From Data to Knowledge

Science reading the Earth System

Issues for Discourse with Youth

Bahá’í Discourse - Data

Science

Knowledge is as wings to man's life, and a ladder for his ascent. Its acquisition is incumbent upon everyone. The knowledge of such sciences, however, should be acquired as can profit the peoples of the earth, and not those which begin with words and end with words. Great indeed is the claim of scientists and craftsmen on the peoples of the world.

(Bahá'u'lláh, *Tablets of Bahá'u'lláh*, pp. 51-52)

Science

This scientific power investigates and apprehends created objects and the laws surrounding them. It is the discoverer of the hidden and mysterious secrets of the material universe and is peculiar to man alone. The most noble and praiseworthy accomplishment of man, therefore, is scientific knowledge and attainment.

('Abdu'l-Bahá, *The Promulgation of Universal Peace*, 12, pp.29-30)

Science

Science may be likened to a mirror wherein the images of the mysteries of outer phenomena are reflected…. Science is the governor of nature and its mysteries, the one agency by which man explores the institutions of material creation. All created things are captives of nature and subject to its laws. They cannot transgress the control of these laws in one detail or particular…. The earth and its myriad organisms, all minerals, plants and animals are thralls of its dominion.

(‘Abdu’l-Bahá, *The Promulgation of Universal Peace*, 12, pp.29-30)

Science

Nature's laws and methods, the hidden secrets and mysteries of the universe, human inventions and discoveries, all our scientific acquisitions should naturally remain concealed and unknown, but man through his intellectual acumen searches them out of the plane of the invisible, draws them into the plane of the visible, exposes and explains them.

('Abdu'l-Bahá, *The Promulgation of Universal Peace*, 12, pp.29-30)

Science

...man, although in body a part of nature, nevertheless in spirit possesses a power transcending nature…. God has conferred upon and added to man a distinctive power—the faculty of intellectual investigation into the secrets of creation, the acquisition of higher knowledge—the greatest virtue of which is scientific enlightenment.

(‘Abdu’l-Bahá, *The Promulgation of Universal Peace*, 12, pp.29-30)

Bahá'í perspective on Science

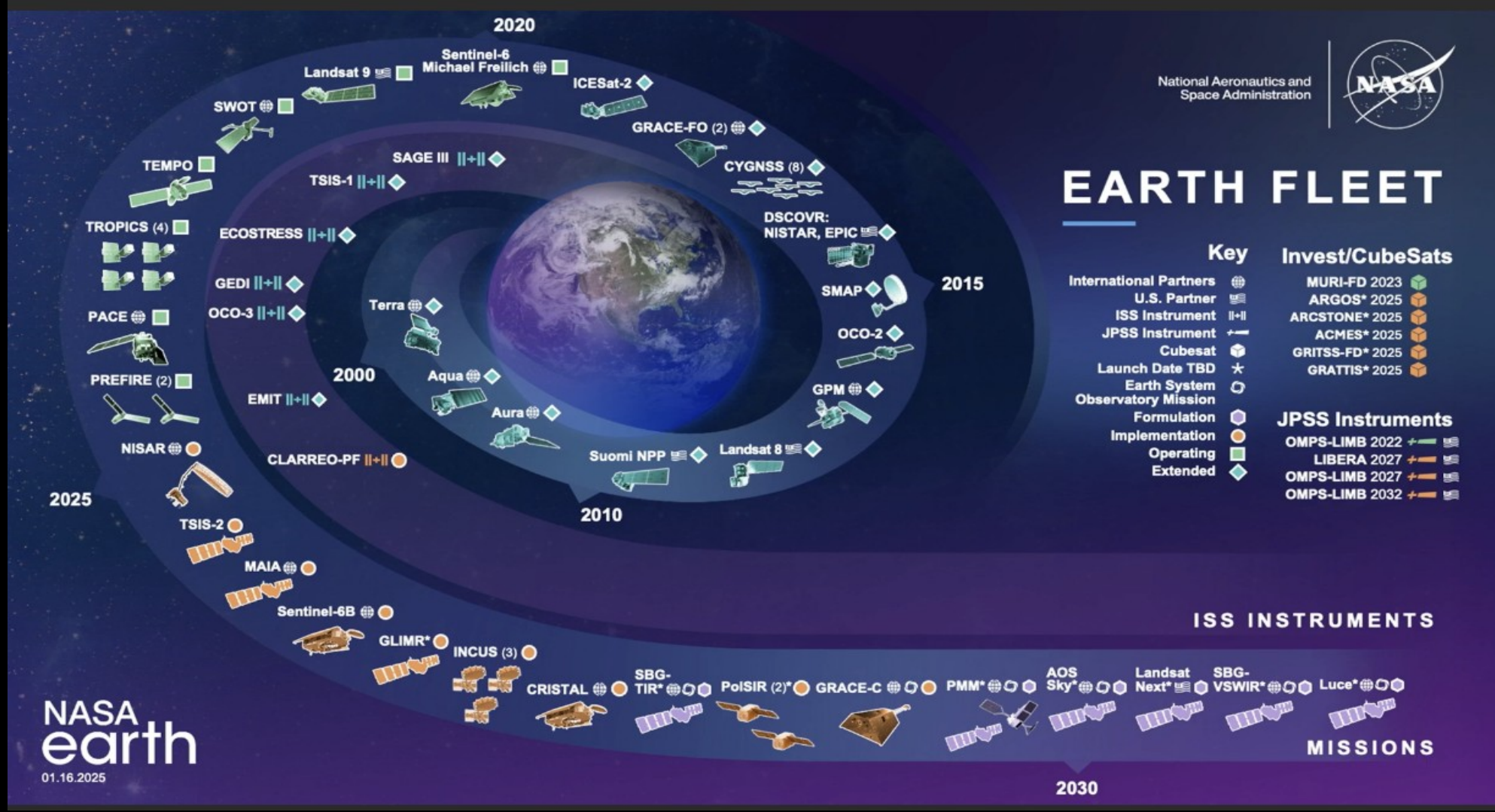
Scientific inquiry has been a vital instrument in seeking to understand physical reality and in forging innovative solutions based on a search for truth and a commitment to learning. When combined with values such as freedom from prejudice and bias it has enabled humanity to separate fact from conjecture. Scientific capabilities—of observing, measuring, rigorously testing ideas—have allowed us to construct a coherent understanding of the laws and processes governing physical reality, as well as to gain insights into human conduct and the working of society.

(Bahá'í International Community, *One Planet, One Habitation*, 2022, box Science and Religion)

Science and Data

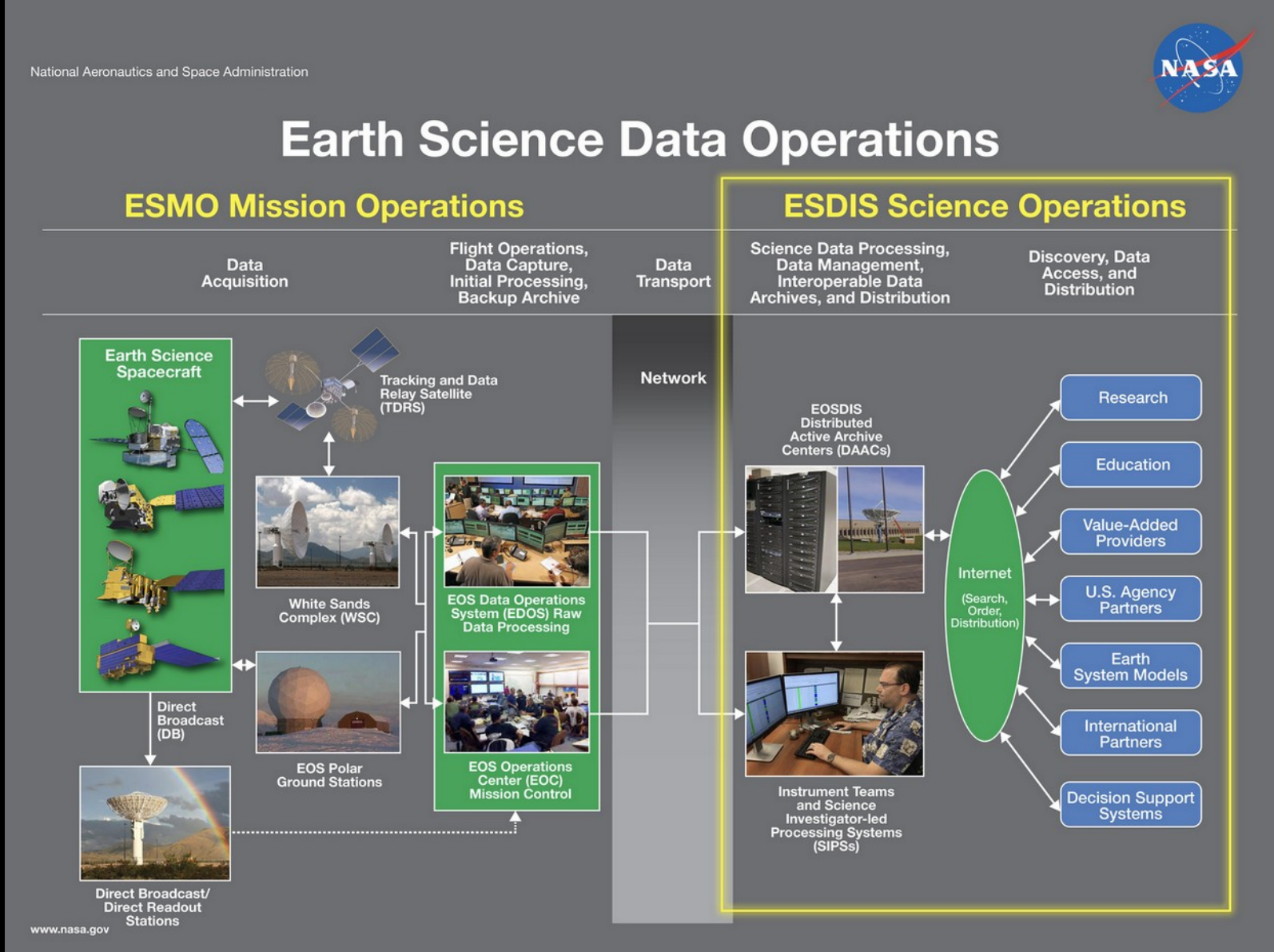
Science uses data to tell us about the health of our environment and how that impacts our society. One tool is remote sensing from space with satellites.

https://www.earthdata.nasa.gov/learn/gis/storymaps/esri-federal-gis-conference-2025 (9 minute video)



NASA Satellite missions, past and future

NASA Earth Science produces data



Remote Sensing of Coral Reefs

Measuring cyclone impact Aitutaki, Cook Islands

Loubersac, Dahl et al. 1989

Bahá'í perspective on Science

The natural world, in all its wonder and majesty, offers profound insight into the essence of interdependence. From the biosphere as a whole to the smallest microorganism, it demonstrates how dependent any one life-form is on numerous others—and how imbalances in one system reverberate across an interconnected whole.

(Bahá'í International Community, *One Planet, One Habitation*, 2022, §1)

Science and Data

Another way is to collect data through direct observation and quantitative measurements. For example, to understand unity in diversity in nature, Arthur Dahl, a marine biologist, chose the most complex ecosystem, the coral reef, as his object for study. Nature could provide a lesson for humanity.

Coral reef slope, Palau, Micronesia, 1972

Learning from nature

Thousands of species on a coral reef build their own community, like a city. Each has a role as they cooperate together and help each other, like the plants (algae) living inside the coral animals and feeding them while being held to the light, fertilised and protected.

