Basics of sustainability

Foundations and Challenges of sustainability

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Preface

This introduction to the foundations and challenges of sustainable development is aimed at students and lecturers who deal with the most pressing issues of our time from different disciplinary perspectives. It arose from the desire to promote a common understanding - across disciplinary boundaries, in teaching, research and social practice.

The world as we know it today is characterised by a multitude of interwoven crises: Climate change, loss of biodiversity, social inequalities, economic instability and political polarisation - in short, a polycrisis. These challenges are neither linear nor easy to solve. They call for a profound rethink of our economic, social and ecological systems, our actions and our idea of development and progress.

Against this background, this textbook sees itself as a shared learning space: it offers systematic access to central concepts, scientific perspectives, normative questions and specific fields of action for sustainable development. The aim is not only to impart knowledge, but also to promote the ability to reflect, think critically and be creative.

This book was written in the context of the study programmes of the Centre for Development and Environment (CDE) at the University of Bern. It reflects the many years of experience in research and teaching on sustainable development and brings together contributions from various disciplines - from environmental sciences, geography and economics to sociology, ethics and law.

Special thanks go to all the authors who have contributed to the creation of this book with their expertise, passion and commitment. We would also like to thank the students, whose critical questions and perspectives are a key driver for the further development of the content. After all, sustainable development is not only a scientific project, but above all a social project - and this begins with education.

We hope that this book will provide a sound basis for your own engagement with sustainability - and encourage you to take responsibility and play an active role in shaping a fair and sustainable world.

About the book

To contribute to sustainable development, we need to analyse the causes of symptoms such as biodiversity loss or global warming, and learn to understand how they are connected and how they interact. We will therefore look at current problems and challenges such as global warming, pollution, biodiversity loss, social inequality, and economic disparities, to understand how they can be tackled at both the local and the global level.

The aim of this textbook is to encourage readers to think critically about the role of individuals, communities, businesses, and governments in the context of sustainable development – and thus to identify and pursue approaches to support sustainable development. In addition, we want to develop visions of the future, especially in the Master's study programmes, that make it possible to imagine a high quality of life in a sustainable modern age, and that make changing the present seem attractive rather than daunting. We want to envision a different food culture, a different economic system, a different type of land use, and a different way of building and living. To make progress towards sustainability, it will be critical to engage stakeholders and foster collaboration across sectors and disciplines. As this textbook will emphasize, education, communication, and participation will also be indispensable in shaping a more sustainable future. With Christo's Wrapped Globe in mind, and Daly's understanding of the empty and the full world as a foundation, we will embark on a journey through the many aspects of sustainable development. We hope that you will find this journey both informative and inspiring, and that it will give you an understanding of both the urgency and the opportunities for sustainable development.

Finally, we hope that our study programmes will inspire students to reflect on their own roles and responsibilities in relation to sustainability, and that it will equip you to make a difference to ensure that the Earth remains a place worth living in for future generations. Only together can we bring about the changes needed to create a sustainable, just, and environmentally friendly world.

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Introduction

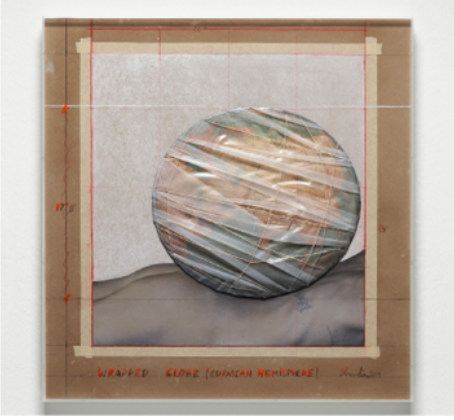

Figure 1: "Wrapped Globe (Eurasian Hemisphere)" by Christo (2019)

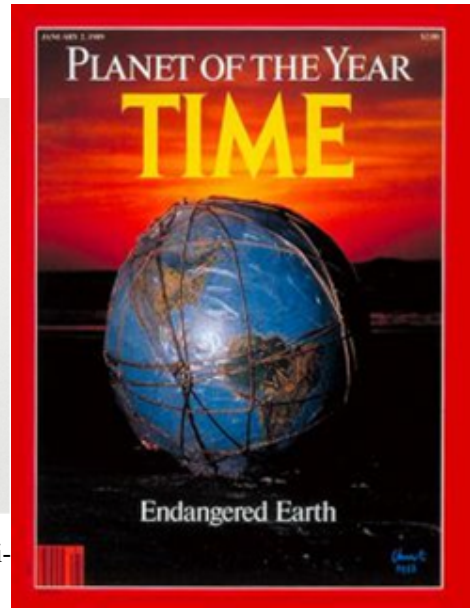

Figure 2: "Planet of the Year" Times Magazine Cover (1989)

Amid the mounting challenges of sustainable development, Christo and Jeanne-Claude's "Wrapped Globe" is a powerful symbol of humanity's responsibility towards our planet and its resources. The artwork depicts a globe wrapped in transparent plastic and a filigree net. Meanwhile, in real life, the world is facing a "polycrisis" – the word used to describe the many serious crises our Earth is facing, including ecological crises, growing inequality, excessive national debt, and the effects of the Covid-19 pandemic, to name but a few. In a polycrisis, crises are increasingly intertwined and mutually reinforcing (Tooze 2022), and they are mainly caused by a structural dependence on growth (as measured by gross domestic product, GDP) (Hickel et al., 2022; Sennholz, 2021); a vicious circle of ever-increasing concentration of economic and political power in the hands of a few (Piketty, 2014); and persistent inequalities between and within countries (Chancel et al., 2021; Milanovic, 2016). And yet, we keep striving for GDP growth in our society and our economy, in order to maintain and create jobs, finance our social security systems, secure tax revenues, and fulfil the

needs of companies and industries that depend on growth to exist. As these expectations become increasingly unrealistic, the idea of decoupling economic growth from resource consumption has gained traction. However, there is no empirical evidence that doing so will achieve anywhere near the scale required to halt multidimensional ecological collapse (Parrique et al., 2019; Hickel and Kallis, 2020; Wiedmann et al., 2020).

Full and empty world

The plastic cover and the net wrapped around Christo's globe thus represent the interconnectedness and interdependence of the Earth's various elements, and emphasize the need to maintain and preserve these relationships. A similar idea was described by the economist Herman Daly (2015), who put forth a concept of the "empty" and the "full" world. The empty world describes a situation in which human activities and resource use have only a minor impact on the environment. In this world, natural systems are still intact and untouched, and resources are sufficient to meet human needs. This contrasts with the full world, in which human activities and resource use overload the ecosystem and pollute the environment. Since at least the Second World War, we have pursued an industrialized society and a growth economy. As a result, we now live in a "full" world, where natural resources are scarce and the balance of ecosystems is under threat. Daly's epiphany came in 1962 upon reading Rachel Carson's book, Silent Spring, which called for a life in harmony with nature. Daly was already sceptical about the hyper-individualism of economic models, and Carson's work highlighted the conflict between a growing economy and a fragile environment. Following a lecture by the economist Nicholas Georgescu-Roegen on his magnum opus, The Entropy Law and the Economic Process (1971), Daly adopted the idea that the economy was more like an hourglass than a pendulum, with valuable resources turning into waste and thus largely irreversibly lost. There is no master plan to counter the polycrisis and make our economic and social system more sustainable.

