

Genomic solutions to sustainable development

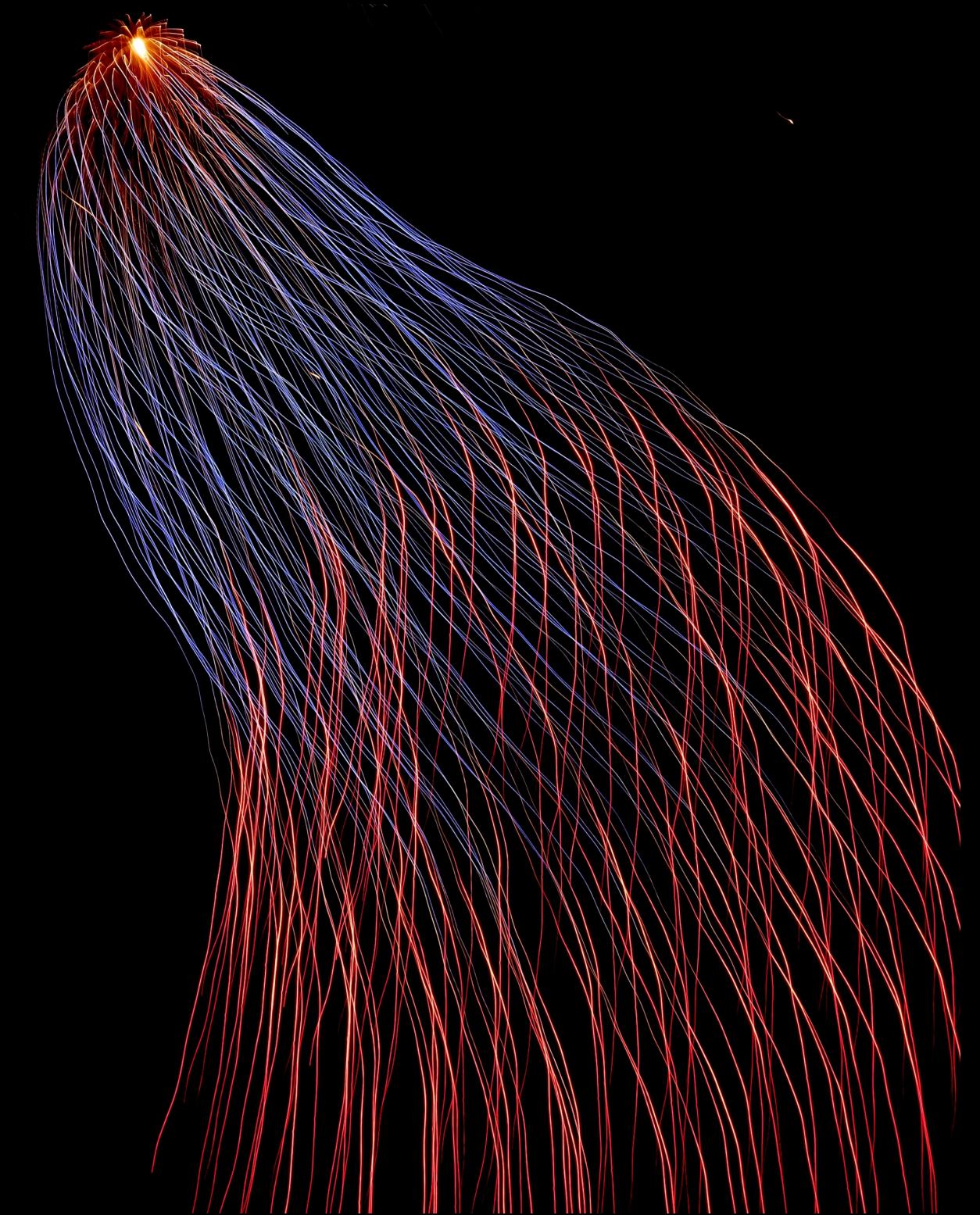
**Week 1 — Introduction to
UN SDGs and policies**