Research can require living in the environment under study, here at the bottom of a coral reef, where one could swim out all day to collect data

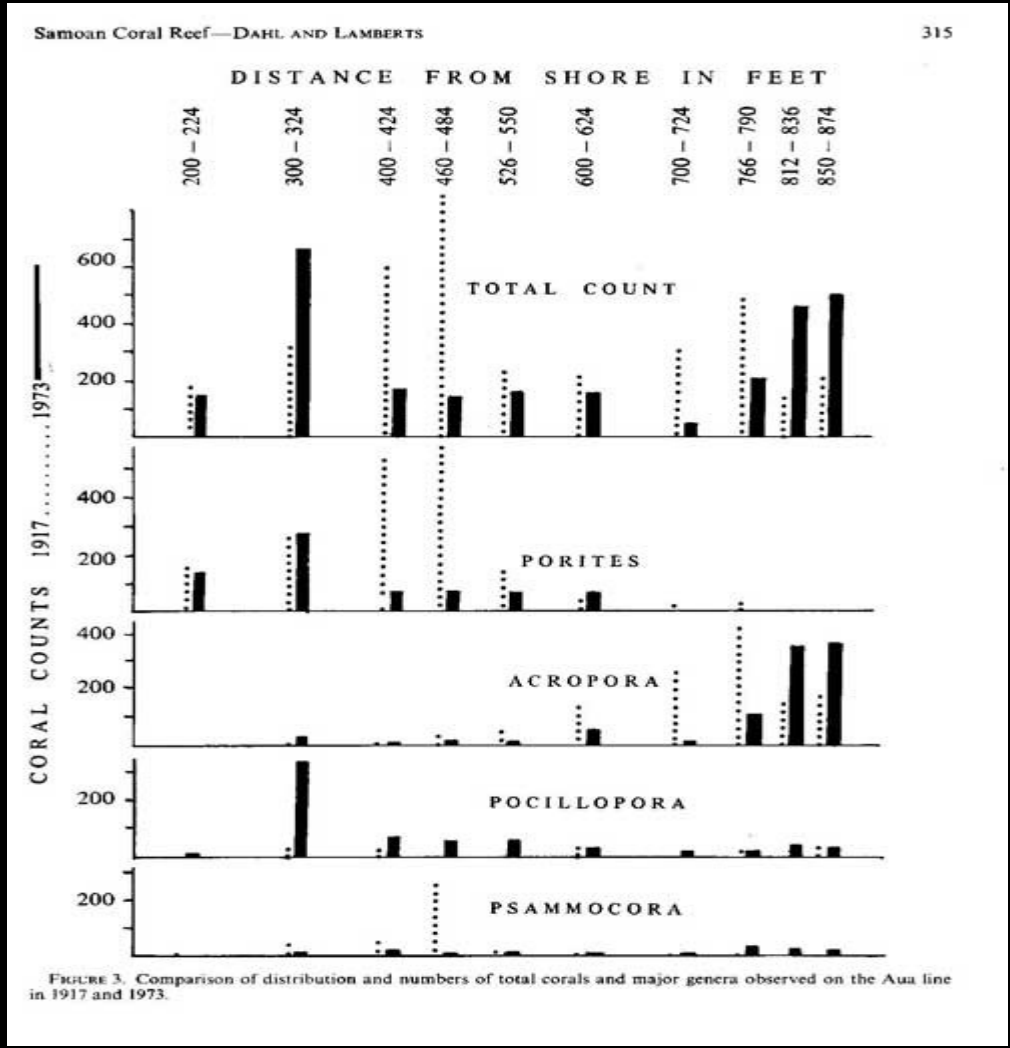
Arthur as aquanaut in Puerto Rico undersea habitat 2 weeks at 20m 1972

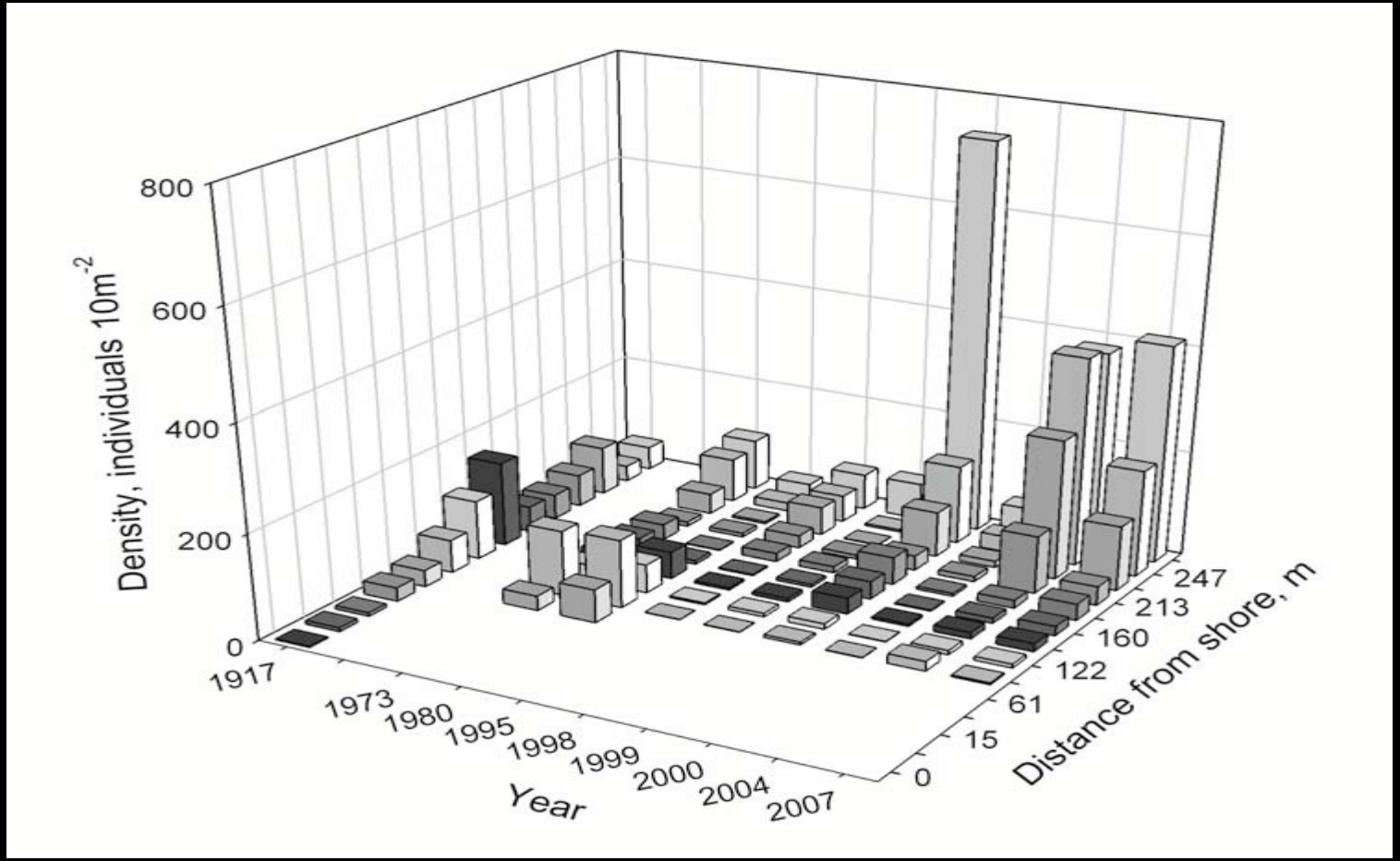
Caribbean *Acropora palmata* coral now endangered

Learning from nature

Data from coral reef surveys can show how they are changing from environmental and human impacts. Arthur found a coral reef in Samoa that had been surveyed and corals counted in 1917. Repeated surveys since 1973 record ninty years of changes.

A survey line across a coral reef at Aua, American Samoa, allowed a comparison of the density of corals from 1917-1973





Aua transect, American Samoa density of corals 1917-2007

Learning from nature

In a complex system such as a coral reef, standard survey techniques need to be developed, and data recorded. For example, how much of the surface of the reef is covered by an organism or community.

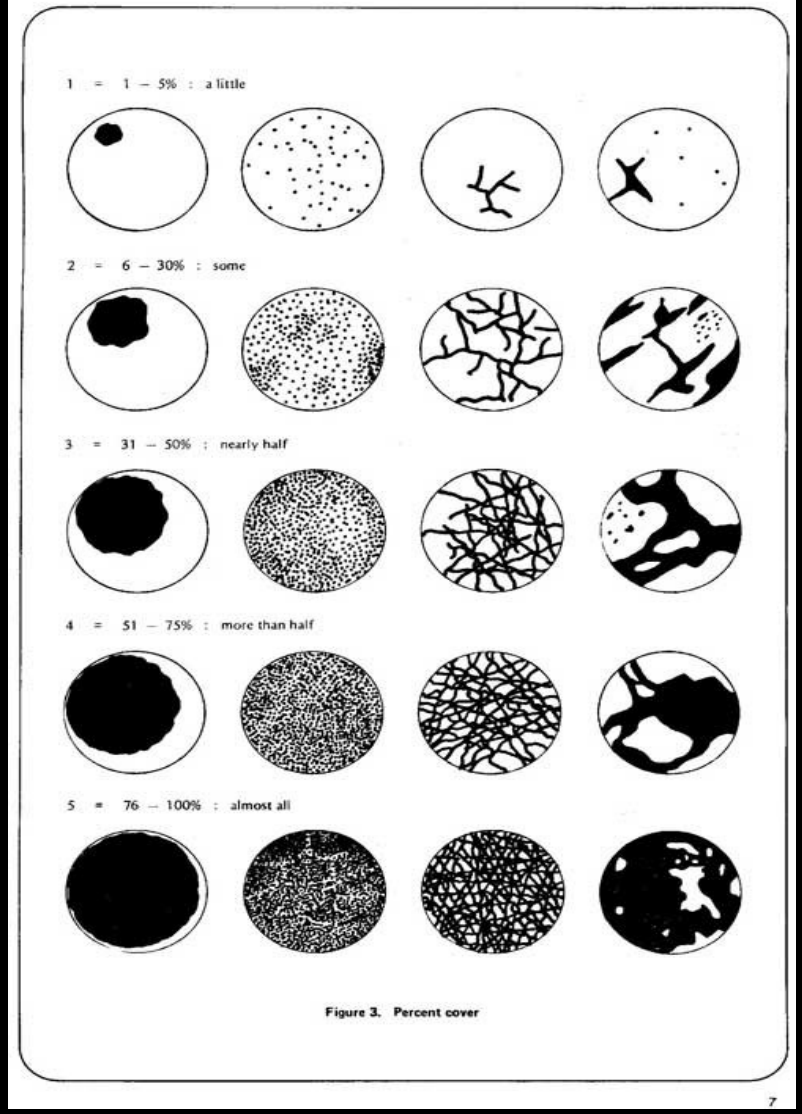


Figure 3. Percent cover

7

CORAL REEF MONITORING DATA SHEET

Locality: Mopapea	Date: 2 February 1982	Recorder: S. Ale	
Circle number	1	2	3
Location on reef	Reef slope	Inner reef flat	Back reef
Water depth	1-2 metres	0.5 m	1m
FISH COUNTS (100 metre line)			
Predators	3	—	0
Butterfly fish	16	—	11
PERCENT COVER	Code: 0% = 0	1–5% = 1	6–30% = 2	31–50% = 3	51–75% = 4	76–100%=5	
Sediment: mud	0			0			0
Sediment: sand	0			1			3
Sediment: rubble	2			4			1
Sediment: blocks	0			2			2
Live hard coral	3			2			2
Soft corals and sponges	0			1			2
Dead standing coral	1			2			2
Crustose corallines	3			2			1
Marine plants	1			3			3

FORMS PRESENT AND DOMINANT	Size code: fist = 1	forearm = 2	arm span = 3						
	PRES	DOM	SIZE	PRES	DOM	SIZE	PRES	DOM	SIZE
Hard corals: branching	✓			✓			✓	✓	3
Hard corals: staghorn				✓	✓	1	✓		
Hard corals: massive	✓	✓	2	✓			✓		
Hard corals: encrusting	✓			✓					
Hard corals: tabulate/flat	✓								
Hard corals: erect foliose							✓		
Hard corals: cup-shaped									
Hard corals: mushroom	✓						✓		
Soft coral and sponges: massive				✓	✓	2	✓	✓	2
Soft coral and sponges: fans and whips							✓		
Plants: thick turf	✓			✓	✓	1	✓		
Plants: long filaments							✓		
Plants: large browns				✓			✓		
Plants: halimeda	✓	✓	1	✓			✓		
Plants: other fleshy	✓			✓			✓		
Plants: sea grass							✓	✓	2

COUNTS OF ANIMALS			
Mushroom coral	2	0	3
Giant clams	0	7	6
Synaptids	0	0	5
Other holothurians	3	4	7
Acanthaster	0	0	1
Other starfish	2	3	2
Urchins	>20	4	2
Trochus	0	0	0
Other (specify)			1 lobster
VISIBLE POLLUTION (specify/count)	none	none	1 bottle, 2 cans
OTHER NOTES			3 recently dead corals from Acanthaster

