পরীক্ষার জন্য জেব্রাফিশের পেটে দেওয়ার কারণ হলো, এটি আকারে বড় হলেও জিনগত ও শারীরবৃত্তীয় ভাবে এই মাছের সঙ্গে মানুষের মিল প্রায় ৭০ শতাংশ। তা ছাড়া অন্য প্রাণীর ডিম্বাণুর সংখ্যা অনেক কম। তাই পরীক্ষা-নিরীক্ষা চালানো বেশ কঠিন। সে দিক থেকে এই মাছের ডুড়ি মেলা ভার। একসঙ্গে কয়েকশো ডিম্বাণু পাওয়ায় বেশি করে পরীক্ষা চালানোর সম্ভব হয়েছে বলে জানানো গবেষকেরা।

মানুষের শরীরে যে হারে মাইক্রো-প্লাস্টিক কণা ঢোকে, সেই হারে ৩ মাস বয়সী জেব্রাফিশকে মাইক্রোপ্লাস্টিক কণা মিশ্রিত জলে ২১ দিন রাখার পরে দেখা গিয়েছে যে ডালের মধ্যে পলিসিস্টিক ওভারিয়ান সিন্ড্রোম রোগ তৈরি হয়েছে। ডিম্বাণু ও অন্যান্য স্টেটোস্টেরনের ক্ষরণ, ওজন বৃদ্ধি, ডিম্বাণুর অপরিপক্ক অবস্থায় থেকে যাওয়া, ওভুলেসন না হওয়া, ট্রী হরমোন ইস্ট্রাডিয়লের ক্ষরণ কম হওয়া, গোনাডোট্রোপিন হরমোনের অনুপাত বদলে যাওয়া প্রমাণ করে যে মাছগুলি পলিসিস্টিক ওভারিয়ান সিন্ড্রোমের শিকার। পরীক্ষায় আরও দেখা গিয়েছে, রোগাক্রান্ত মাছেদের গায়ত্বিং প্রায় দুশোগুণ স্যাভারিনের চেয়ে প্রায় দ্বিগুণ। পিসিওএস-এ আক্রান্ত মাছগুলিকে আরও ৩ মাস রাখার পরে দেখা গিয়েছে, তাদের ডিম্বাশয়ে অতিরিক্ত কোলাজেন ও মান ডুস পাওয়ায় প্রক্রমন ক্রিয়া ব্যাহত হয়।

পরীক্ষায় প্রাপ্ত তথ্য মানুষের উপরেও একই ভাবে খাটে বলে মনে করছেন গবেষকরা। প্রতিদিন মাইক্রো-প্লাস্টিক কণা মানুষের শরীরে ঢোকায় পিসিওএস রোগীর সংখ্যা দিন দিন বাড়ছে। এখনই সচেতন না হলে আগামী দিনে সারা বিশ্বে মহিলাদের মধ্যে বন্ধ্যাত্বের অন্যতম কারণ হয়ে দাঁড়াবে বলে আশঙ্কা করছেন তাঁরা।

রোগ-পরিচয় পরিচয় পরিচয়

পিসিওএস কী?

পলিসিস্টিক ওভারিয়ান সিন্ড্রোম মহিলাদের সবচেয়ে 'কমন' হরমোনঘটিত অসুখ। এতে ডিম্বাশয় থেকে ডিম্বাণু নিঃসরণ বাধাপ্রাপ্ত হয়।

কী সমস্যা হয়?