18 February 2025

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Genome research, biomedical data science, AI/ML, neuro-oncology

Early-life health, aging, and sustainability

■ Childhood cancer & long-term health

- 80% of children diagnosed with cancer are cured
- 500,000 childhood cancer survivors in the United States
- Cancer survivors face plethora of late effects (eg, cardiovascular, endocrine, chronic pain)

■ Decade of healthy aging (2020-2030)

- Demographic aging is a global challenge
- Need for healthy aging and improved healthcare
- Healthy aging promotes decision-making that is global, inclusive, and sustainable



Source: *Ageing and Old Age in Contemporary Society*, FSO

Sustainability

Sustainability is based on a simple principle: Everything that we need for our survival and well-being depends, either directly or indirectly, on our natural environment. To pursue sustainability is to create and maintain the conditions under which humans and nature can exist in productive harmony to support present and future generations. *Source: US EPA.*

However, there are different approaches to its social and political implementation:

- **Sustainable Development:** a concept that seeks to balance economic growth, environmental policies, and social well-being of people.
- **The Doughnut Model:** a framework based on planetary boundaries and social boundaries that define a safe and just space for humanity to thrive in.
- **Degrowth&Postgrowth:** philosophies advocating for reduced consumption and development of alternative economic models beyond the traditional focus on GDP growth.

2030 Agenda for Sustainable Development

A blueprint for peace and prosperity for people and the planet, now and into the future

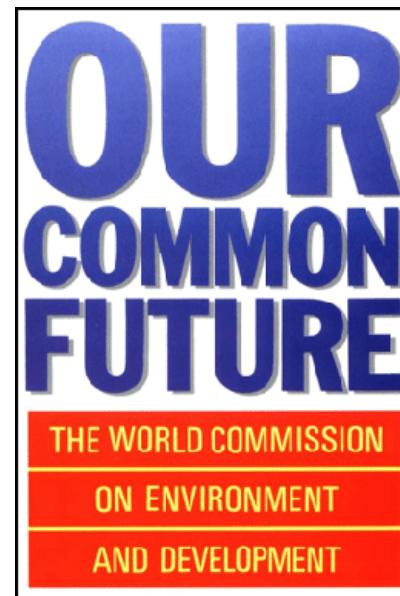
BIO-312 Genomic solutions to sustainable development



The road to 2030: from vision to action

1987

Our Common Future Report
(UN WCED/Brundtland Commission)



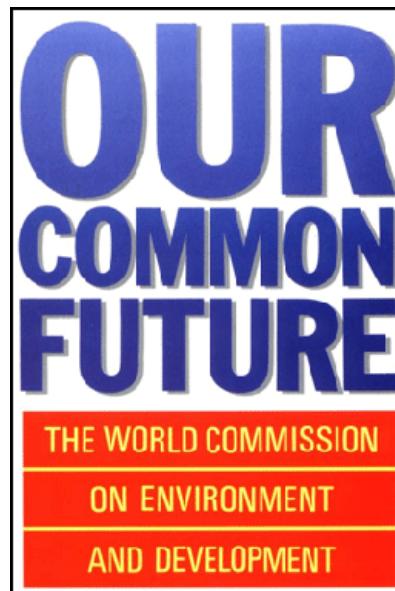
The Brundtland Report defined **Sustainable Development** as:
“Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

- Growing realisation that economic development, social inequality, and environmental protection are deeply interconnected (United Nations General Assembly 1982)
- Global environmental problems are a result of non-sustainable patterns of consumption and production in the North and poverty in the South.
- A new concept was proposed that united development and environment
- The concept of sustainable development implied limits, not absolute limits but limitations imposed by the *present state of technology* and *social organisation* on environmental resources and by the ability of the biosphere to absorb the effects of human activities