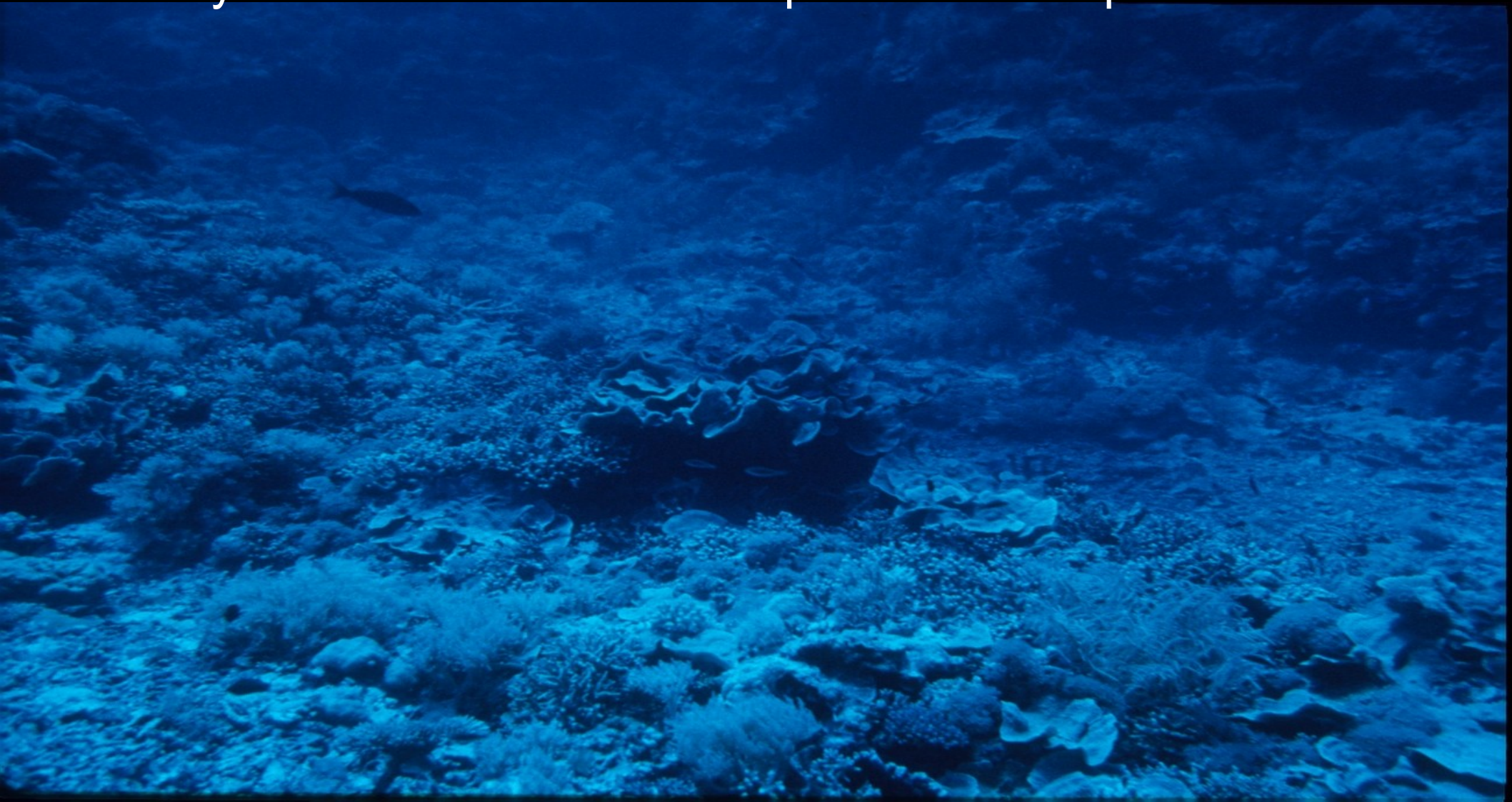
Figure 8. Example of completed data sheet

14

SPC/UNEP Coral Reef Monitoring Handbook – estimating cover, recording data

Coral reef complex spatial organization (Palau)

Ecosystem creates additional space for more productive life

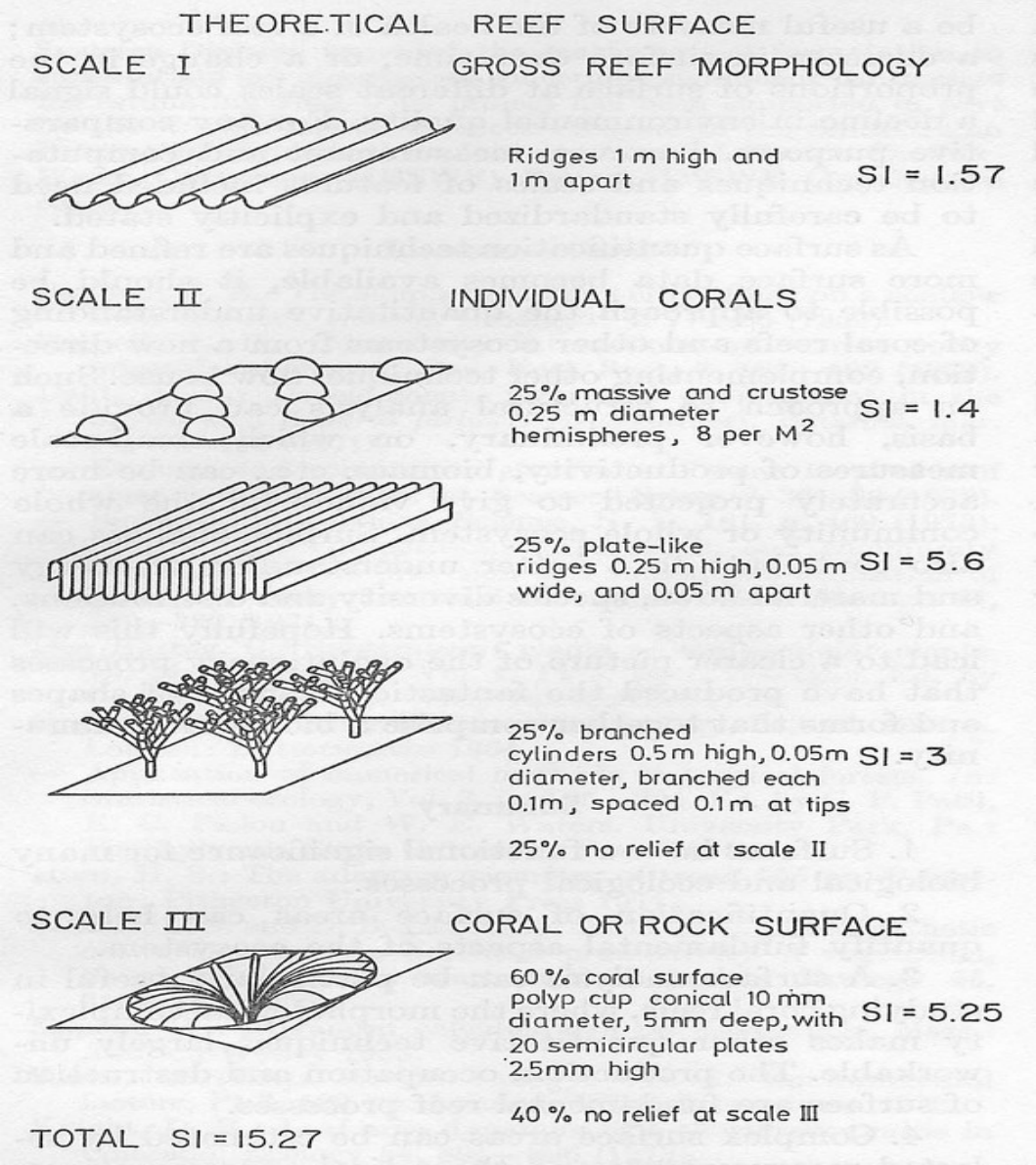


Learning from nature

Since the reef is entirely built by its coral animals and plants, it can make complex structures that can capture more light for photosynthesis, filter food from the water, and provide shelter for fish and other animals. Data on its surface area can estimate this.

Modelling how coral reef creates more surface area

(Dahl, 1973)



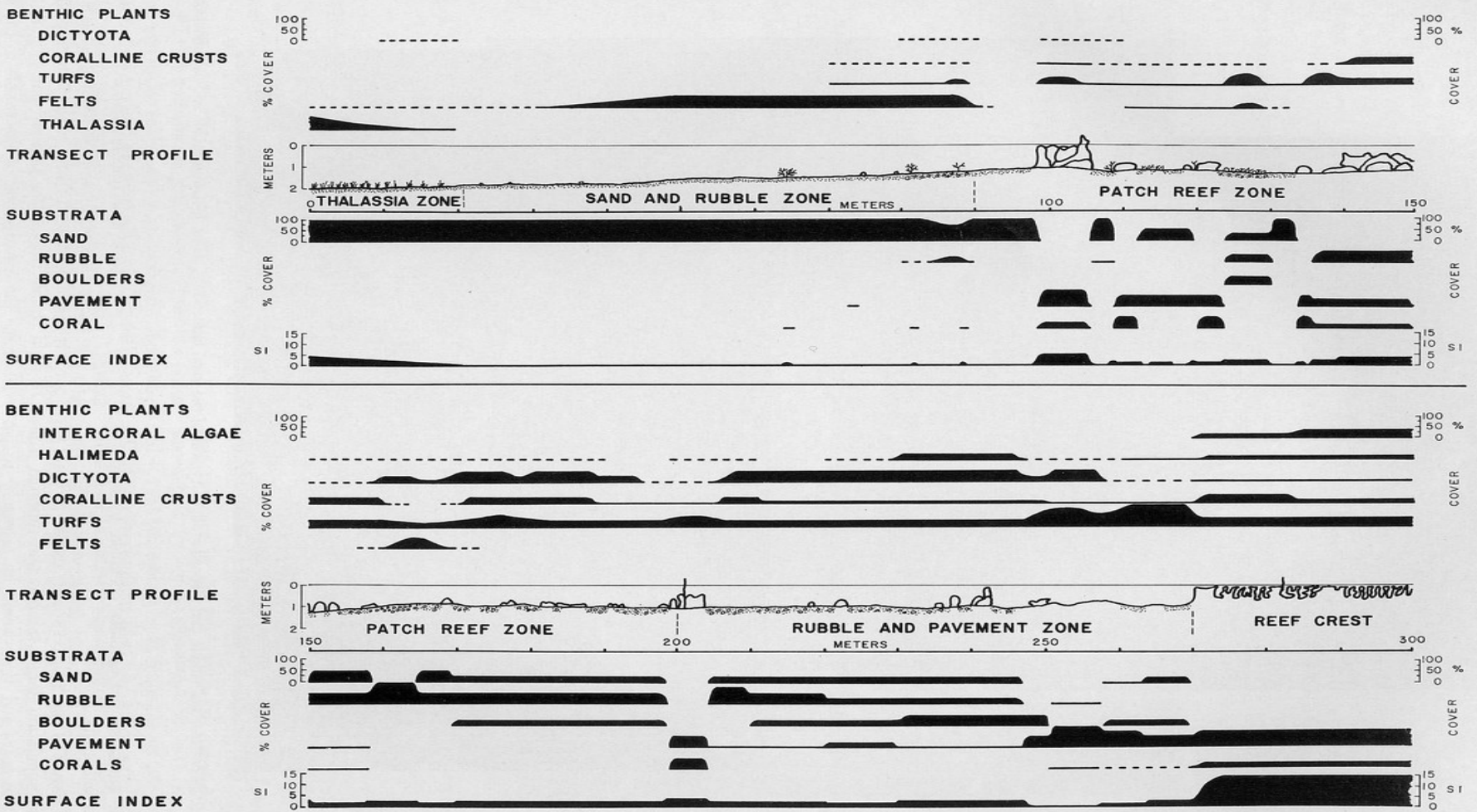


Fig. 3. Transect profile from lagoon bottom to reef crest on the barrier reef near Carrie Bow Cay, British Honduras, showing area coverage of the major plant and substrate types and surface index (SI)