Part I

Foundations

Chapter 1

Understandings and concepts of sustainability

Where do the concept, mission statement, and guiding principles of sustainable development come from? How did the concept emerge, how did it evolve – and why? The following explanations provide an overview of the history of sustainability, the political background, and key conferences and documents. In short, what has made sustainability what it is today. It's about seeing the big picture. Because only those who know the past can assess the future.

Sustainability has been the buzzword of recent years, from science to politics and business to the media. Initially, the term has a positive connotation because it is associated with the long term, the durable, and many things are sustainable today: coffee, corporate philosophy, even tuna pizzas. These are the demands of a consumer society with an inconsiderate appetite for abundance. First thing in the morning, the shampoo removes our dandruff "sustainably". Then we drive to work at a company that prides itself on its "sustainable corporate philosophy", and over lunch we discuss sustainable investments. At home, we stick a tuna pizza in the oven – sustainably sourced and produced, of course, as it says on the box.

Today, the term "sustainability" is everywhere: it's used in connection with energy, mobility, building renovation, nutrition, population development, corporate environmental management, and climate protection. It's also used in art, culture, design, and advertising.

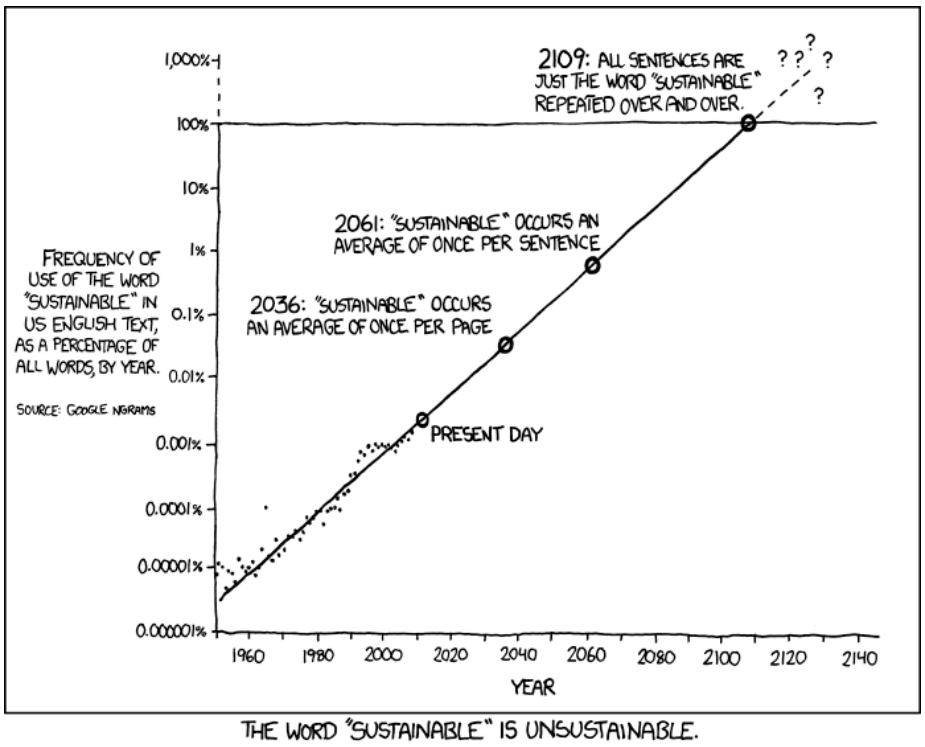

Figure 1.1: Frequency of use of the word "sustainable" in US English texts, as a percentage of all words per year, based on data from Google Ngrams. Source: https://xkcd.com/1007/

Is the term "sustainability" so overused as to slowly become meaningless? Even if this is the case, we shouldn't abandon key terms like this lightly. For example, it's still important for companies to have a sustainability strategy, even if many such strategies are inadequate or amount to greenwashing. We need to clarify the meaning of "sustainability" and hold those who use it to account. And we should base our interpretation on science and historical developments. The historical precursors to the sustainability model explained in this textbook are:

- Start of the discussion about sustainability: Carlowitz's forest management principle of 1713
- Clash of economy and ecology First and second UN Development Decades (1960s and 1970s)
- The Limits to Growth (1972)
- Brundtland Report (1987)
- Rio Earth Summit 1992 Agenda 21 UN Millennium Development Goals (MDGs) (2000–2015)
- 2030 Agenda with the Sustainable Development Goals (SDGs) (2015–2030)

1.1 A normative concept

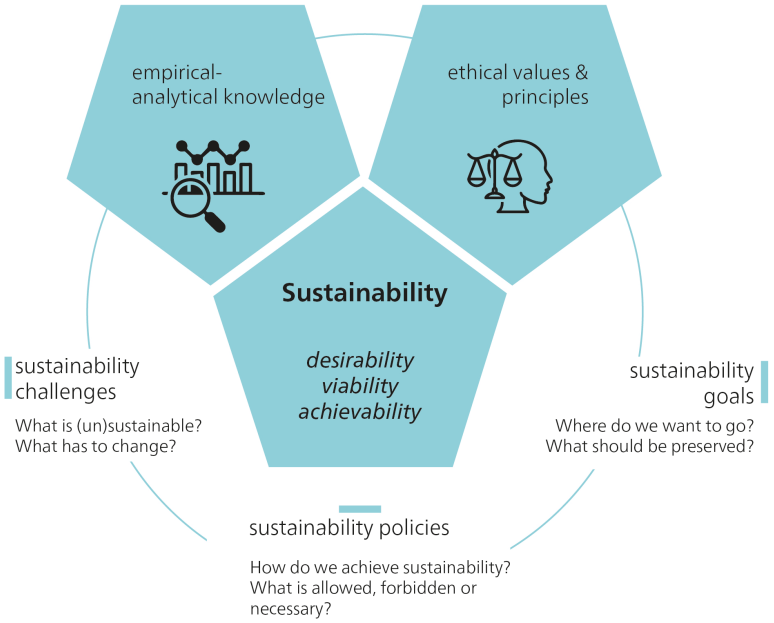

Figure 1.2: Sustainable Development as a normative concept (Own illustration).

To achieve sustainability, we need **sustainable development**: a strategic process that requires changes in our socio-ecological systems and institutions. "Development" implies controlled improvement, and the ethical question of what exactly "better" means is key. The use of the term "development" has been criticized by some (e.g. Lang et al. 2014; Kothari et al. 2019), as it is often equated with unbridled growth. Unbridled growth of the "ecological footprint" – the proportion of the biosphere used for human production, consumption, and waste – is unsustainable in the long term. Nonetheless, there are different interpretations of "development", ranging from economic growth to improving quality of life. Sustainable development therefore remains a stimulating and controversial concept. Sustainability and sustainable development play a key role in today's political discourse. The term "unsustainability" refers to conditions or developments that are considered negative, while "sustainability" represents a positive state.