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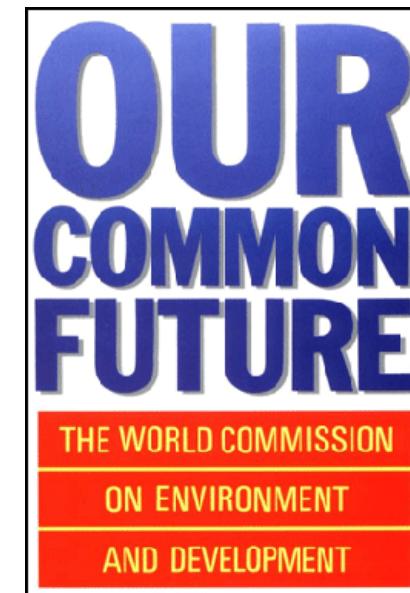
Gro Harlem Brundtland, MD

Physician and scientist in the Norwegian public health system (1966-1974)
Minister for Environmental Affairs in Norway (1974-1979)
First Female Prime Minister of Norway (1981, 1986-1989, 1990-1996)
Chair of the UN World Commission on Environment & Development (1983-1987)
Director-General of the Weald Health Organisation (1998-2003)

The road to 2030: from vision to action

1987 —→ 1992

Our Common Future
(UN WCED)



UN Earth Summit
(Rio de Janeiro)



178 countries adopted the global action plan **Agenda 21** for sustainable development. Each country developed its own **local** Agenda with the goal of achieving global sustainable development.

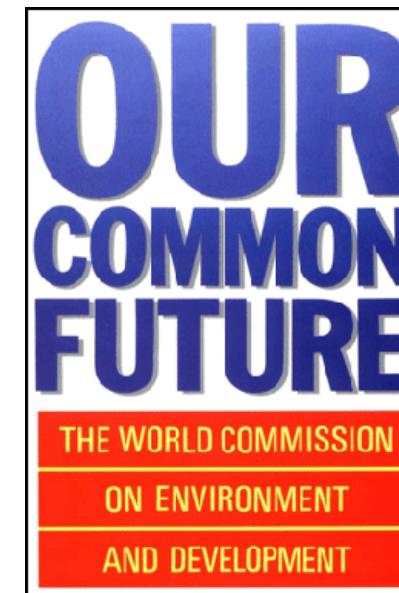
Agenda 21 is grouped into 4 sections:

- Section I: Social and Economic Dimensions (eg, poverty, health)
- Section II: Conservation and Management of Resources for Development (eg, biodiversity)
- Section III: Strengthening the Role of Major Groups (eg, children, indigenous people)
- Section IV: Means of Implementation (eg, science, technology transfer)

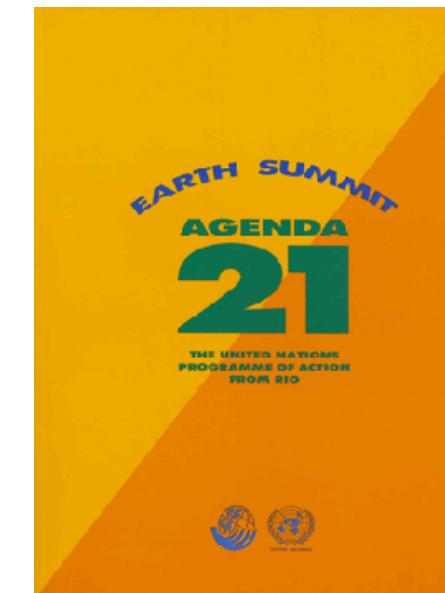
The road to 2030: from vision to action

1987 → 1992 → 2000

Our Common Future
(UN WCED)



UN Earth Summit
(Rio de Janeiro)



UN MDG Summit
(New York)



191 UN member states committed to eight **global** developmental goals.

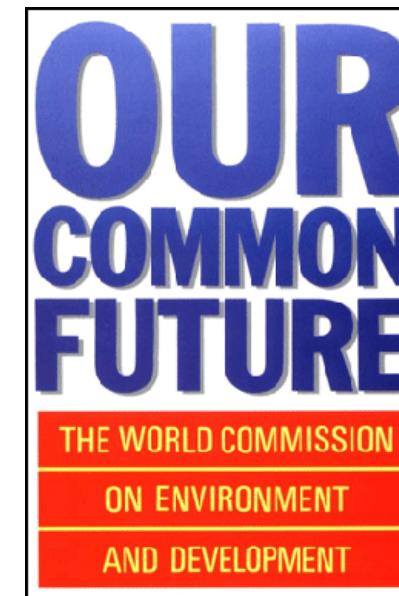
Millennium Developmental Goals (MDGs): first globally agreed, time-bound, and measurable development goals, with focus and coordination for international developmental efforts.