Generation of surface across a reef, Belize, Caribbean

Learning from nature

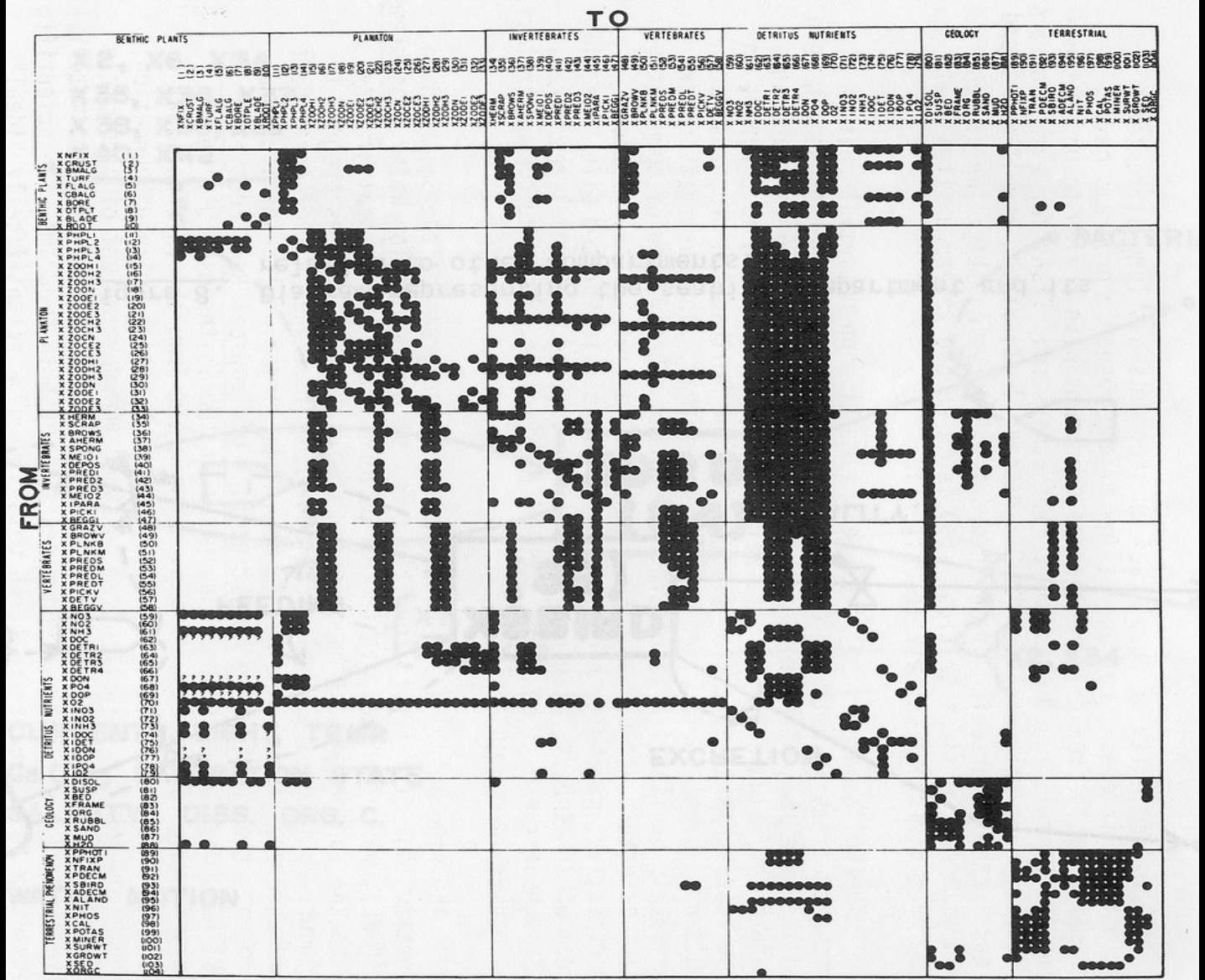
These coral reef studies provided the data to prepare a model of the coral reef ecosystem, and how energy flows through 104 compartments of the system, such as different groups of plants and animals. This shows the benefits of cooperation.

Coral reef systems model

carbon flow between compartments

104 compartments

(Dahl et al. 1974)



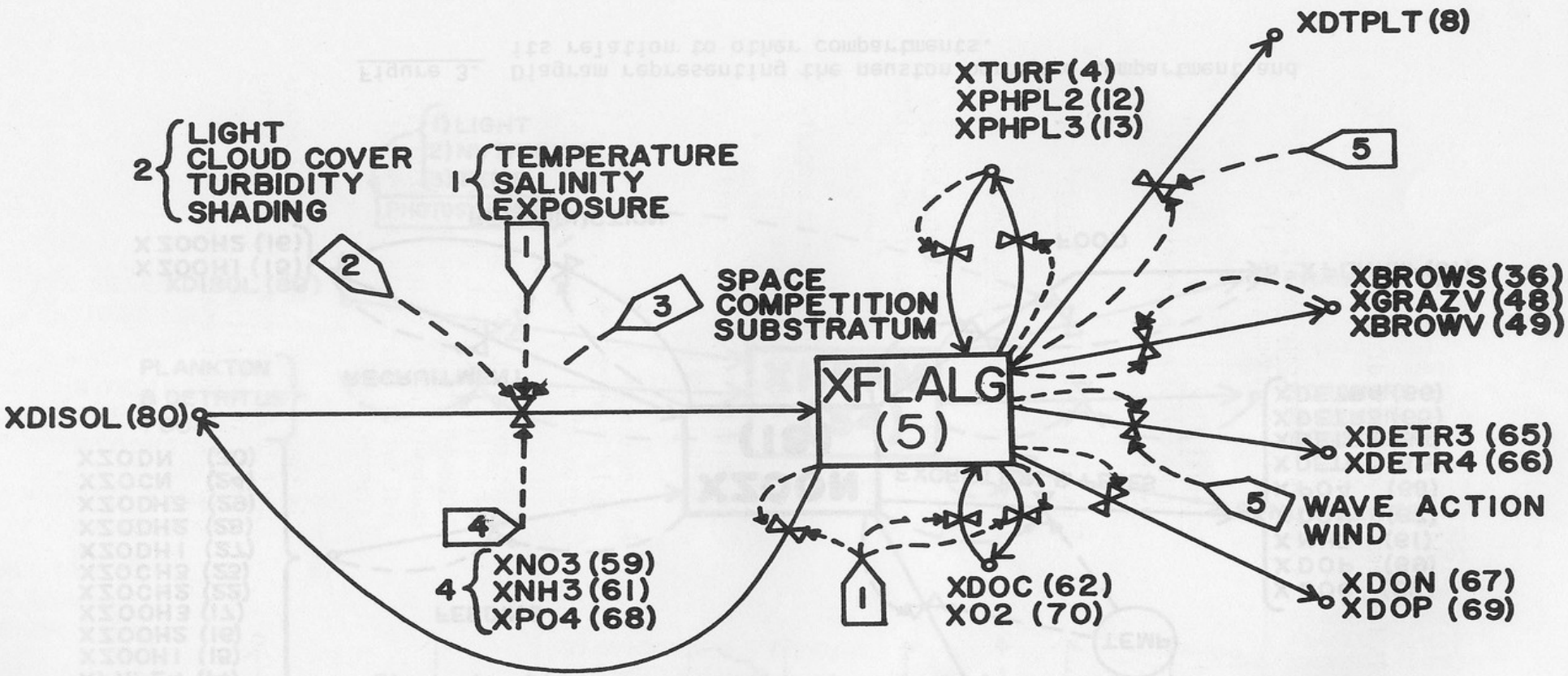


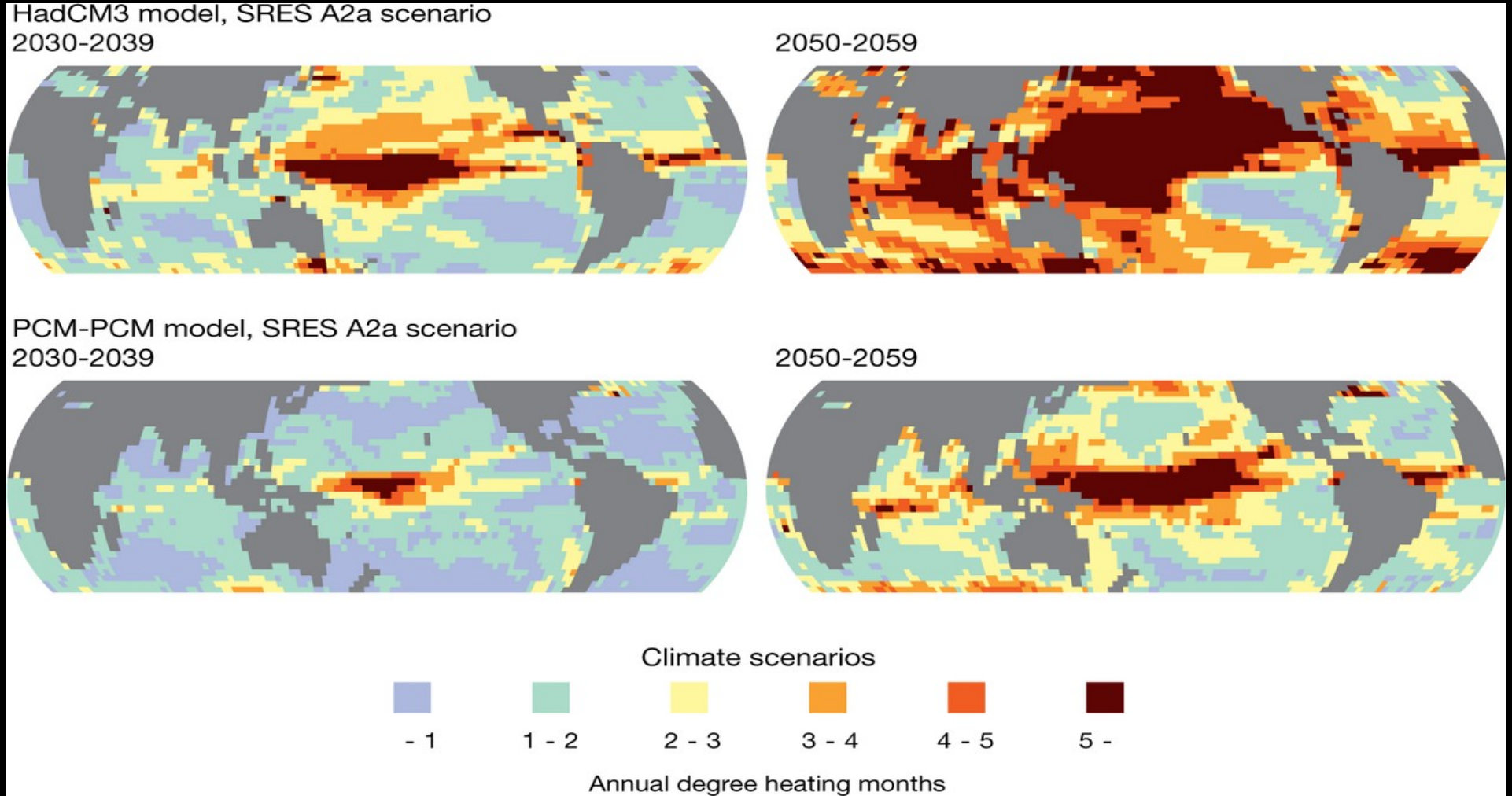
Figure 2. Diagram representing the fleshy macro-algal compartment and its relation to other compartments.

Coral reef systems model – fleshy algae compartment (Dahl et al. 1974)

Threats to coral reefs

Today climate change is heating the oceans, becoming too hot for corals, that eject their symbiotic algae, turn white (bleach), and then die for lack of food. Some coral islands like Tuvalu in the Pacific have lost all their living reefs.

Climate change: ocean hot spots kill corals



El Niño of 2015 bleached corals - American Samoa (Catlin photo)

Beyond GDP

Everyone talks about Gross Domestic Product (GDP), data on the flow of money, which economists use to measure the size of a country's economy. They always want GDP to grow. But GDP does not measure what is important for us or the planet, such as natural resource depletion, unpaid work, and societal well-being. And growth cannot continue forever on a finite planet. The UN and many others call for measures beyond GDP.

https://sdg.iisd.org/news/beyond-gdp-integrating-new-approaches-in-global-frameworks/

Bahá'í perspective on GDP

If humanity's relationship with the natural world is to be refashioned, notions of progress, civilization, and development will need to be redefined. Efforts in this direction, such as budgets centered around well-being or indicators of progress more holistic than gross domestic product, must be expanded and deepened, and fundamental questions interrogated further. What are the qualities by which a person, nation, or corporation are judged successful? For what are they commended and appreciated?