The concept of sustainable development commits us to certain values and norms that define ethical goals and rules of behaviour. These values and norms shape our ideas of what we consider a desirable or "positive" change. A neutral point of view is not possible, as our perceptions are shaped by a variety of influences. Our personal experiences, upbringing, social environment, and cultural background all influence how we see and interpret the world, including our perceptions of what "should be" and what actions "should be taken". Ethics play a key role in determining how the current situa-

tion can be improved to achieve sustainability, by defining normative goals and limits. Sustainable development is therefore a conceptual framework that is strongly driven by ethical considerations.

Sustainability challenges such as poverty reduction and climate change are therefore ethical challenges. The identification of situations as sustainability problems (and therefore as "negative") and the choice of solutions are based on ethical values. Sustainability goals are also based on ethical values, as well as on knowledge of cause-and-effect relationships. Sustainability issues are often referred to as "wicked problems", because of their complex and pluralistic nature. Global warming, in particular, has been described as a "super wicked problem", as finding solutions is urgent, political institutions are often inadequate, and decision-making processes suffer from short-sightedness.

1.2 Global challenges as wicked problems

Mike Hulme, author of *Why We Disagree About Climate Change* (2009), suggests that we view climate change as a "wicked problem" of enormous scale and likely longevity. This approach helps us see climate change not as a problem that needs to be solved, but as a condition in which we are directly involved. The categorization of problems as "wicked", i.e. those that do not lend themselves to clear-cut solutions, originated with the planning theorists Horst Rittl and Melvin Webber (1973). They argued that planners have to deal with unpredictable human behaviour, and that some problems are too complicated to be solved completely. Some "wicked problems" may never be fully solved, but we can learn to cope with them and not let them dominate us.

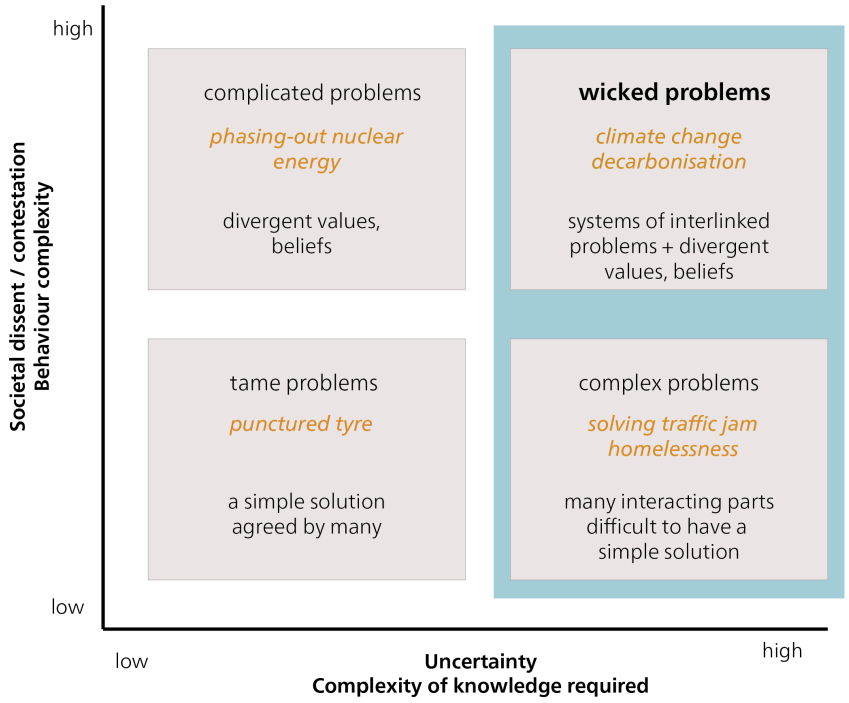

Figure 1.3: Sustainability challenges as wicked problems. Source: Own illustration based on Roth, G. L., & Senge, P. M. (1996)

Wicked problems

According to Bannink and Trommel (2019), wicked problems arise at the intersection of factual uncertainty and a heterogeneity of preferences and interests. Wicked problems are characterized by (Rittel & Weber, 1973; Alford, 2017; Sediri, 2020):

- **Complexity**: Wicked problems are characterized by many interrelated factors and interactions. There are no clear cause-and-effect relationships, and changes in one area can have unforeseen effects in other areas.
- **Normative conflicts**: Wicked problems are perceived and interpreted differently by different stakeholders and interest groups. There is no clear definition or consensus on what exactly the problem is, or how it should be solved.
- **Interdisciplinarity**: Wicked problems require an interdisciplinary approach as they involve different topics, perspectives, and stakeholders. Finding a solution often requires the cooperation and coordination of different disciplines and experts. Uncertainty: Incorrect, missing, or inaccessible information about the problem situation and about the continuity of the values of the variables involved.

- **No definitive solution**: Wicked problems defy clear-cut solutions. They are dynamic, change over time, and require continuous adjustment and iterations.

Examples of wicked problems include climate change, poverty alleviation, global health, and sustainability. The complexity and interaction of different factors in these areas make it difficult to find simple and clear-cut solutions. Dealing with wicked problems requires a high degree of reflection, collaboration, and the use of systemic thinking methods.

How have we manoeuvred ourselves into the current situation, where wicked problems pose such a challenge to sustainable development? In this textbook, we will analyse and learn to understand three key global challenges:

- the emergence of human-induced global warming;
- the persistence of global poverty and rising inequalities;
- and the threat of species extinction and overexploitation of natural resources.

The debate about human influence on global warming and climate change has intensified since the publications of the Intergovernmental Panel on Climate Change (IPCC). The driving force behind global warming is our dependence on oil and other fossil fuels for transport, (electricity) generation, agriculture, and many everyday products. Another wicked problem is global poverty. Although there have been global efforts to reduce poverty for decades, the globalized market economy often leads to increased poverty in certain regions, and the gap between rich and poor seems to be widening overall (Chancel et al., 2021). High-income countries have maintained their prosperity and living standards at the expense of others. These are "externalized costs", and they include environmental degradation. For example, the wealth and living standards of high-income countries are largely responsible for the threat of species extinction and the overuse of natural resources (Lessenich, 2018). In addition to the above mentioned "big three" – climate change, poverty, and biodiversity loss – there are many other global sustainability challenges, such as deforestation, desertification, declining soil fertility, dwindling fish stocks, pollution, wars, conflicts, and increasing migration.

In analysing these comprehensive challenges we must also consider the temporal dimension. In 2004, graphs depicting socio-economic and Earth system trends from 1750 to 2000 were first published, revealing a dramatic upsurge and aptly termed "The Great Acceleration" (Steffen et al., 2004).