1. To eradicate extreme poverty & hunger
2. To achieve universal primary education
3. To promote gender equality
4. To reduce child mortality
5. To improve maternal health
6. To combat HIV/AIDS, malaria & other diseases
7. To ensure environmental sustainability
8. To develop global partnership for development

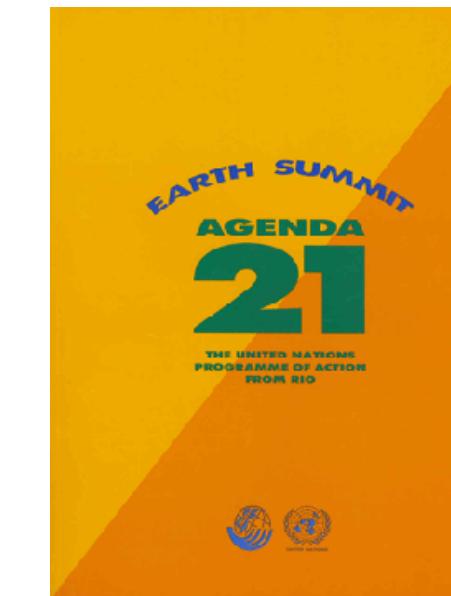
The road to 2030: from vision to action

1987 —→ 1992 —→ 2000 —→ 2002

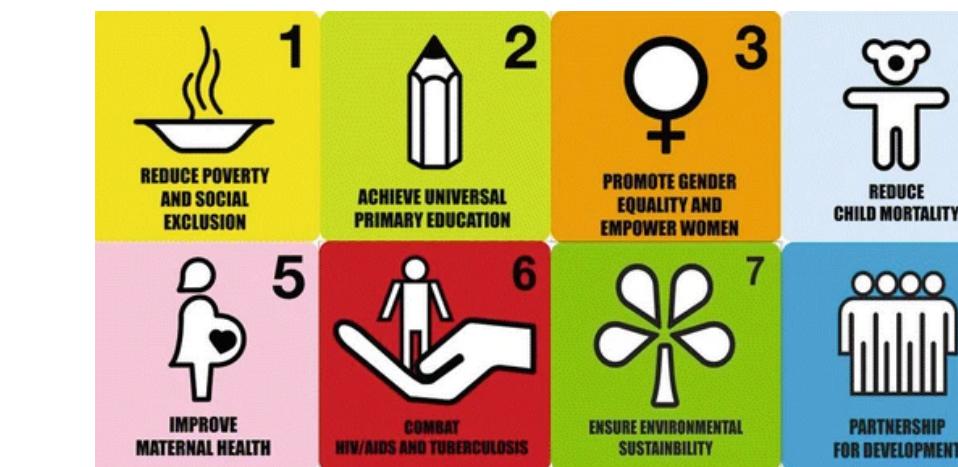
Our Common Future
(UN WCED)



UN Earth Summit
(Rio de Janeiro)



UN MDG Summit
(New York)



UN WSSD
(Johannesburg)



World Summit on Sustainable Development

- *Johannesburg Declaration*: Reaffirmed global commitment to sustainable development
- *Johannesburg Plan of Implementation*: Provided concrete action plans for practical implementation of sustainable development goals
- *Public-private Partnerships*: voluntary partnerships between governments, business, and civil society (eg, novel partnerships around clean energy, sustainable agriculture)
- *Global Governance*: monitor progress and empower UN Commission on Sustainable Development (CSD) to guide policy development at the national and international level

The road to 2030: from vision to action

2012

UN Rio+20
(Rio de Janeiro)



United Nations Conference on Sustainable Development (Rio+20)

- *The Future We Want*: political agreement for international commitment to sustainable development and set the foundation for the 2030 Agenda.
- *Sustainable Developmental Goals*: a new global framework and process was established to define goals that replace the Millennium Developmental Goals
- *UN High-Level Political Forum (HLPF)*: central platform for reviewing and monitoring global sustainability progress, and replaced the UN Commission on Sustainable Development.