অনিয়মিত ঋতুচক্র, সাময়িক বন্ধ্যত্ব, পেটে বাথা, অতিরিক্ত রক্তস্রাব, মুখে ও গায়ে পুরুষোচিত লোম, ব্রণ, ঘনঘনে ত্বকের



The Telegraph

SUNSHINE WATCH | BATTLE OF 2024 | BLEAK CHOICE | RAM REVENGE

IN BRIEF

ICSE, ISC results on Monday

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Bose barricade on 'abuse' probe

Sympathy for Pawar and Uddhav

Cong Scindia versus BJP Scindia

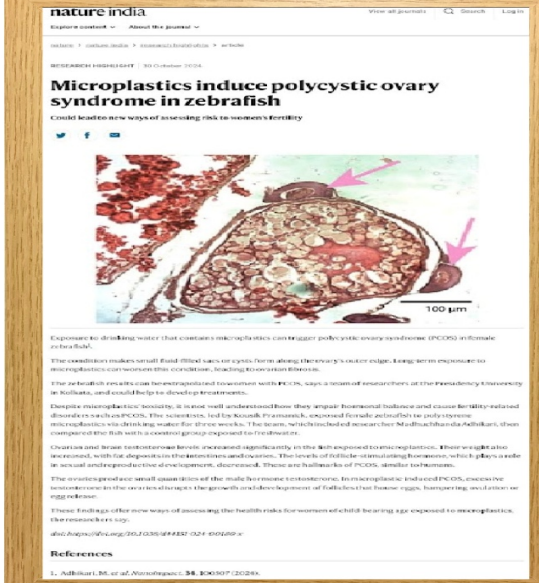
TRAINED VOLUNTEERS/ FULL SAFETY VACUUM

Armed youths in Manipur bunkers: Security forces failed to protect us

Plastic 'pests' in water raise PCOS risk

LPU SETTING RECORDS!

₹3 Crore



nature india

Microplastics induce polycystic ovary syndrome in zebrafish

Could lead to new ways of assessing risk to women's fertility

100 µm

Exposure to drinking water that contains microplastics can trigger polycystic ovary syndrome (PCOS) in female zebrafish.

The condition makes small fluid-filled sacs or cysts form along the ovary's outer edge. Long-term exposure to microplastics can worsen this condition, leading to ovarian fibrosis.

The zebrafish results can be extrapolated to women with PCOS, says a team of researchers at the Presidency University in Kolkata, and could help to develop treatments.

Despite microplastics' toxicity, it is not well understood how they impair hormonal balance and cause fertility-related disorders such as PCOS. The scientists, led by Kousik Pramanick, exposed female zebrafish to polystyrene microplastics via drinking water for three weeks. The team, which included researcher Madhuchhanda Adhikari, then compared the fish with a control group exposed to fresh water.

Ovarian and brain testosterone levels increased significantly in the fish exposed to microplastics. Their weight also increased, with fat deposits in the intestines and ovaries. The levels of follicle-stimulating hormone, which plays a role in sexual and reproductive development, decreased. These are hallmarks of PCOS, similar to humans.