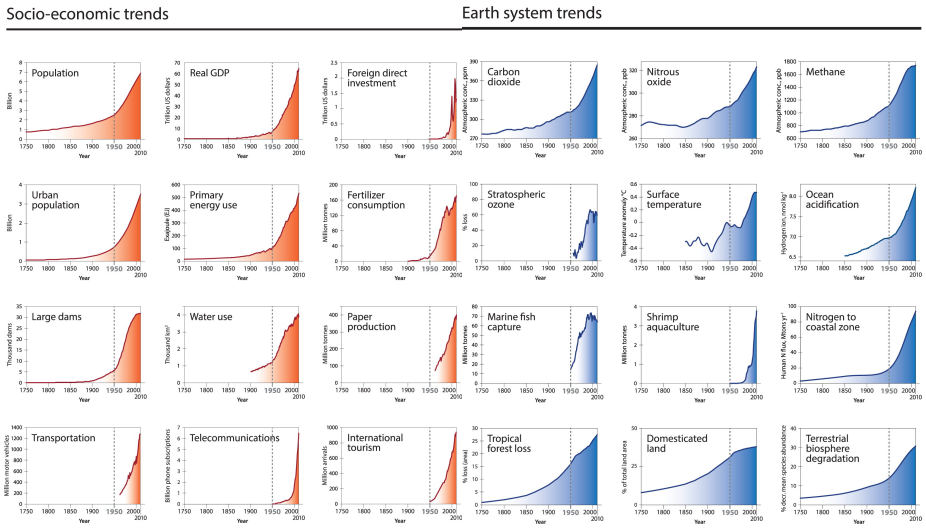

Figure 1.4: 12 socio-economic and 12 Earth system trends from 1750 to today are a strong indication that the Earth system has entered a new state. Source: https://futureearth.org/2015/01/16/the-great-acceleration/.

The Great Acceleration described the exponential growth dynamics that occurred as a result of the Industrial Revolution, which led to a surge in productivity in the mode of production and a significant increase in material wealth. At the same time, but to a much lesser extent, there was a massive increase in natural resource consumption and emissions. Socio-economic growth went hand in hand with the acceleration of biophysical trends. Figure **??** describes some examples of important biophysical and socio-economic indicators, all of which start to increase with the Industrial Revolution. From the middle of the 20th century, the trend towards exponential growth becomes apparent.

The Wheat and Chessboard Problem: an illustration of exponential growth

The Wheat and Chessboard Problem is a mathematical problem often used to illustrate the concept of exponential growth. In the story, a servant asks the king to fill every square on a chessboard with grains of wheat, doubling the number on each square. Growth starts slowly, but with each doubling, the number of grains increases exponentially. By the 50th square, the number of rice grains would be large enough to cover Berlin's 365-metre-high television tower on Alexanderplatz. This story illustrates the immense power of exponential growth and its impressive results. Understanding the concept of exponential growth is crucial to analysing phenomena such as population growth, technological progress, environmental change, and the spread of disease. It illustrates how even small changes or developments in a system can have a significant impact. History reminds us that we need to think carefully about how we manage such growth and the long-term consequences it can have.

Resource extraction has increased significantly in recent decades, from 22 billion tonnes in 1970 to 70 billion tonnes in 2010 (UNEP, 2016). Global warming is another press-

ing issue. The latest IPCC report (IPCC, 2023) predicts an increase in global average temperature of between 1.5 and 5.8 degrees Celsius, depending on the scenario and future emissions. Another alarming phenomenon is deforestation. Every two seconds, an area of forest the size of a football field is cut down – an area the size of New York City every day. And then there is the decline in biodiversity, marked by the extinction of animal and plant species, which threatens the ecological diversity of our planet.

The Great Acceleration (Figure **??**) describes the observable and measurable (negative) developments of key socio-economic and biophysical indicators since 1950. The causes of these negative developments can be far removed from the place where the problems arise or become most evident. For example, job losses in one country may be caused by a multinational company's decision to relocate part of its operations to another country, in order to maximize profits. We cannot hope to fix such issues unless we understand how the system – in this case, the globalized economy – works. Similarly, we need to understand the Earth's global climate systems to imagine what the consequences of global warming might be in a particular area or region.

This is why many of the methods and concepts of sustainability science require systemic thinking. A systemic thinking approach often begins with brainstorming to create a "rich picture" of all the factors you need to consider in order to understand the current behaviour of the system in question. For example, in the case of a multinational company closing a particular business unit, these would be the factors that might influence the decision to continue, expand, or close certain business units. While an initial mapping might look overly complex or even messy, creating a linear flowchart can help clarify the flows of inputs and influences. This kind of mapping may already reveal opportunities to reassess the relevant influences and redesign the system to avoid unwanted outcomes. However, further work may be required to develop "conceptual models" of the system that identify unforeseen opportunities for improvement.

Incorporating systemic thinking into the methods and concepts of sustainability science enables us to tackle the complexity of problems and develop sound strategies for sustainable development. Systemic thinking thus provides an important basis for understanding and shaping the different understandings and concepts of sustainable development, as the next chapter discusses in more detail.

1.3 Sustainability: When did we start talking about it?

In 1713, Saxony's chief mining officer, Hans Carl von Carlowitz, demonstrated the necessity and possibility of "sustainable forestry" in a book entitled *Sylvicultura oeconomica, oder hauswirthliche Nachricht und Naturmässige Anweisung zur wilden Baum-Zucht (Sylvicultura oeconomica, A Guide to the Cultivation of Native Wild Trees)*. Another sustainability pioneer was Duchess Anna Amalia, the mother of Duke Carl August. In the late 1700s, she initiated the world's first forestry reform, which was aimed at ensuring a continuous and steady supply of timber. At that time, Europe had an insatiable appetite for materia prima, or raw materials needed for building ships and houses, and for cooking and heating. This demand threatened to deplete resources and endanger their long-term survival.

In the 18th century, scholars in Germany as well as in other parts of Europe addressed the finite nature of natural resources. Unlike von Carlowitz, however, no one spoke

about sustainability. One important aspect was the provision of food for a growing population. Before industrialization, economic growth was largely determined by nature as a factor of production, such as the number of mines or ships built, or the amount of land available for farming. However, Thomas Robert Malthus, a British economist, warned that food production would not be able to keep up with the rapid population growth following the Industrial Revolution. Malthus believed that the population would grow at a exponential rate, while food production would increase at a linear rate. Although Malthus's thesis did not come true in the dramatic way he predicted, his work is often regarded as the first systematic treatise on the limits to growth in a finite world.

For a time, Malthus's ideas fell out of favour, as unlimited growth seemed possible due to the Industrial Revolution and the rise of capitalism. Talk of natural limits didn't resurface until the mid-20th century, when a "neo-Malthusian" perspective re-emerged in the context of the Club of Rome (founded in 1968), debates on planetary boundaries, and critiques of growth. While Malthusianism traditionally focuses on external, physical limits to growth, the ecological economist, Giorgos Kallis, proposes a different approach. Kallis (2019) advocates personal moderation and voluntary restraint, an approach to life that has deep roots in Romanticism and ancient Greek philosophy. He argues for an inner limit to our wants, to free us from the economic assumption of scarcity and the associated obsession with growth. While acknowledging the reality of external limits, Kallis believes they should not dominate the environmental argument against limitless growth. Kallis therefore asks whether it makes sense to frame climate change primarily as a problem of external limits, of scarcity, or of a finite atmosphere that cannot absorb any more of our emissions.