The road to 2030: from vision to action

2012 → 2013

UN Rio+20
(Rio de Janeiro)



UN Open Working Group
(New York)



United Nations Open Working Group

- *Inclusive & Participatory*: 70 countries divided into 30 seats with encouragement for collaboration between governments, experts, and civil society
- *Sustainable Developmental Goals*: OWG was responsible to draft 17 SDG goals
- *Integrated Approach to Sustainability*: economic growth, social inclusion, and environmental responsibility
- *Accountability & Measurability*: 169 targets and foundation for global monitoring & reporting

The road to 2030: from vision to action

2012 → 2013 → 2015

UN Rio+20
(Rio de Janeiro)



UN Open Working Group
(New York)



UN 2030 Agenda
(New York)



UN Sustainable Development Summit

- *2030 Agenda for Sustainable Development* (2015-2030): global roadmap with introduction of 17 goals and 169 targets
- *Transition from MDGs to SDGs*: MDGs had narrower goals and focused mostly on developing countries (eg, eradicate extreme poverty). SDGs are universal, apply to all countries, and cover broader topics in economy, social inequality, and environment
- *Leave No One Behind Principle*: 2030 Agenda prioritises inclusivity
- *Connection to other landmark agreements*: Paris agreement on climate change, Addis Ababa Action Agenda, and Sendai framework for disaster risk reduction

Transforming our world: the 2030 Agenda for Sustainable Development

- This Agenda is a plan of action for people, planet and prosperity.
- All countries and all stakeholders, acting in collaborative partnership, will implement this plan.
- They are integrated and indivisible and balance the three dimensions of sustainable development: the economic, social, and environmental.



SDG1

End poverty in all its forms everywhere.



SDG2

End hunger, achieve food security, improve nutrition, and promote sustainable agriculture.



SDG3

Ensure healthy lives and promote well-being for all at all ages.



SDG4

Ensure inclusive and quality education and promote lifelong learning opportunities for all.



SDG5

Achieve gender equality and empower all women and girls.



SDG6

Ensure availability and sustainable management of water and sanitation for all.



SDG7

Ensure access to affordable, reliable,
sustainable, and modern energy for all.



SDG8

Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all.



SDG9

Build resilient infrastructure, promote inclusive and sustainable industrialisation, and foster innovation.



SDG10

Reduce inequality within and among countries.



SDG11
Make cities and human settlements inclusive, safe, resilient, and sustainable.



SDG12

Ensure sustainable consumption and production patterns.



SDG13

Take urgent action to combat climate change and its impacts.



SDG14

Conserve and sustainably use the oceans, seas, and marine resources for sustainable development.



SDG15

Protect, restore, and promote the sustainable use of terrestrial ecosystems, manage forests sustainably, combat desertification, halt and reverse land degradation, and halt biodiversity loss.



SDG16

Promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable, and inclusive institutions at all levels.