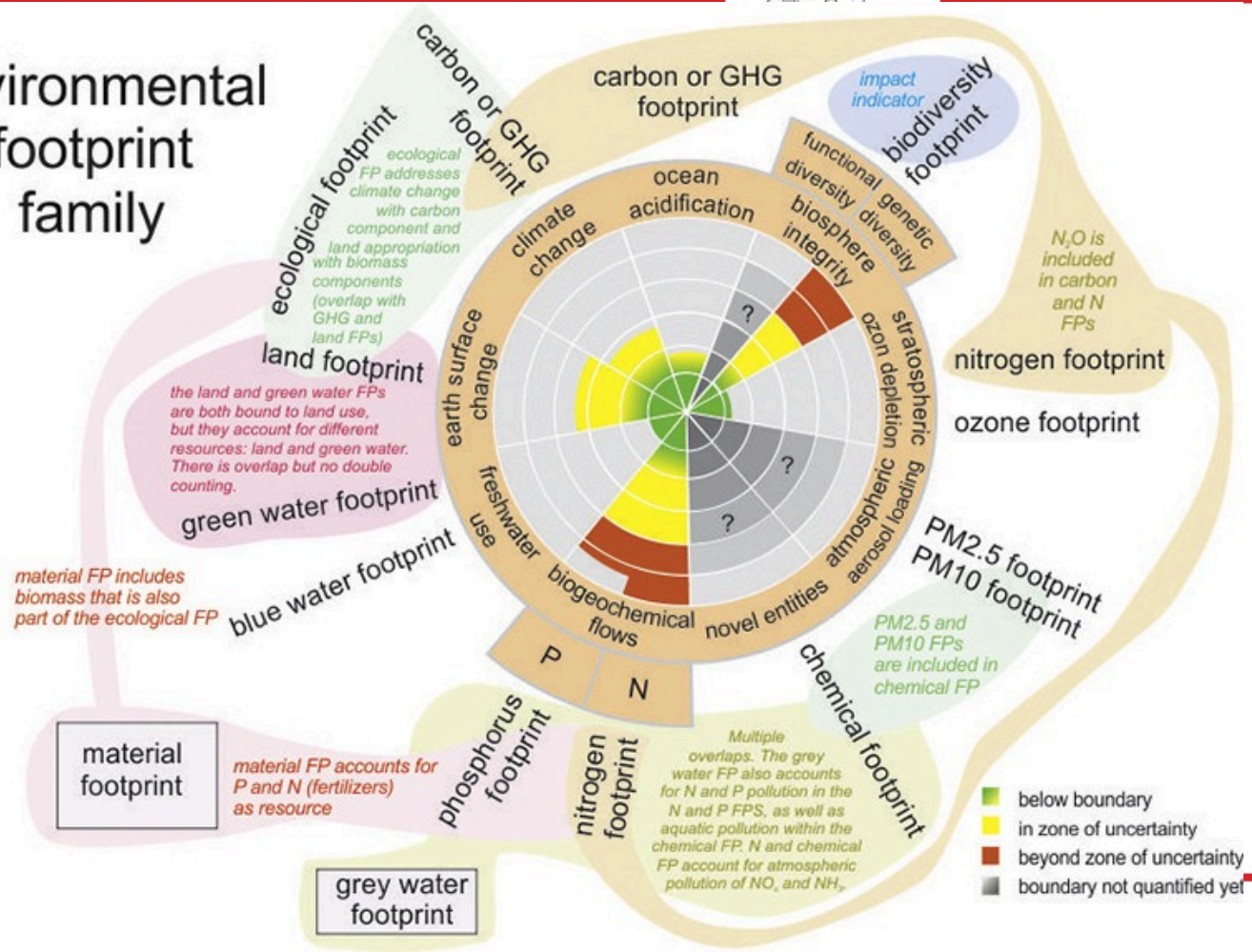
The ovaries produce small quantities of the male hormone testosterone. In microplastic-induced PCOS, excess testosterone in the ovaries disrupts the growth and development of follicles that house eggs, hampering ovulation or egg release.

These findings offer new ways of assessing the health risks for women of child-bearing age exposed to microplastics, the researchers say.

References

1. Adhikari, M. et al. *NanoImpact*, **34**, 100507 (2024).

environmental footprint family



Source: Vanham et al., 2019

ANIL AGARWAL DIALOGUE 2026

The Ecological Footprint

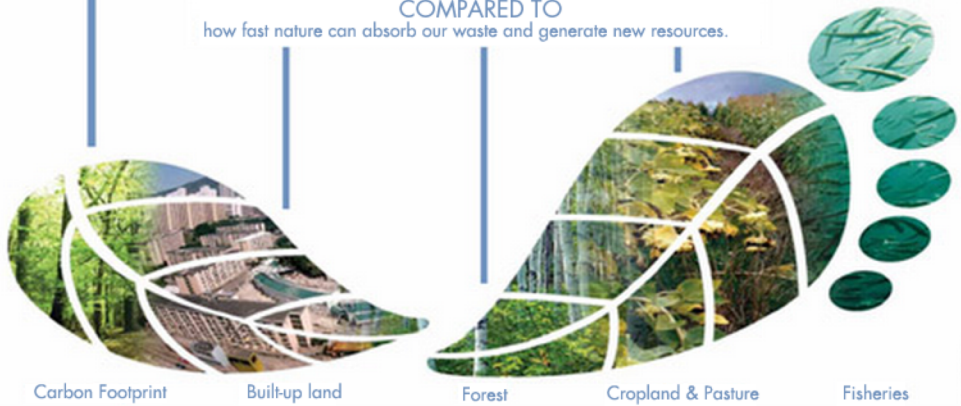
MEASURES

how fast we consume resources and generate waste



COMPARED TO

how fast nature can absorb our waste and generate new resources.