In the Malthusian logic, we would have to ever increase our production to meet the needs of a world with limits. As long as this mindset persists, the focus is on how we can exceed those limits, and how we can push the capacity of the climate to absorb a growing population and its demands.

1.3.1 The clash of economy and ecology

Originally, sustainability was a principle of resource economics that combined the economic goal of maximizing long-term forest use with ecological conditions for regrowth. In the 19th century, the concept of an 'eternal forest' emerged with the aim of putting an end to overexploitation and ensuring a long-term supply of wood, a vital raw material. Forestry scientists such as Heinrich Cotta developed mathematical methods for calculating timber stocks and growth. Over time, however, the focus shifted towards the pure yield theory, which focused on short rotation periods, high-yield monocultures and maximizing financial benefits. The focus was suddenly on the highest possible direct cash yield instead of a steady high timber yield. Natural cycles were replaced by capitalist dynamics; exchange value took precedence over utility value. This devalued the guiding principle of sustainability, and it took over a hundred years, until the 1960s and 70s, for the scientific disciplines of ecology and sustainability to regain prominence.

1.3.2 Club of Rome and The Limits to Growth

> "If the present growth trends in world population, industrialization, pollution, food production, and resource depletion continue unchanged, the

limits to growth on this planet will be reached sometime within the next one hundred years." Meadows et al. (1972), p. 23

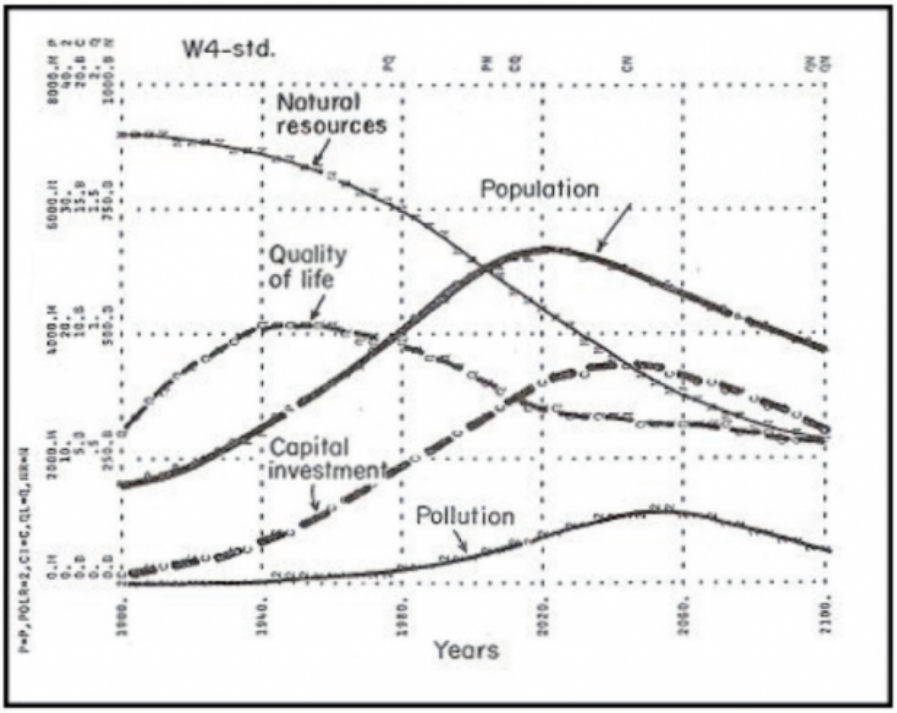

Figure 1.5: The "Basic model" of the simulation carried out at MIT, published in the autumn of 1970. Source: https://donellameadows.org/.

In 1972, the Club of Rome published a report, *The Limits to Growth*, which introduced a much broader understanding of "sustainability". Scientists begin to call for a global state of equilibrium, or homeostasis, that would only be possible through coordinated international action. They integrate economic, ecological, and social aspects of sustainability and use the model of the dynamics of complex systems ("system dynamics") to understand the world. They take into account the interactions between population density, food resources, energy, materials, capital, environmental degradation, and land use. Computer simulations of different scenarios show similar results: a catastrophic decline in the world's population and living standards within 50 to 100 years, if current trends continue. The problem with the resource- and emission-intensive industrialized societies is that growth is not linear but exponential. In the long run, this kind of growth leads to collapse. And ecological collapse can only be prevented through a course correction, argued the report.

The *Meadows Report*, as it is also known, was heavily criticized for its predictions and methods. Some critics argued that the system dynamics model was too simplistic and failed to consider important factors such as technology and innovation. Others said insufficient account was taken of human adaptability and the possibility of political solutions and change. Others yet criticized what they called a Malthusian outlook and

a pessimistic view of the future. Despite these criticisms, however, the report sparked an important debate about sustainability and the need to protect the environment.

A year later, E.F. Schumacher published *Small is Beautiful: Economics as if People Mattered* (1973). Schumacher challenged the prevailing notion of limitless economic growth and technological progress. Instead, he advocated for a sustainable, human-centred economy that respects local communities and the environment. Schumacher argued that a decentralized economy, based on human values, not just profit, would create a better future for all. He also emphasized the importance of education and cultural development in creating a sustainable society.

1.4 From the development debate to the sustainability debate

Worsening air and water pollution helped raise the profile of environmental issues in politics and the media. Greenpeace was founded in 1971. In the 1960s and 1970s, Paul Crutzen and his research team studied the impact of nitrogen oxides on the ozone layer, predicting that this layer would be greatly depleted by human-made CFCs. The use of CFCs in refrigerators and air conditioners was subsequently banned. In response to the growing importance of environmental issues, the United Nations organized the first ever major environmental conference in Stockholm in 1972. The United Nations Conference on the Human Environment, as it was called, led to the creation of the United Nations Environment Programme (UNEP) and independent environment ministries in many countries.

Figure 1.6: Demonstration against air pollution, Zurich, December 1986. Source: Schweizerisches Sozialarchiv/Gertrud Vogler.

The emergence of environmental problems in the 1970s and 1980s coincided with the first “development crises” after the Second World War. In those days we still spoke of

"underdeveloped countries". Following the success of the Marshall Plan in rebuilding Europe after World War II, it was assumed that similar programmes, such as a Marshall Plan for Africa, would lead to a rapid catch-up in socio-economic development of the poor countries of the Global South. But the 70s and 80s proved otherwise. Even exemplary countries such as Mexico and Brazil succumbed to debt crises, demonstrating that achieving socio-economic development and overcoming poverty were far more complex challenges.

From then on, it was clear that issues related to development and the environment had to be considered together at the intergovernmental level. In 1983, the United Nations set up a World Commission on Environment and Development, chaired by the Norwegian Prime Minister, Gro Harlem Brundtland.