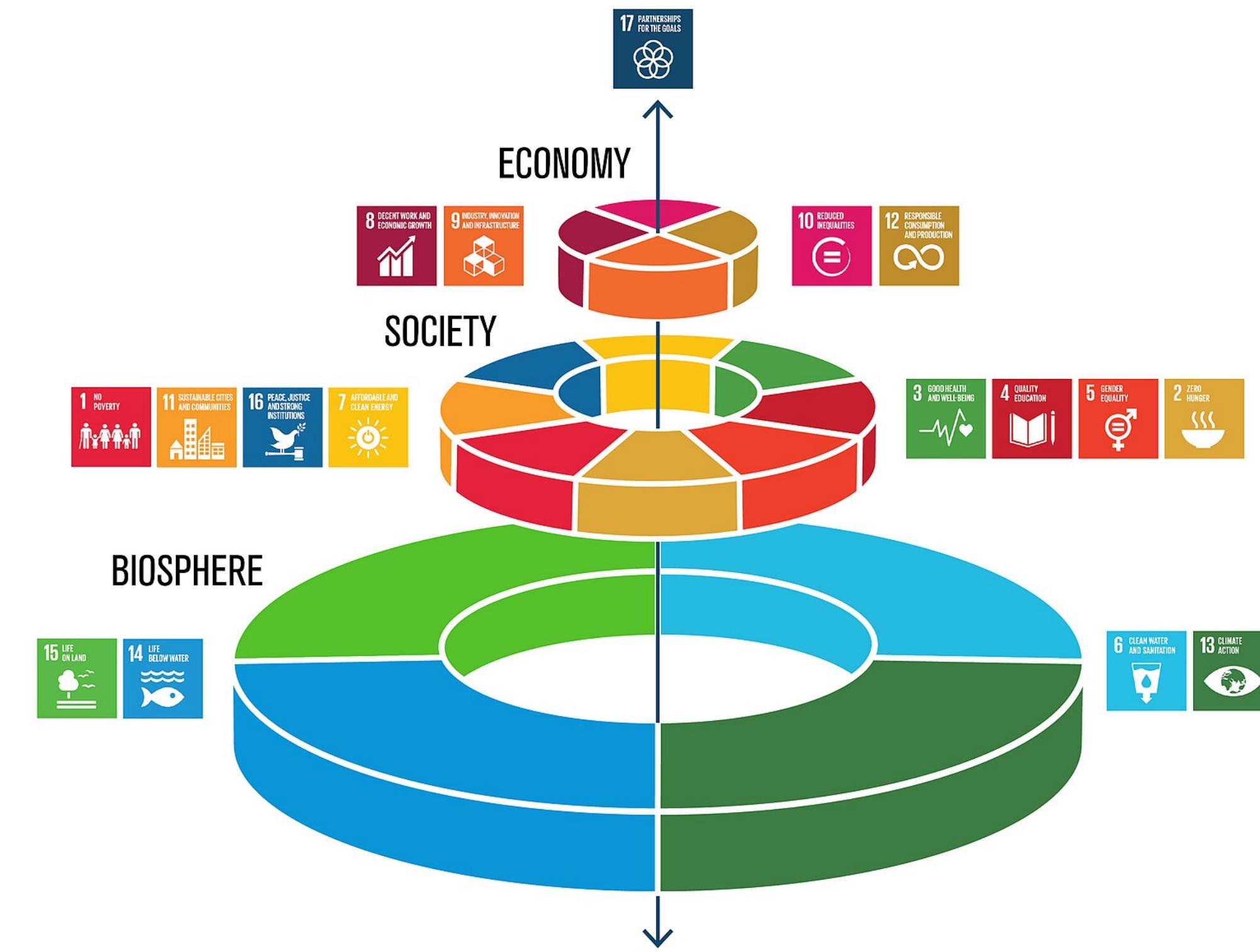


SDG17

Strengthen the means of implementation and revitalise the global partnership for sustainable development.

SDG weeding cake model: balancing people, planet, and prosperity

- **Global framework:** SDGs are interconnected and address environmental, social, and economic dimensions
- **Planetary boundaries:** Human development needs to respect environmental limits to ensure the long-term viability of our planet
- **Social foundations:** Meeting basic human needs is fundamental for development (eg, health, education)
- **Economic growth:** Economic progress must align with social justice and environmental preservation.
- **Policy integration:** Effective sustainability requires coherent policies that balance economic, social, and environmental goals.



The road to 2030: where are we now?