(Bahá'í International Community, *One Planet, One Habitation*, 2022, §17)

Bahá'í perspective on GDP

So long as such questions are answered according to values that prioritize possessions over relationships or acquisition over responsibility, a sustainable world will remain out of reach. Such values, by their very nature and effect on the human spirit, beckon incessantly to excess, exploitation, and depletion. They also give rise to gross extremes of alienating wealth and debilitating poverty. Only to the degree that these are set aside can the profound contradictions they give rise to—not least the expectation of infinite growth on a finite planet—be resolved. And only as progress is understood in new terms can the fundamental drivers of present environmental crises be accurately identified and lasting change be made.

(Bahá'í International Community, *One Planet, One Habitation*, 2022, §18)

Limits to Growth 1972

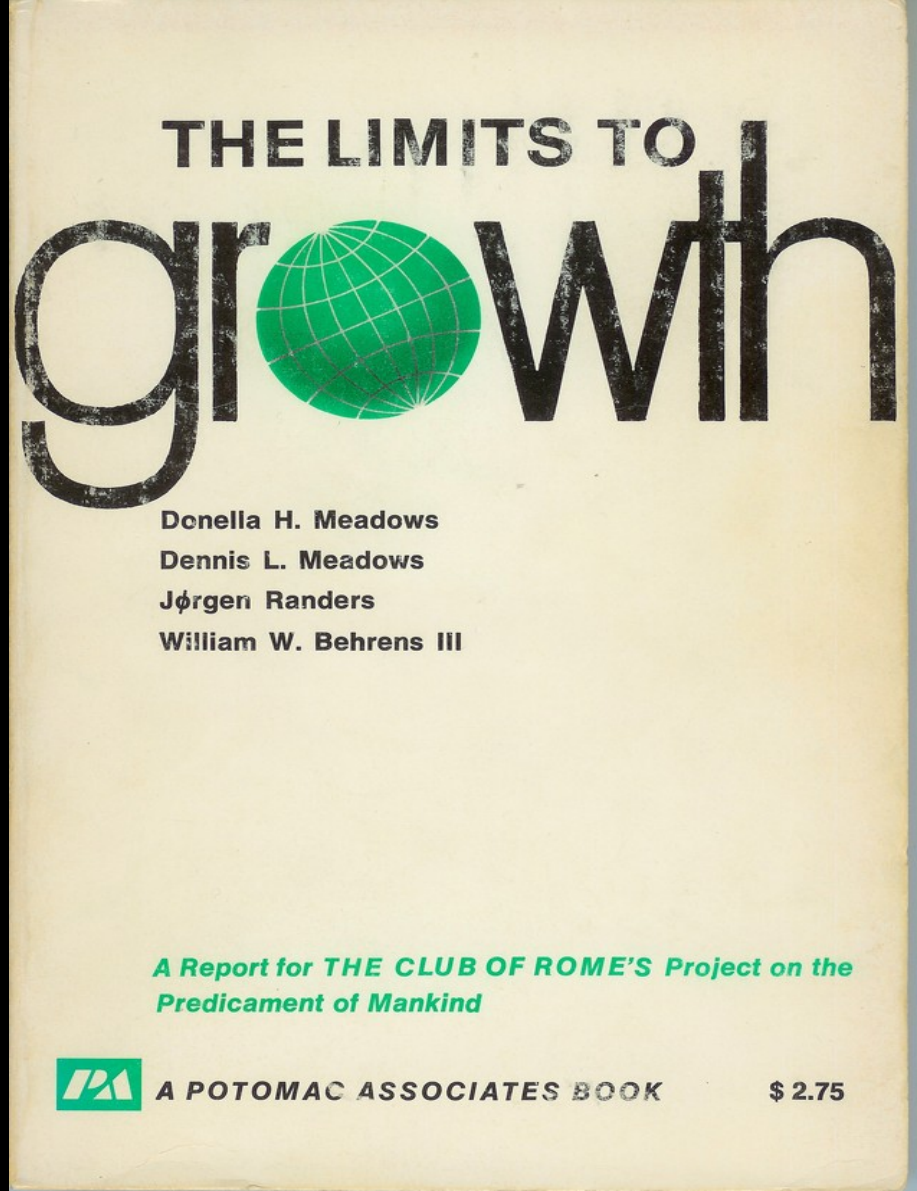
Club of Rome

computer modelling

questioning the

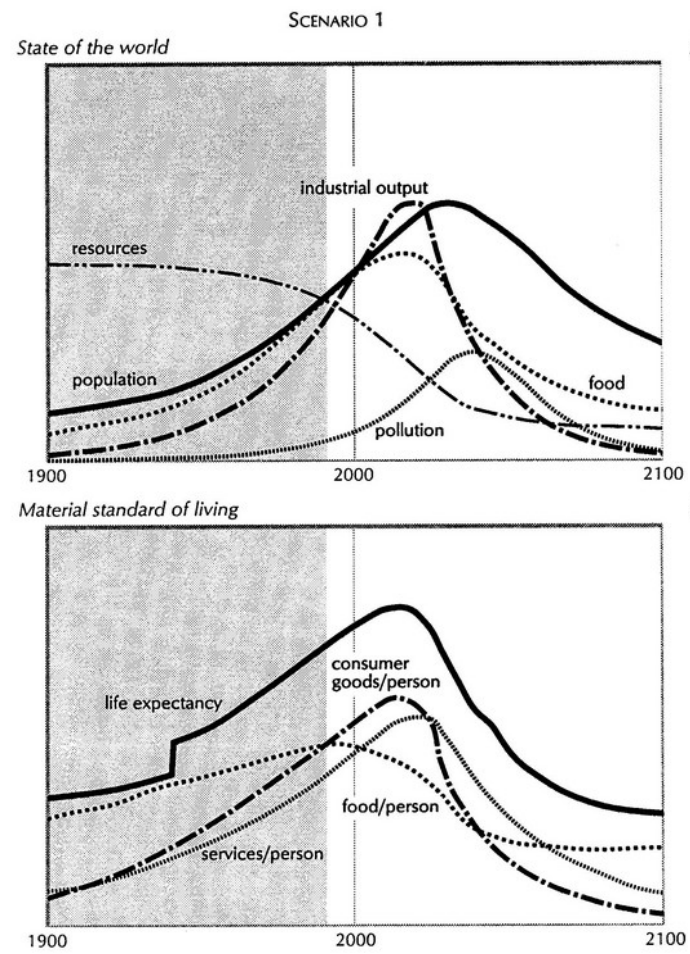
consumer society

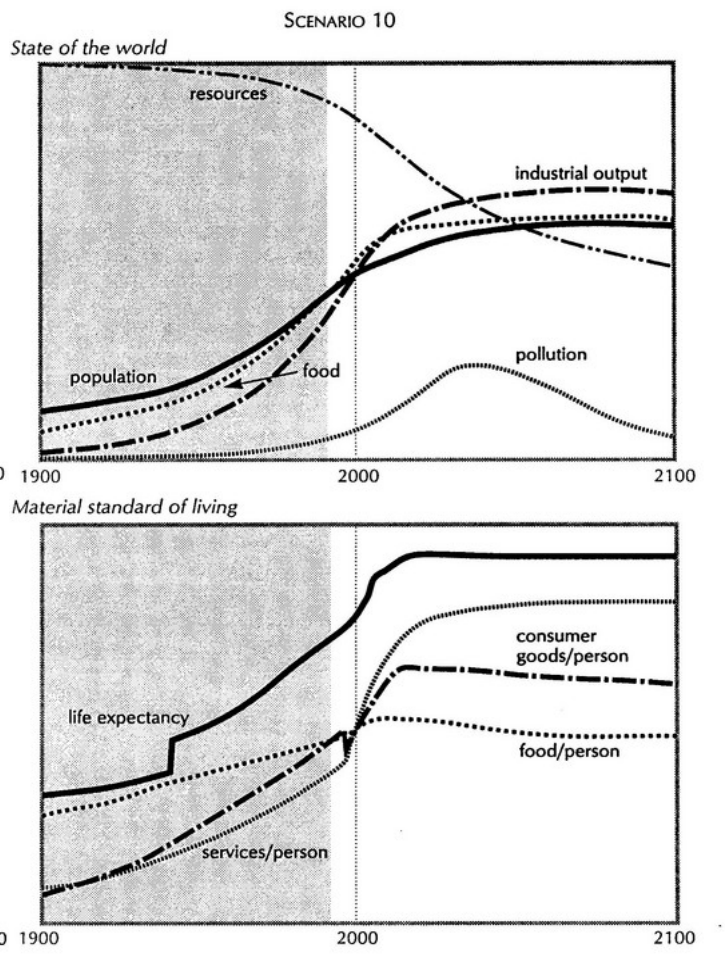
showing that growing forever beyond planetary limits would make civilisation collapse

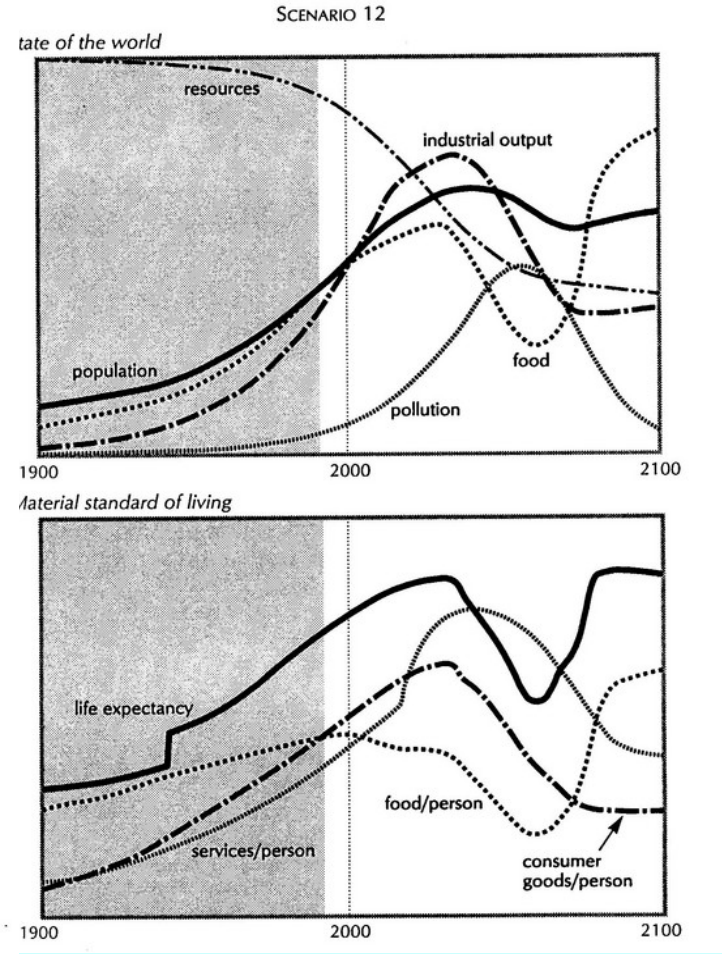


Scenarios from World 3 simulating collapse

(Meadows et al. (1992) *Beyond the Limits*)