1.4.1 Brundtland Commission

Gro Harlem Brundtland appointed 22 commission members, ¾ of whom were from the Global South. During this time, the Soviet Union, facing economic stagnation, was beginning to change political course. As the arms race with the US had contributed to a substantial budget deficit, Mikhail Gorbachev, the newly appointed General Secretary of the Communist Party of the Soviet Union, introduced major reforms. At the same time, a new world view and global consciousness were starting to emerge. It was against this background that the Brundtland Commission was tasked with drawing up a report on the perspective of global, sustainable, environmentally friendly development up to and beyond the year 2000. The report presented in 1987 was entitled *Our Common Future*, but it's often referred to as the *Brundtland Report*.

The Brundtland Report found that global environmental problems were mainly due to unsustainable consumption and production patterns in the North and severe poverty in the South. The overexploitation of nature and depletion of natural resources were exacerbating inequalities (of income and wealth), increasing absolute poverty, and posing a threat to peace and security. The Report sought to develop a fair and just definition of sustainability:

> "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (WCED 1987)

This definition introduced an ethical perspective into the sustainability debate, placing the principle of responsibility at the centre for both present and future generations. By focusing on human needs, the Brundtland Commission adopted an anthropocentric position. The Brundtland Commission identified three key principles for analysing problems and guiding action: a global perspective, the interconnectedness of environment and development, and the pursuit of justice, or equity. The concept of justice/equity was further divided into two distinct perspectives:

1. The intergenerational perspective: Responsibility for future generations.
2. The intragenerational perspective: Responsibility for people living today, particularly in developing countries, and ensuring equity within countries.

Sustainability and sustainable development

The concepts of "sustainability" and "sustainable development" differ in focus. Sustainability is static; it emphasizes a consistent state, while sustainable development is the dynamic process of achieving that state, implying movement and referring to something that is emerging.

1.5 From Rio 1992 to today

After the Brundtland Report's call for international action, the focus turned to translating demands and proposals into binding treaties and conventions. The UN chose a conference as an instrument for this, and it was held exactly 20 years after 1972 Stockholm Conference, the first global environmental conference. The UN Conference on Environment and Development held in Rio de Janeiro, Brazil, in June 1992 – also known as the Earth Summit – was the largest international conference to date, with delegates from over 170 nations.

The Rio Earth Summit adopted the following five documents:

- A Forest Declaration, aimed at the ecological management and protection of the world's forests;
- A Climate Protection Convention committing states to reducing greenhouse gas emissions worldwide to 1990 levels;
- A Biodiversity Convention to combat the decline in biodiversity through steps that are binding under international law;
- The Rio Declaration on Environment and Development; and • Agenda 21, the best known of the five agreements, according to which national governments are responsible for implementing the sustainability model in their countries.

The Rio Declaration on Environment and Development emphasizes that long-term economic progress is only possible using an ecosystem approach. This, in turn, requires a new and equitable global partnership among governments, people, and key societal groups. To achieve this, international agreements are necessary to protect the environment and the development system. The Rio Declaration established key principles of sustainable development, including precaution and polluter pays. For example, Principle 15 states: "In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation". (UN 1992)

In December 1992, the Commission on Sustainable Development (CSD) was established to ensure effective follow-up of the Summit.

1.5.1 Agenda 21: Think globally – act locally

Agenda 21, which contains 40 chapters, addresses all critical policy areas and actions for sustainable development. According to the Preamble, "…integration of environ-

ment and development concerns and greater attention to them will lead to the fulfilment of basic needs, improved living standards for all, better protected and managed ecosystems and a safer, more prosperous future. No nation can achieve this on its own; but together we can – in a global partnership for sustainable development." (UN CSD, 1992)

1.5.2 The Millenium Development Goals (MDGs)

The core principles of Agenda 21 – empowering women, protecting the environment, and promoting an equitable and inclusive society – laid the foundation for the Millennium Development Goals (MDGs) . Adopted by the UN in 2000, the MDGs comprised eight specific goals to be achieved by 2015. Although not all of these goals were met, the MDGs raised significant awareness of the need for sustainable development. The MDGs were succeeded by the Sustainable Development Goals (SDGs), which were adopted by the UN in 2015.

1.5.3 Rio+20

The UN Conference on Sustainable Development, or Rio+20, was held in Rio de Janeiro in 2012, 20 years after the historic 1992 Earth Summit that adopted Agenda 21. The main objective of Rio+20 was to reaffirm global political commitment to sustainable development. Participants, including government leaders and NGO and private sector representatives, discussed a wide range of issues, including poverty eradication , environmental protection, sustainable energy, food security, and resource management. The Summit's key outcome was the adoption of a declaration entitled "The Future We Want". This declaration renewed the international community's commitment to sustainable development and to the Rio Principles and past action plans , and outlined further measures to achieve these goals. In addition, Rio +20 paved the way for a universal development framework to define global sustainability goals and priorities beyond 2015.

1.5.4 The 2030 Agenda and the Sustainable Development Goals (SDGs)

> "We are the first generation that can put an end to poverty and we are the last generation that can put an end to climate change, so we [must] address climate change." Ban-Ki Moon, UN Secretary General 2007–2016, on the 2030 Agenda

Rio +20 laid the foundation for the 2030 Agenda, which the UN adopted in 2015. The 2030 Agenda builds on the results of Rio+20 and sets out a comprehensive framework for sustainable development. The 2030 Agenda is based on five key principles or pillars (the 5 Ps) and introduces the 17 Sustainable Development Goals (SDGs), which aim to create a sustainable and just world by 2030.

The 5 Ps of the SDGs

The 5 Ps represent five key principles of sustainability : People, Planet, Prosperity, Peace, and Partnership.
People: This P stands for the aim to promote social justice, equal opportunities, good health, and education for all people. It also seeks to end poverty, promote gender equality, and improve people's well-being.
Planet: The aim of this P is to protect natural resources and to use them sustainably, to preserve biodiversity, to protect the climate, and to reduce pollution. Overall, it seeks to preserve our planet and promote sustainable environmental practices.
Prosperity: This refers to economic growth, sustainable production and consumption patterns, and the creation of jobs and economic prosperity for all. This P aims to promote a strong and sustainable economy that benefits all people.
Peace: This is about promoting peace, justice, good governance, and strong institutions. It's also about preventing conflict, reducing violence, and building inclusive societies.
Partnership: This refers to the importance of global cooperation, partnerships, and solidarity among all stakeholders. It's about working together to implement the 2030 Agenda, and sharing resources, experience, and knowledge.

1.5.5 2015 Paris Climate Agreement

The Paris Climate Agreement of 2015 is a landmark international agreement adopted at the 21st Conference of the Parties (COP 21) to the UN Framework Convention on Climate Change (UNFCCC) in Paris. The Agreement aims to limit the global temperature rise to well below 2 degrees Celsius compared to pre-industrial levels, and to endeavour to limit it to 1.5 degrees Celsius. The Paris Agreement is based on the principle of common but differentiated responsibilities and respect for national circumstances. It encourages all countries to take action to reduce their greenhouse gas emissions and to set themselves voluntary climate targets, known as Nationally Determined Contributions (NDCs).

The 2015 Paris Climate Agreement applies to every country that has ratified it, including Switzerland . As a Party to the Agreement, Switzerland has committed to contributing to the global reduction of greenhouse gas emissions and to implementing the Agreement's objectives.