What is an ecological footprint?

It is a measure of how much biologically productive land and water an individual, population or activity requires to produce all the resources it consumes, and to absorb the waste it generates.
The Ecological Footprint is usually measured in global hectares (gha)

Carbon
Represents the amount of forest land that could sequester CO_2 emissions from the burning of fossil fuels, excluding the fraction absorbed by the oceans which leads to acidification





Cropland
Represents the amount of cropland used to grow crops for food and fibre for human consumption as well as for animal feed, oil crops and rubber



Grazing land
Represents the amount of grazing land used to raise livestock for meat, dairy, hide and wool products



Forest
Represents the amount of forest required to supply timber products, pulp and fuel wood



Built-up land
Represents the amount of land covered by human infrastructure, including transportation, housing industrial structures and reservoirs for hydropower



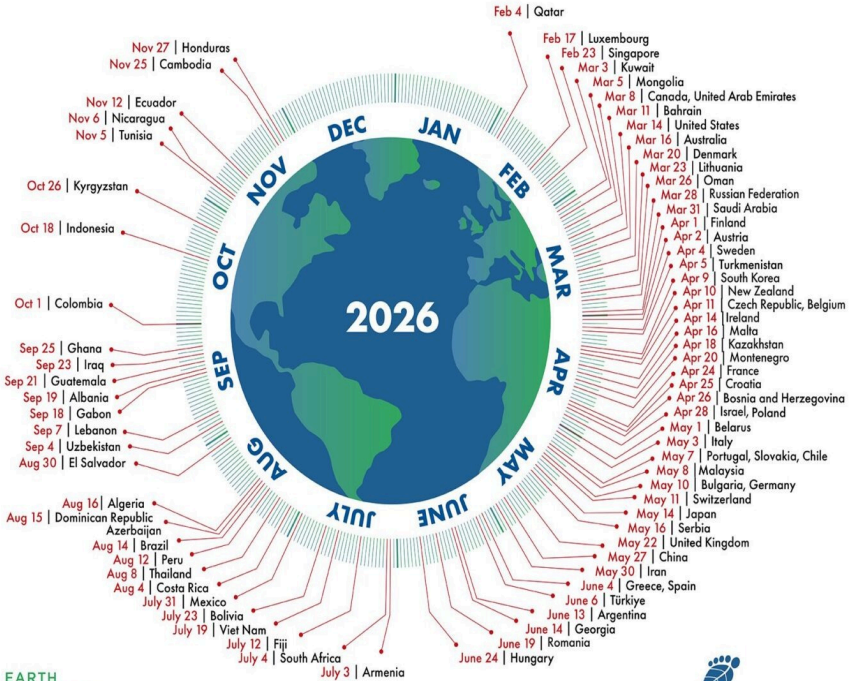
Fishing grounds
Calculated from the estimated primary production required to support the fish and seafood caught, based on catch data for marine and freshwater species

ANIL AGARWAL DIALOGUE 2026

PRESIDENCY UNIVERSITY

Country Overshoot Days 2026

When Earth Overshoot Day would land if all the people around the world lived like...