Business as usual

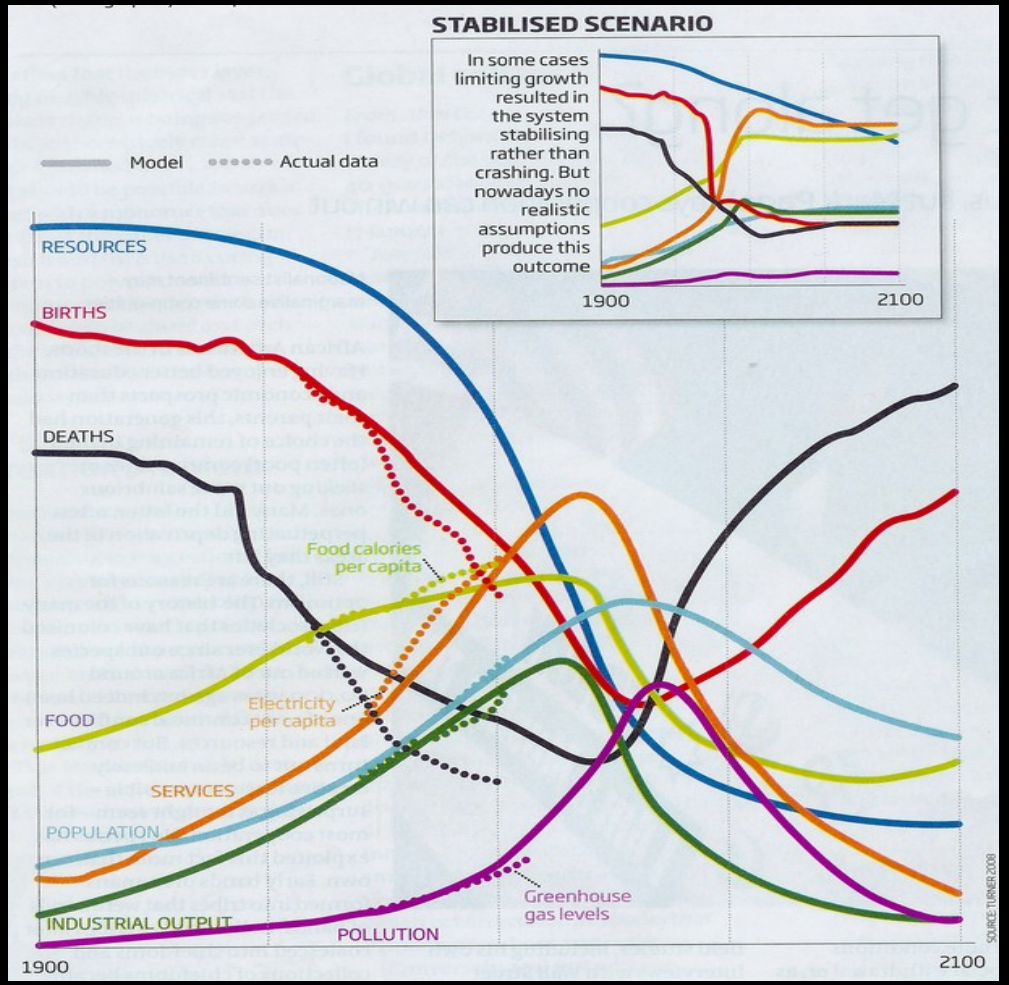
Transition 1995

Transition 2015

Where are we now?

The actual data since 1972 shows that the predictions were close to reality

MacKenzie, Debora. 2012 Doomsday Book. *New Scientist*, 7 January 2012, pp. 38-41.

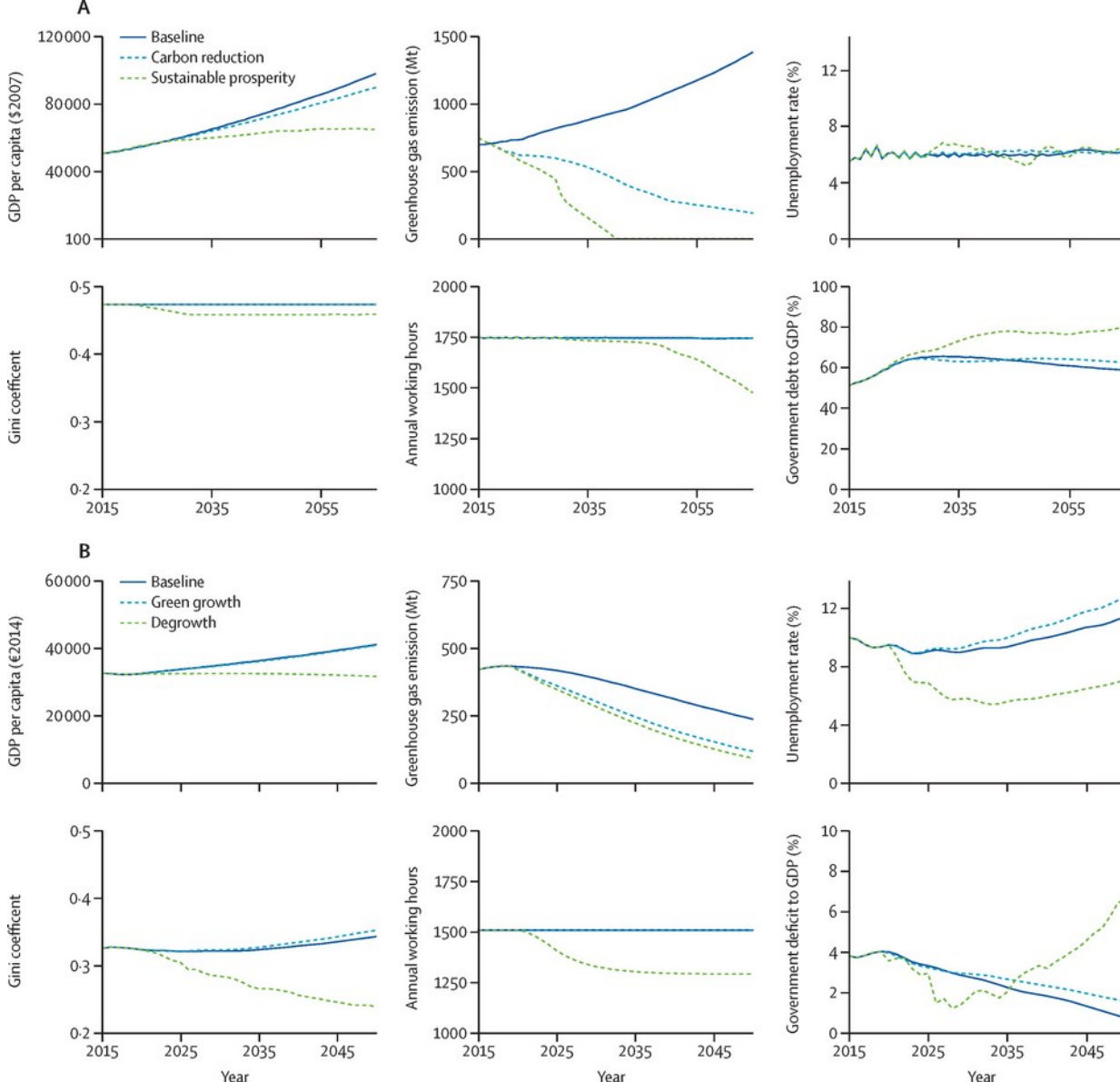


Beyond GDP

Scenarios for France and Canada to 2050

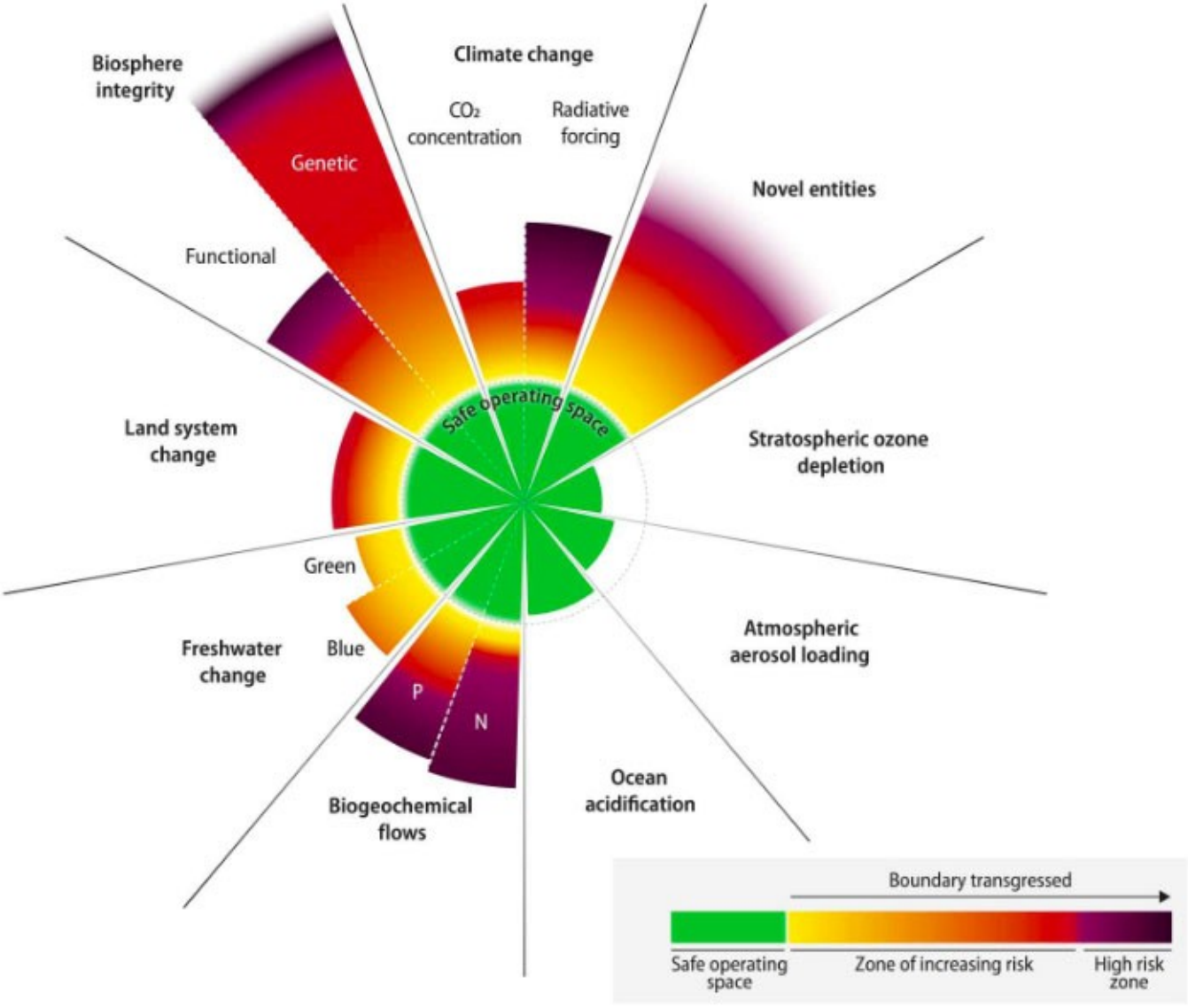
GDP per capita
Inequality (GINI coefficient)

(from Kallis et al. 2025. Post-growth: the science of wellbeing within planetary boundaries. www.thelancet.com/planetary-health Vol 9, January 2025)



PLANETARY BOUNDARIES

We have overshot seven of the planetary boundaries.The green zone is the safe operating space, and the red is a high-risk zone.



Overshooting planetary limits

As the grave effects of surpassing planetary limits become increasingly apparent, from climate change to biodiversity loss to environmental degradation and pollution, humanity is being compelled to develop more mature, collaborative, and constructive relationships between its peoples and with the natural environment.