1.5.6 Conclusion – there is progress, but it's too slow

While there has been some progress in institutionalizing and disseminating sustainability approaches in business, policymaking, and other areas, a large number of studies show that the world as a whole is on an unsustainable course (see the Voluntary National Review of Switzerland 2022). A similar picture is painted by various studies on the global environmental situation, such as UNEP's Global Environment Outlook 5 (GEO-5) published in 2012, the 2010 Millennium Development Goals Report (MDGs Report 2010), and reports on the 2030 Agenda and climate change (IPCC 2022). As

these studies show, the international community is a long way from sustainable, intergenerationally equitable ecological, social, and economic development.

For example, international climate policies have not stopped the rise in CO2 emissions, the main cause of human-induced climate change, which have risen by around 50% since 1990. Species loss continues to accelerate in many places. The global fight against poverty falls short of the desired goals, and economic globalization over the past three decades has worsened socio-economic inequality in many countries, often linked to sociopolitical and sociocultural disparities.

1.6 The guiding principle of sustainable development as a normative concept

Turning the concept of sustainability into action and developing implementation strategies is a major challenge for our society. There are different understandings and concepts of sustainability and sustainable development, with no consensus on how to achieve sustainability and which measures to prioritize. Some of these understandings are presented below. The diversity of approaches reflects the different perspectives and interests of different stakeholders. To navigate this complexity, we need to reconcile economic, social, and environmental considerations. This requires an integrative approach. The challenge is to define common goals and develop strategies to achieve sustainability at all levels – global, national, regional, and local. We need broad societal participation and dialogue and cooperation between governments, business, civil society, and research institutions, to find solutions and drive the necessary change.

> "When powerful metaphors become fashionable buzzwords, we risk that diversity is accompanied by vagueness, i.e. the phenomenon of a term that has several meanings that 'have so much in common that it is difficult to separate them' " (Strunz 2012: 113 as cited in Feola 2015: 377).

The concept of sustainability usually has a positive connotation, but it can be viewed from different perspectives. In order to function as a guiding principle (in an ecological, social, and economic sense), it requires clear criteria. But what grounds can we use to define these criteria?

According to Hirsch Hadorn & Brun (2007), "sustainable development" should:

- Fulfil *needs*…
- …in a *just* way,
- …with a view to people living today and in the future, and
- taking into account the diversity of values and the limits to which nature can be used.

The guiding principle of sustainable development is therefore not only the result of scientific research, but is first and foremost a normative, ethically based concept. It brings together "ethical and analytical ideas" and formulates "norms that express what

is desirable and what should happen" (Renn et al. 2007: 39). As a result, sustainable development is a social process of negotiation and decision-making – of searching, learning, and gaining experience – that is guided by ethical considerations. Accordingly, sustainability research must always be aware of its involvement in social processes of perception and evaluation.

1.6.1 What values and norms should we be guided by, and why?

Moving from the concept of sustainable development to its implementation, ethics come into play. Ethics provide evaluation criteria, methodological procedures, or principles for "justifying and criticizing rules of action or normative statements about how we should act" (Fenner 2008, p. 5). Ethics also help to structure and justify complex decisions that arise in dilemma situations. In contrast to problems with single solutions, a dilemma is more complex and involves trade-offs and the weighing up of different options for action. Ethics provide orientation and decision-making structures that provide a framework for finding a suitable course of action in such situations. The core function of ethics is therefore not to solve monocausal problems, but to structure and categorize complex dilemmas.

Put simply, "morality" refers to personal or social beliefs about right and wrong, while "ethics" is the philosophical study of these beliefs. Ethics studies the rules and principles that "ought" to govern human behaviour. Ethics can be divided into general and applied ethics (Figure **??**).

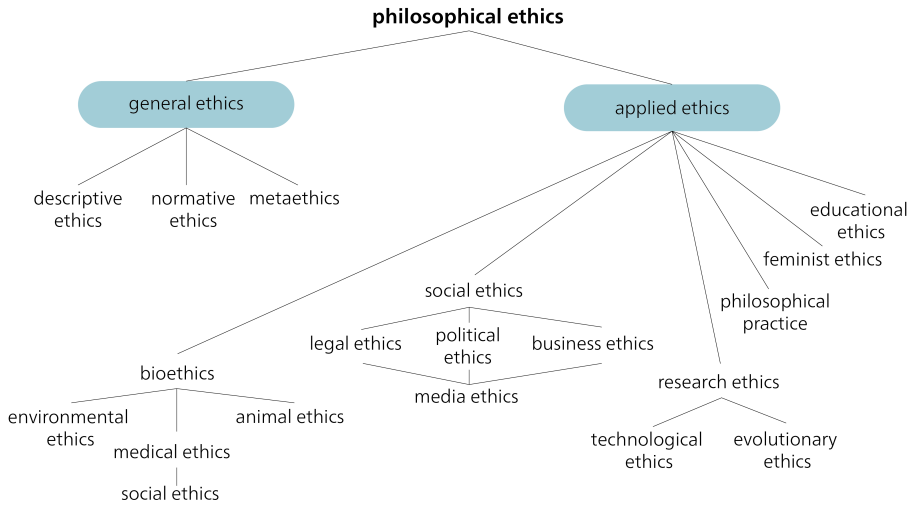

Figure 1.7: The different branches of philosophical ethics. Source: Own illustration based on Pieper and Thurnherr 1998: 9.

General ethics provides us with methods and concepts to discuss fundamental moral problems. It consists of three branches: normative ethics, descriptive ethics, and metaethics. Normative ethics focuses on determining what is morally right or wrong.

For example, questions about what constitutes a good life can have different answers, depending on people's individual values.

For this reason, normative ethics is further divided into teleological and deontological approaches. Teleological ethics (rooted in telos, the Greek word for "end", "purpose", or "goal") evaluates actions based on the good they produce. Utilitarianism, for example, is a teleological theory that evaluates actions based on the resulting utility or happiness. One of the first systematic elaborations of utilitarianism is Jeremy Bentham's (1748–1832) An Introduction to the Principles of Morals and Legislation (1780). Deontological ethics, on the other hand, evaluates actions on the basis of their characteristics rather than their consequences. Its root is deon, Greek for "duty". An example of a deontological ethical theory is Kantian ethics, developed by the German philosopher Immanuel Kant.

The distinction between teleological and deontological approaches is often discussed using the "trolley problem" (see Sandel [2009; 2013] for further reading).

Further reading

Justice: What's The Right Thing To Do? Episode 01 "THE MORAL SIDE OF MURDER." 2009. With Michael Sandel. The Moral Side of Murder. https://www.youtube.com/watch?v=kBdfcR-8hEY.
Sandel, Michael. 2013. *Gerechtigkeit.* Ullstein.