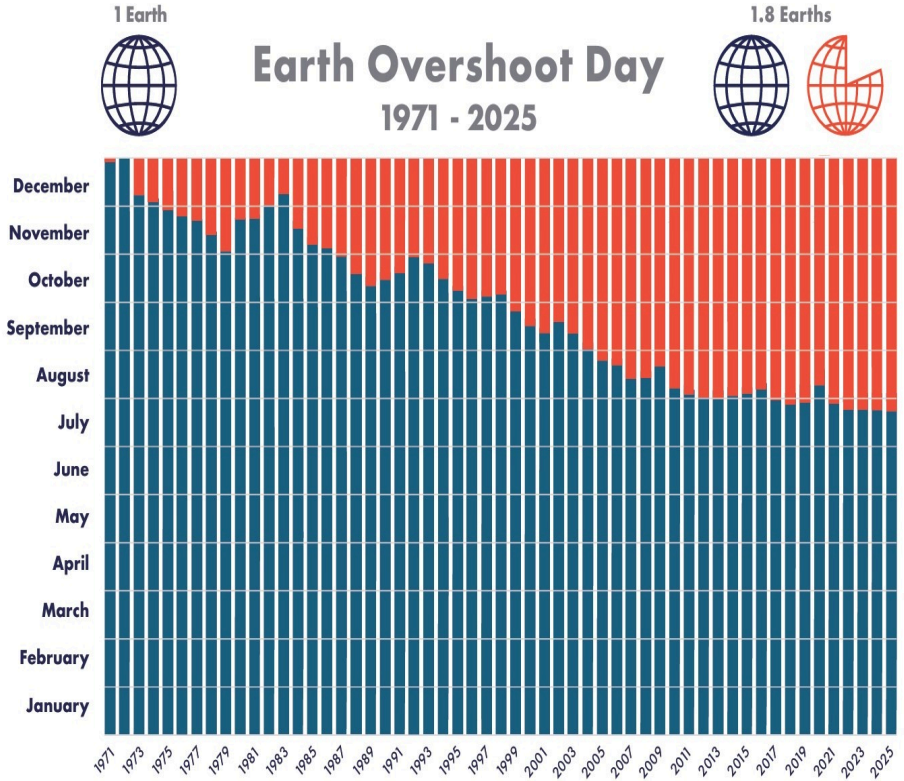
EARTH OVERSHOOT DAY

For more information, visit:
https://overshootday.org/newsroom/country-overshoot-days

Global Footprint Network
Advancing the Science of Sustainability

Source: Country Overshoot Days 2026 are calculated using the National Footprint and Biocapacity Accounts' 2025 Edition (Lo et al. 2025), produced by York University for FoDaFo and Global Footprint Network, available at data.footprintnetwork.org

Earth Overshoot Day
1971 - 2025



EARTH OVERSHOOT DAY | FODAFO FOOTPRINT DATA FOUNDATION | Global Footprint Network Advancing the Science of Sustainability | YORK U

Based on National Footprint and Biocapacity Accounts 2025 Edition

How many countries are required
to meet the demand of its citizens…



Source: Global Footprint Network National Footprint Accounts 2019

Global Footprint Network®
Advancing the Science of Sustainability

EARTH OVERSHOOT DAY



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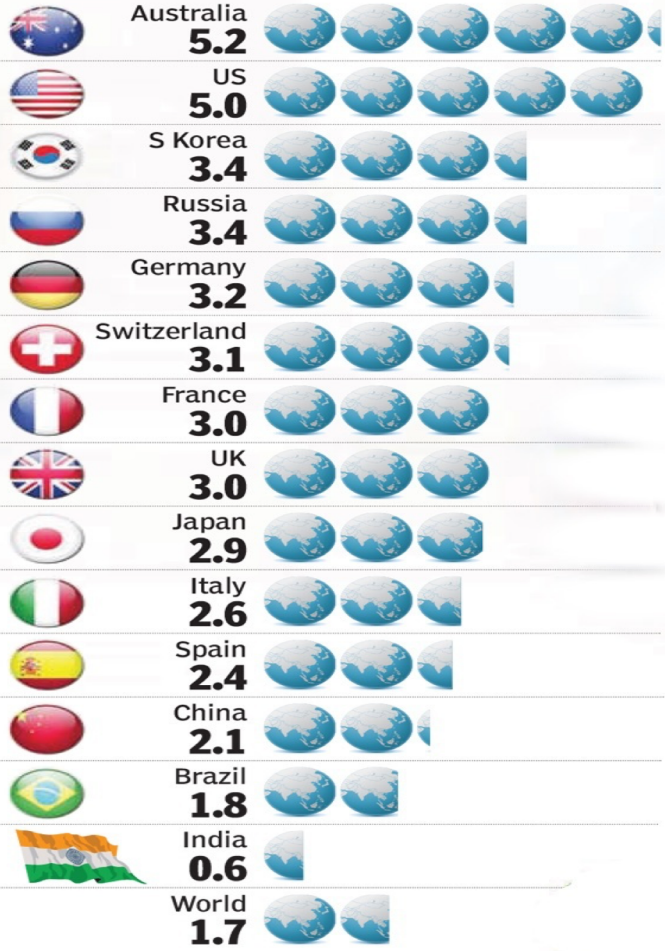
How many Earths do we need if the world's population lived like...