(Bahá'í International Community, *One Planet, One Habitation*, 2022, §3)

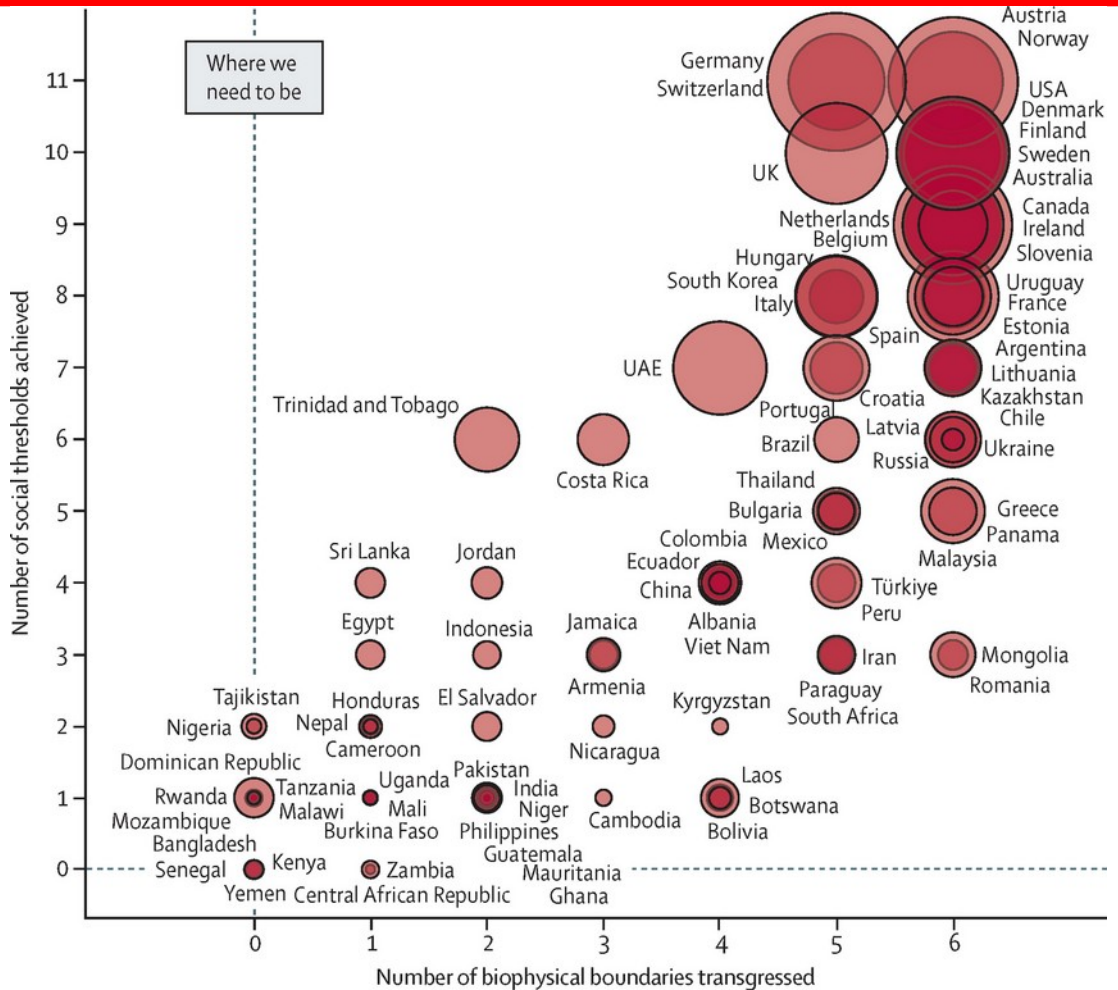
Bahá'í perspective on Science

Intimately embedded in this greater system, and deeply reliant upon it, humanity faces a paradox growing more consequential by the day. On the one hand, the human race has never held more power to shape the physical world on planetary scales—a development some have termed the anthropocene. This is a testament to our collective ingenuity and creativity, as well as the boundless potential before us. On the other, that very power, when untempered by thoughtful consideration and directed by priorities heedless of the present and future common good, gives rise to consequences not only worldwide in scope but potentially irreversible.

(Bahá'í International Community, *One Planet, One Habitation*, 2022, §2)

Planetary limits and social thresholds

Social thresholds and planetary boundaries



(from Kallis et al. 2025. Post-growth: the science of wellbeing within planetary boundaries. www.thelancet.com/planetary-health Vol 9, January 2025)

Observing physical and social reality

Scientific inquiry has been a vital instrument in seeking to understand physical reality and in forging innovative solutions based on a search for truth and a commitment to learning. When combined with values such as freedom from prejudice and bias it has enabled humanity to separate fact from conjecture. Scientific capabilities—of observing, measuring, rigorously testing ideas—have allowed us to construct a coherent understanding of the laws and processes governing physical reality, as well as to gain insights into human conduct and the working of society.

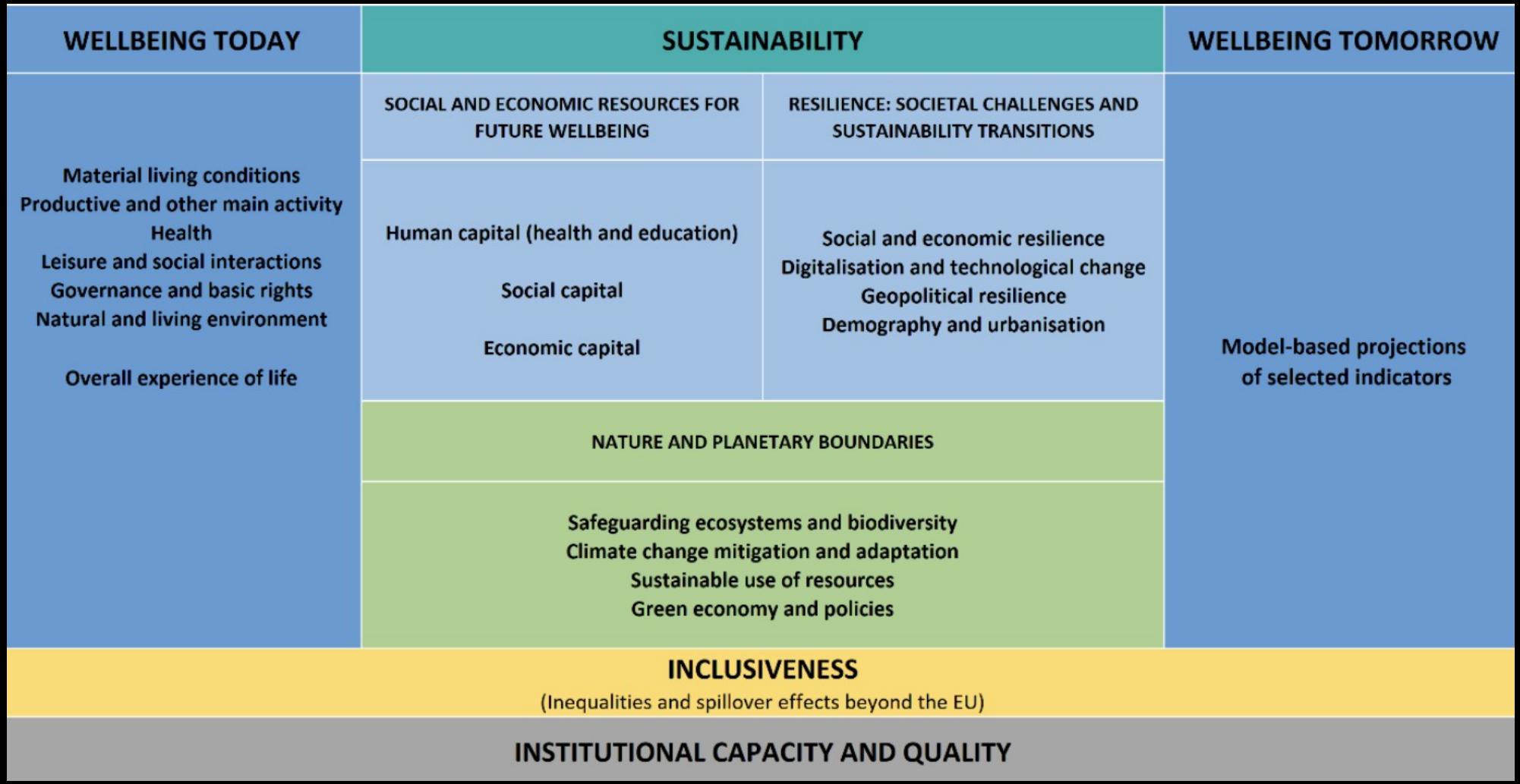
(Bahá'í International Community, *One Planet, One Habitation*, 2022, box Science and Religion)

Sustainable and Inclusive Wellbeing

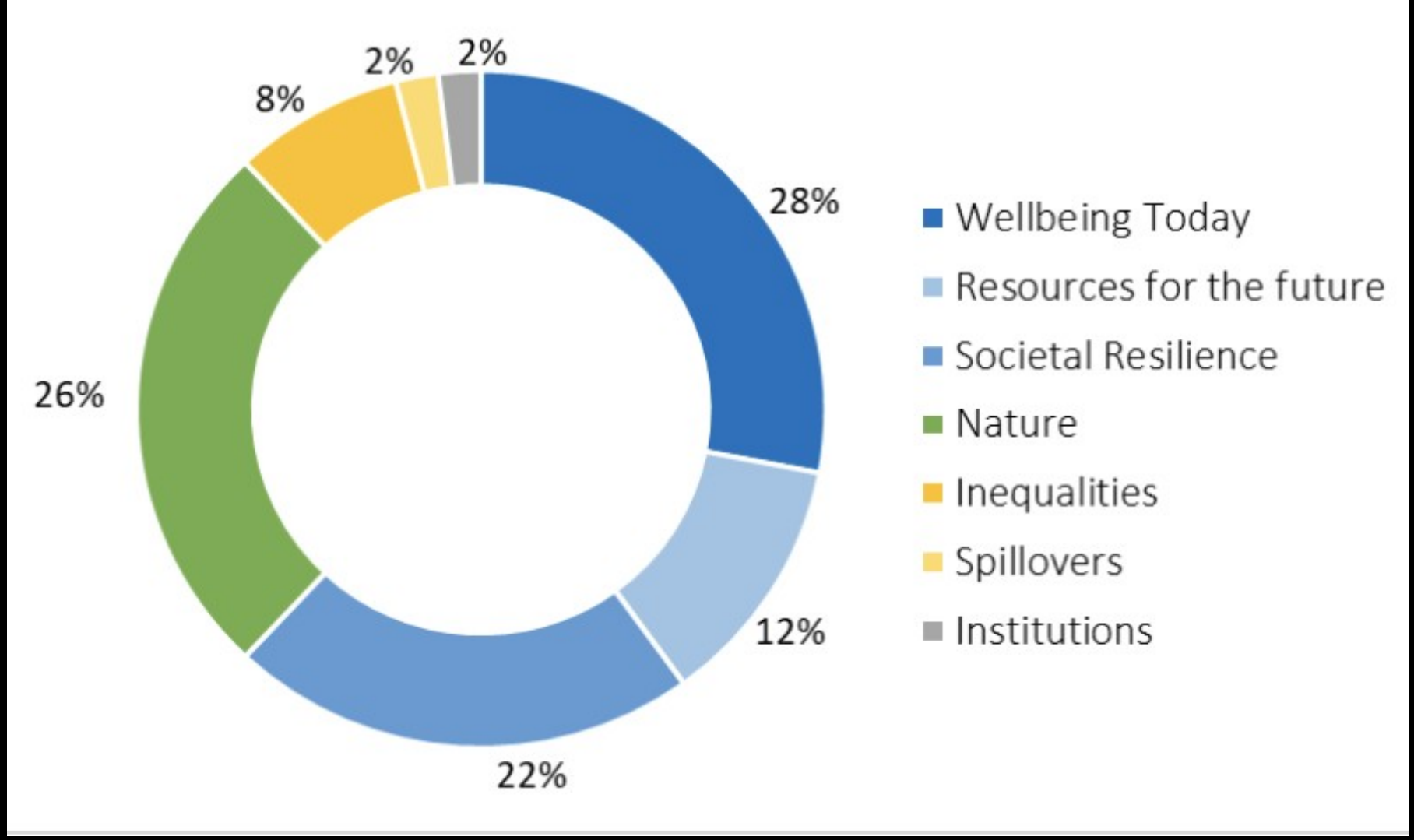
European Commission: Joint Research Centre 2025, *Measuring sustainable and inclusive wellbeing: a multidimensional dashboard approach*.

The JRC Sustainable and inclusive wellbeing initiative recognizes the usefulness of GDP but also the need for complimentary indicators to fully capture all aspects of the quality of life, inclusiveness, and sustainability. It produced a set of 50 indicators that provide a holistic view of the wellbeing of people and the planet. It aims to be a means for delivering wellbeing to all people of the current and future generations, and to the planet.

https://publications.jrc.ec.europa.eu/repository/handle/JRC140456



Sustainable Wellbeing – issues measured



Sustainable Wellbeing Indicators - distribution

Sustainable and Inclusive Wellbeing

The major elements of the framework:

1. Wellbeing today, that refers to all the relevant aspects of the quality of life, including how different population groups and territories experience and perceive it.

2. Social and economic aspects of sustainability, which includes social and economic resources for future wellbeing and aspects of resilience with respect to societal challenges and sustainability transitions.

Sustainable and Inclusive Wellbeing

3. Nature and planetary boundaries, which includes all environmental aspects of sustainability in a unified fashion, including the status and condition of nature (as an endowment, a source of contributions to people, and a resource for the future), aspects of resilience with respect to nature-related challenges, and the planetary boundaries.

Sustainable and Inclusive Wellbeing

4. Wellbeing tomorrow, which would contain model-based projections of selected indicators of wellbeing and inclusiveness. Though added here only as ‘placeholders’, explicit measures of future wellbeing could reveal ongoing trends and emerging challenges better than statistical measures of capitals and resilience. At the same time, they would need to rely on modelling choices and assumptions.