2012 → 2013 → 2015 → 2023

UN Rio+20
(Rio de Janeiro)



RIO+20
United Nations
Conference on
Sustainable
Development

UN Open Working Group
(New York)



UN MDG Summit
(New York)



UN SDG Summit
(New York)



2023 UN SDG Summit revealed

- Only 15% of SDG targets are on track and most SDG goals are falling behind
- Urgent action required for climate, biodiversity, and hunger crisis
- Data-based decision-making and novel technological innovations to achieve SDGs
- Transformation *through* science, and *in* science

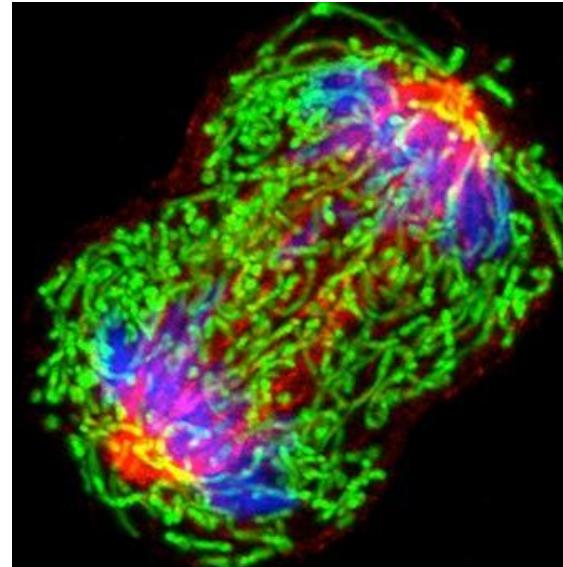
“Today more than ever, scientists, policymakers and multiple social actors need to work closely together at the science-policy-society interface to build trust, establish the scientific base for progress towards the Sustainable Development Goals, deliver findings and communicate these findings to society at large.”

UN GLOBAL SUSTAINABLE DEVELOPMENT REPORT 2023

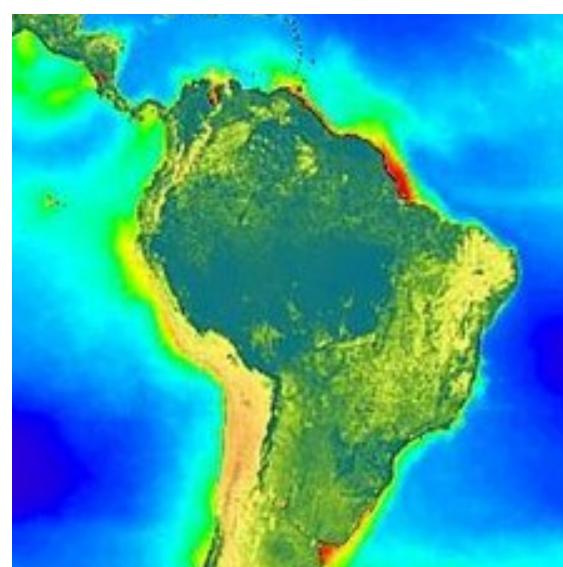
Advancing sustainable development based on genome research



Genome editing to enhance heat tolerance in plants (eg, crops)



Targeted therapy to enhance survival and minimise late effects



eDNA sequencing to study biodiversity and monitor ecosystems

Genomic solutions to sustainable development

Spring course outline

- **Week 1 — Introduction to UN SDG and policies** (18 February, Waszak / Paoli)
- **Week 2 — Personalised health** (25 February, Fellay)
- **Week 3 — Inequality in healthcare** (4 March, Fellay)
- **Week 4 — Gender equality** (11 March, Fellay / Waszak)
- **Week 5 — Microbiome engineering for future health** (18 March, Paoli)
- **Week 6 — Environmental DNA in biomonitoring** (25 March, Waszak)
- **Week 7 — Synthetic biology** (1 April, Waszak)
- **Week 8 — Agrigenomics** (8 April, Waszak)
- **Week 9 — Conservation & ancient genomics** (15 April, Waszak)
- **Week 10 — Introduction to real-time genomics** (29 April, Waszak)
- **Weeks 12-15 — Practical on real-time genomics** (6/13/20/27 May, Delevaux / Waszak)