Water Footprint



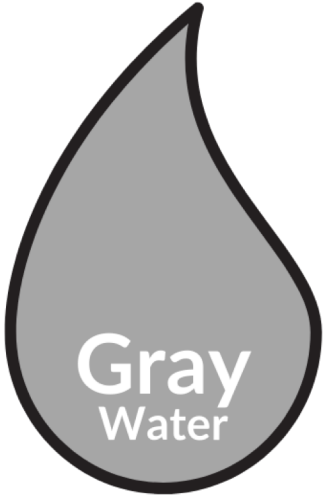
Rain water

Water from precipitation that is stored in the root zone of soil and used by plants.



Irrigation water

Surface or groundwater found in lakes, rivers, and aquifers.



Pollution Management

The amount of fresh water needed to dilute pollutants from crop growth to maintain groundwater quality standards.

The Global water footprint

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US Infrastructure
www.americainfra.com

The 'water footprint' of a country is defined as the volume of water needed for the production of goods and services consumed by the inhabitants of the country.

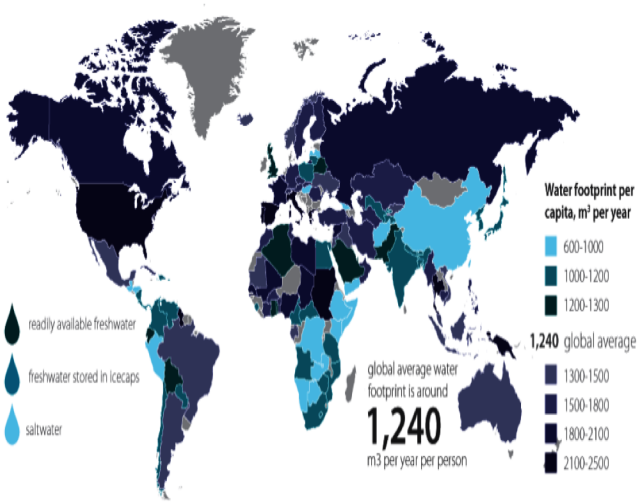
amount of freshwater available



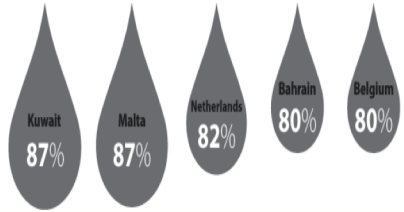
readily available freshwater

freshwater stored in icecaps

saltwater

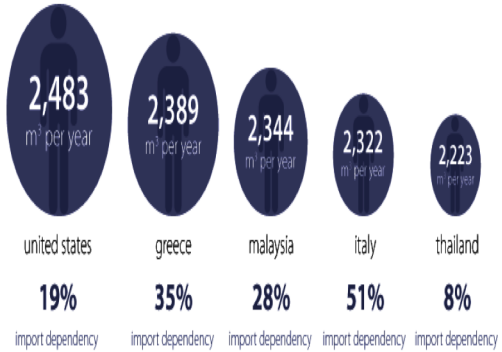


countries most dependent on water imports



70% of existing freshwater is withdrawn for irrigation in agriculture

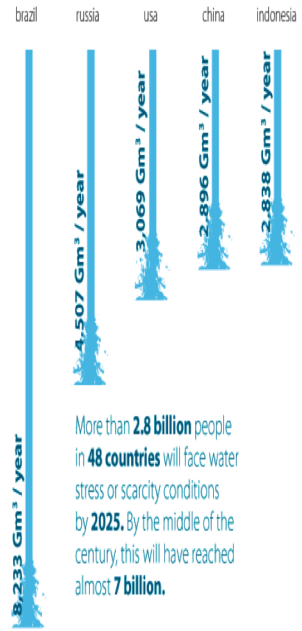
the highest water footprints per capita



water footprint of different foods

24,000 litres	15,500 litres	4,400 litres	1,500 litres	140 litres
1kg of chocolate	1kg of beef	1kg of olives	1kg of sugar	1 cup of coffee

highest renewable water resources



More than **2.8 billion** people in **48 countries** will face water stress or scarcity conditions by **2025.** By the middle of the century, this will have reached almost **7 billion.**

Source: WaterFootprint.org and WWF

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THE GLOBAL "MATERIAL FOOTPRINT"

INCREASED BY 70%

BETWEEN 2000 AND 2017

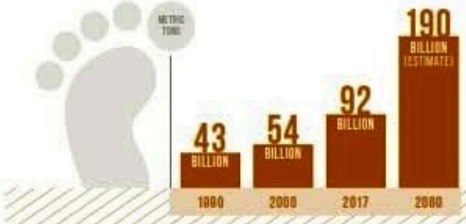


1 MILLION
PLASTIC DRINKING BOTTLES
ARE PURCHASED