Sustainable and Inclusive Wellbeing

5. Inclusiveness, which collects the key fairness and distributional aspects of wellbeing across all the other components and subcomponents. It also includes international spillovers, capturing far-reaching environmental and social impacts to other countries.

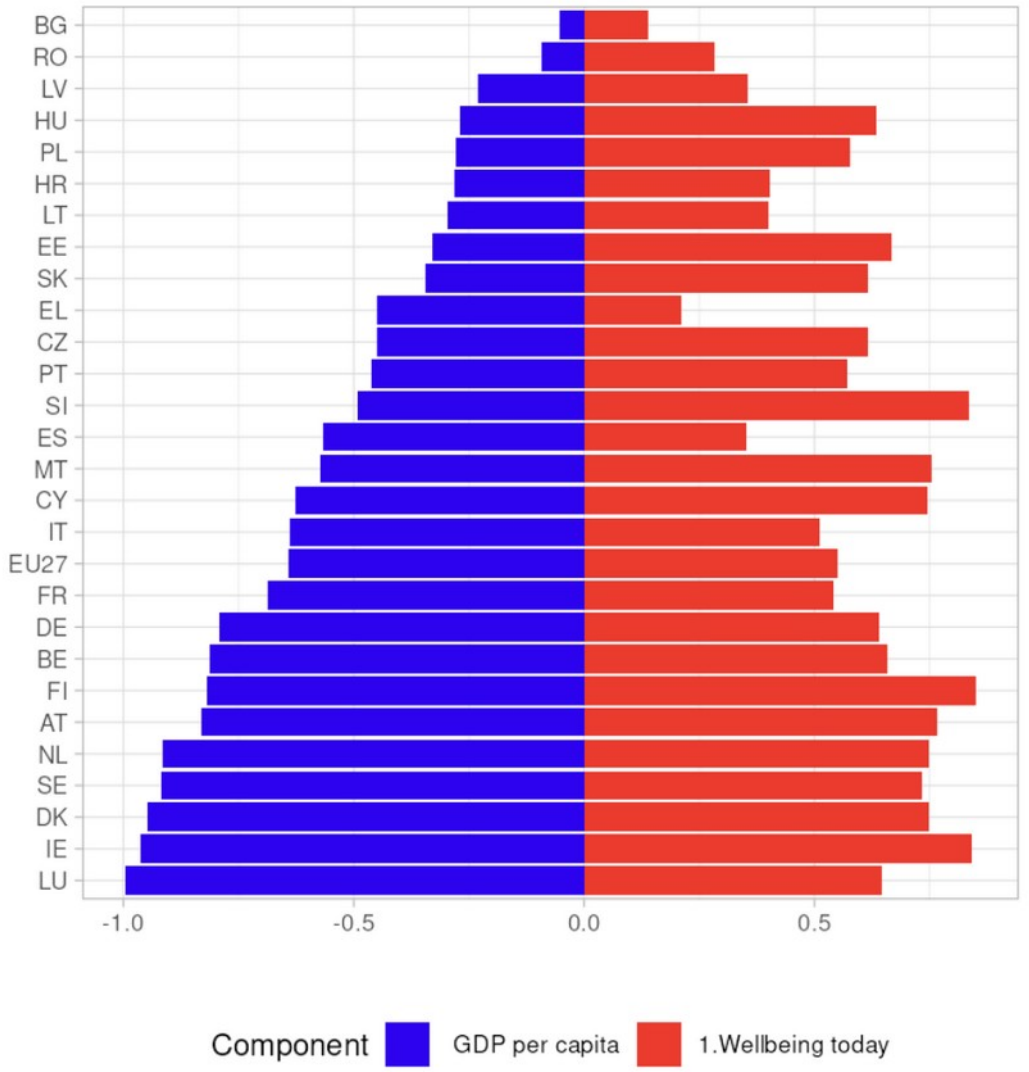
Sustainable and Inclusive Wellbeing

6. Institutional capacity and quality, which points to fundamental characteristics that institutions and governance need in order to ensure the delivery of current and future wellbeing in a fair distribution, intergenerational justice, and the capacity to face challenges and navigate transitions (resilience).

GDP per capita
and
Wellbeing today

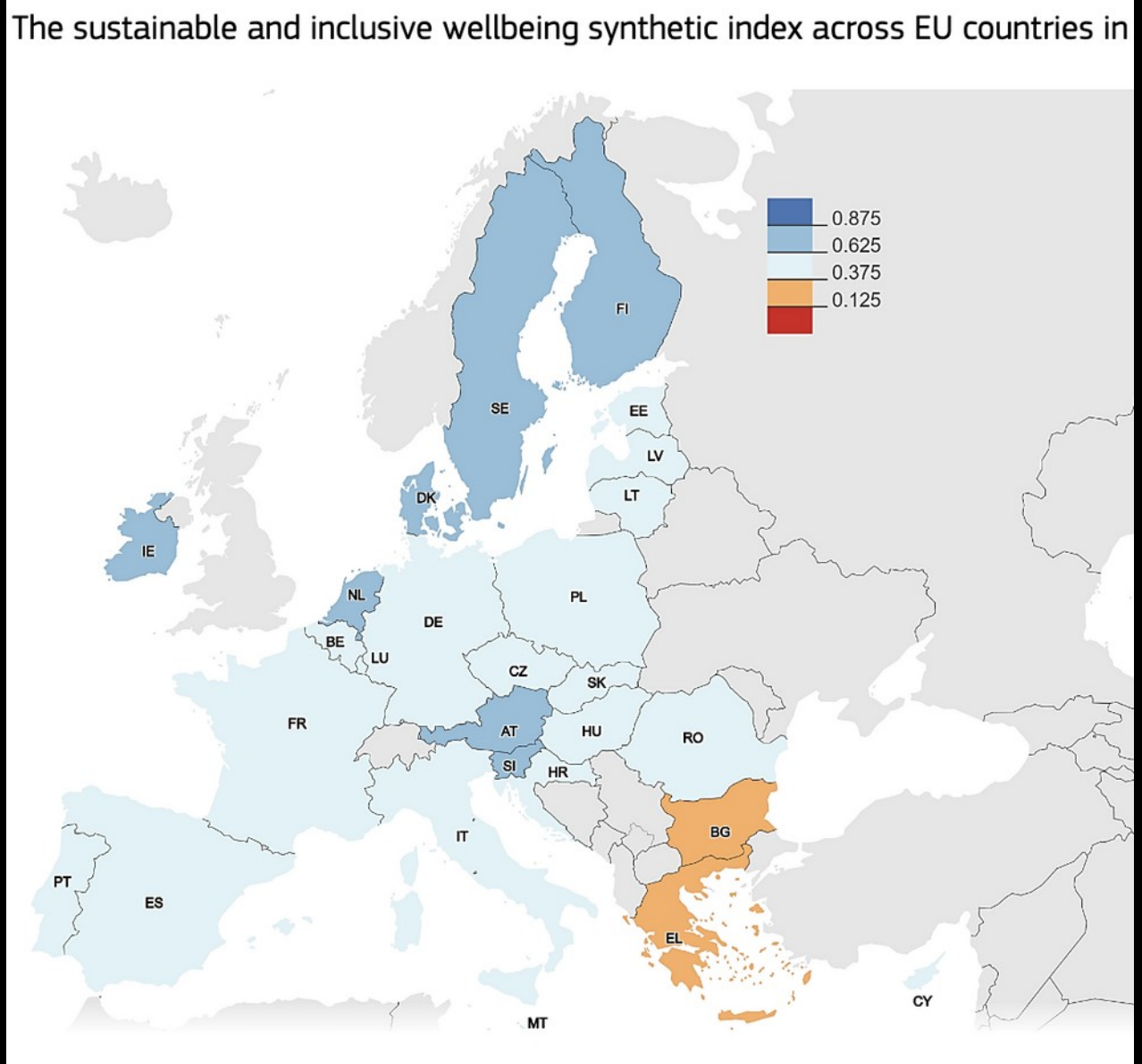
EU countries

Figure 16. Comparison of GDP per capita and Wellbeing today in 2022



Sustainable Wellbeing Index

EU countries



Global Solidarity Accounting

Global Solidarity Accounting (International Environment Forum) using science indicators, not money

- Environmental accounts: Carbon, Biodiversity, Pollution
- Social/economic accounts: minimum living (poverty), food, health, work/employment
- Knowledge and education (information)
- Spiritual accounts (values)

https://iefworld.org/accounting

Community Questions

Reading your reality in your own community

Basic Needs

Are all people's basic needs met and, if not, what are the most urgent problems?

Do all people have access to nutritious, sufficient, and affordable food?

Do all people have access to clean water?

Is the air clean?

Do all people have access to adequate shelter?

Do all people have access to sanitation?

Do all people have access to energy?

https://iefworld.org/acct_conversations_Part1

Community Questions

Food

Is there hunger or malnutrition in the community?
Is there a problem with food availability or affordability?
Are there local small and medium sized farms that can assure some food security?
Is most of the food consumed produced somewhere else, or is a substantial part locally grown?

Health and Health Care

What are the major health problems in the community? (Malaria, water borne diseases, high child mortality, pandemics, high cancer rates, high rates of diabetes, asthma, obesity?)
Are there widespread mental illnesses such as depression?
Is there drug abuse?

Economic Well-being and Justice

Are there very poor people and extremely rich people in the community?
Are there laws instituting a living wage?
Do rich people pay their fair share of taxes?
Are all people engaged in productive work or is there a problem with unemployment?
Are all types of work equally recognized including service traditionally not remunerated such as raising children, caregiving, and subsistence agriculture?

Community Questions

Social Cohesion and Harmony, Culture

Do people live in harmony or are there conflicts, even war?
Is there a problem with gun violence?
Is there racism or historical animosity; are there other prejudices?
Is human diversity valued and appreciated as important to the overall health and success of the community?
Are immigrants and refugees welcomed as active participants in the development of the community?
Is there gender discrimination?

Governance

Does the government serve the interest of all people?
Is there corruption in governmental institutions?
Does the government uphold human rights?
Is there a lack of trust in the government?
Do minorities enjoy equal rights?

Community Questions

Education

Does the educational system include pre-school, elementary education to high school, vocational training, and higher education (college)? Do people have equal access to education?

Do all people have basic literacy?

Is there a high rate of school dropout for children and youth?

Are the schools holistic – do they aim to develop the physical, intellectual, social, spiritual/ethical, and artistic capacities in children and youth?

Spiritual/Ethical Development

Are ethical/moral principles accepted as the foundation of community life? Such principles are, for example trustworthiness and integrity, justice/equity, tolerance and respect for others, unity, compassion, and solidarity. Do people care about social and economic injustice in their community and in the world?

Do people have a sense of personal responsibility toward others?

Is there a widespread consciousness that we humans are interconnected with and depend on the natural world?

Are people generally aware of the impact of their choices on the global environment, and are they mindful consumers?

Science and religion together

Taken together, science and religion provide fundamental organizing principles by which lasting progress can be made. When both the material and spiritual dimensions of humanity are kept in mind, and due attention is given to both scientific and spiritual knowledge, the tendency to reduce human progress to the consumption of goods, services, and technological packages is avoided. Both science and religion are essential to the liberation of individuals and communities from the traps of ignorance and passivity. Both are vital to the advancement of civilization.

(Bahá'í International Community, *One Planet, One Habitation*, 2022, box Science and Religion)

Global cooperation necessary

The Universal House of Justice calls for “global co-operation of the family of nations in devising and adopting measures designed to preserve the ecological balance this earth was given by its Creator.”

“Until such time as the nations of the world understand and follow the admonitions of Bahá’u’lláh to whole-heartedly work together in looking after the best interests of all humankind, and unite in the search for ways and means to meet the many environmental problems besetting our planet, the House of Justice feels that little progress will be made towards their solution….”

(Universal House of Justice, Secretariat, to an individual, 18 October 1981)

An earthly paradise

The Lord of all mankind hath fashioned this human realm to be a Garden of Eden, an earthly paradise. If, as it must, it findeth the way to harmony and peace, to love and mutual trust, it will become a true abode of bliss, a place of manifold blessings and unending delights. Therein shall be revealed the excellence of humankind, therein shall the rays of the Sun of Truth shine forth on every hand.

(‘Abdu’l-Bahá, Selections § 220)