EVERY MINUTE

5 TRILLION
SINGLE-USE PLASTIC BAGS
ARE THROWN AWAY
EACH YEAR

Material footprint

THE GLOBAL MATERIAL FOOTPRINT IS RAPIDLY GROWING, OUTPACING POPULATION AND ECONOMIC GROWTH



MATERIAL FOOTPRINT PER CAPITA IN HIGH-INCOME COUNTRIES IS

60% HIGHER
THAN IN UPPER-MIDDLE-INCOME COUNTRIES AND MORE THAN
13 TIMES
THE LEVEL OF LOW-INCOME COUNTRIES



DEVELOPED COUNTRIES
USE ONE FIFTH OF NATURAL RESOURCES
TO PRODUCE THE SAME AMOUNT OF ECONOMIC OUTPUT AS DEVELOPING COUNTRIES

NEARLY 100 COUNTRIES ARE **ACTIVELY** ADOPTING POLICIES AND MEASURES TO PROMOTE SUSTAINABLE CONSUMPTION AND PRODUCTION

303 POLICIES AND INSTRUMENTS ARE IN PLACE GLOBALLY

Source: SDG Report (UN DESA)

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10 Steps to Reduce Your Environmental Footprint



“Every individual soul is potentially divine”, proclaimed Swami Vivekananda.

Sarvam Khalvidam Brahma“ (everything is Brahman)

Ancient Indian culture, thus, has always had a deep understanding of ecology and the relationship between man and nature.





Ayam Nijah Paroveti Ganana Laghu Chetasaam

Udaara Charitaanaam tu Vasudhaiva Kutumbakam

It says: “Small and narrow-minded people look at the reality in terms of ‘this is yours and this is mine’; for those of higher consciousness the whole world is a family”.



Apart from this, the recognition that every animal played a role in creating an ecological balance, allowed us to live in harmony with animals.

The holy prayer from time immemorial has been:

सर्वे भवन्तु सुखिनः
सर्वे सन्तु निरामयाः।
सर्वे भद्राणि पश्यन्तु
मा कश्चिद्दुःखभाग्भवेत्।

May All be Happy,
May All be Free from Illness.
May All See what is Auspicious,
May no one suffer from grief.

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