1.6.2 The imperative of responsibility – Hans Jonas

Hans Jonas's "imperative of responsibility" (1979) offers an important contribution to the sustainability debate by emphasizing our ethical responsibility for future generations and for nature. Jonas's approach, which has been described as a kind of "ethics of the future", aims to address the new challenges posed specifically by a technological civilization. The link to sustainability ethics lies in his understanding of the concept of ethical responsibility towards future generations, which he views as an asymmetric, non-reciprocal relationship (Jonas 1987a, p. 177). The asymmetry is derived from the power of a "moral subject" over someone or something that requires care; Jonas describes the vulnerability of life (ontological vulnerability) and responsibility as our duty of care to protect other beings from harm (Jonas 1987a, p. 391).

Jonas's approach differs from other ethical theories in that it doesn't take the existence of humanity for granted, and instead includes duties towards future generations as well as to nature. Jonas argues that the first duty of ethics of the future consists in recognizing the distant effects of human action (Jonas 1987a, p. 64). Given the uncertainty about the long-term consequences of human action, he proposes a decision-making principle based on the Latin term, in dubio pro malo, which he interprets to mean: "[…] when in doubt, give the worse prognosis precedence over the better, as the stakes have become too high for the game" (Jonas 1987b, p. 67). Jonas thus develops a new categorical imperative, emphasizing the need to preserve both nature and humanity. It is based on the idea that nature has inherent value and purpose: "Act in such a way that the effects of your action are contractual with the permanence of genuine human life on earth", or "Act in such a way that the effects of your action are not destructive to the future possibilities of such life" (Jonas 1987a, p. 36).

Already in the late 1970s, therefore, Hans Jonas articulated a fundamental uncertainty about the risks and harm that could arise for future generations from the technologies that were being used, such as nuclear energy. Decision-making around issues such as new technologies requires a continuous evaluation of risks and opportunities, often amid incomplete information and uncertain future forecasts. These choices not only impact the environment, but also raise ethical questions about our obligation to ensure sustainability for future generations. Jonas's imperative of responsibility emphasizes the link between responsibility and duty as key concepts in the sustainability debate. According to Jonas, current generations have a forward-looking responsibility to future generations. He leaves open, however, the extent of this duty, and whether future generations are entitled to absolute or comparative standards.

Jonas's imperative of responsibility can be considered in connection with various areas of responsibility that represent different ethical approaches: anthropocentrism, pathocentrism, biocentrism, and physiocentrism.

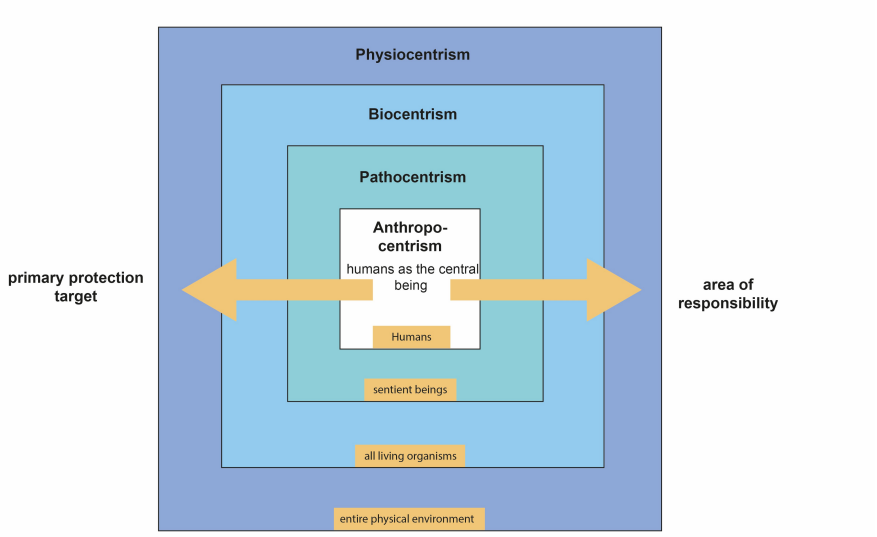

Figure 1.8: Different ethical approaches. Source: Own illustration based on Carnau 2011: 143.

Anthropocentrism views humans as the central beings, emphasizing responsibility towards human society and its well-being. This includes considering the needs and interests of both present and future generations. Pathocentrism, on the other hand, emphasizes responsibility towards sentient beings and their well-being. It recognizes that not only humans, but also animals and other living beings, have the right to be free from suffering and harm. Biocentrism, in turn, recognizes the intrinsic value of all living organisms and focuses on the protection and preservation of biodiversity. It emphasizes the importance of respecting the natural environment and promoting sustainable practices. Finally, physiocentrism focuses on the responsibility towards the entire physical environment, including inanimate nature and ecosystems. It recognizes the intrinsic value of nature and emphasizes the complex interactions between all components of the ecosystem.

Hans Jonas's imperative of responsibility reconciles all of these different areas of responsibility. It urges us to take responsibility for people as well as for other living beings, nature, and the environment. In doing so, it is important to adopt a balanced and comprehensive perspective that takes into account long-term effects and the well-being of all.

By integrating these different areas of responsibility, we can cultivate a holistic and sustainable ethic that takes due account of the needs and interests of all aspects of life and nature.

1.7 Sustainable Development in the context of development debates

Is "sustainable development" a development theory? Yes and no. No, because sustainable development is a broader social model and acts as an overarching framework that encompasses various development theories. Yes, because sustainable development is a normative theory that de facto competes in scientific and social practice with other theories of social and, in particular, socio-economic development.

Development theories analyse social development, either retrospectively or prospectively, and either as a whole or through specific aspects (e.g. economic development). The retrospective study of social development seeks to explain past or current social developments and to draw lessons for future planning and development policy. The prospective study of social development aims to inform social development management and policy. Development theories can be categorized into different types: normative, strategic, and explanatory theories. Each type focuses on different aspects and objectives of development research.

Normative theories focus on the question of what development should look like, and what normative goals it should achieve. They examine values and goals associated with development, often referring to concepts such as social justice, sustainability, or poverty alleviation. Normative theories emphasize the definition of criteria for good development, and provide a normative framework for policy decisions and measures. Examples include the theory of sustainable development, John Rawls's theory of social justice, or Amartya Sens's Capability approach.

Strategic theories investigate which strategies and measures are needed to achieve desired development outcomes. They focus on questions of policy design, resource allocation, and the implementation of measures, analysing how specific approaches, such as neoclassical growth theory, can promote development.

Explanatory theories aim to explain the causes and mechanisms of development. They analyse factors that drive development processes in societies and study the links between the different variables. This involves examining economic, social, political, or cultural factors to identify patterns and connections. Examples include modernization theory and dependency theory.

Note: All theories are based on normative foundations – i.e. underlying values and beliefs – and therefore imply, even unintentionally, certain ideas about how society should develop.

Table 1.1: Overview of Development Debates. Source: Extended table based on Egli et al. (2022), p. 378

	1950s/60s	1970s	1980s	1990s	Since 2008
Narrative	Economic growth, modernization, and integration into the world economy	Fight against extreme poverty and inequality	Lost decade: collapse of commodity prices; increase in debt	Sustainable development; decade of hope	Polycrisis
Basic idea	Catch-up development through industrialization and large-scale projects	Satisfaction of basic needs, growth, and effective distribution	Overcoming the debt crisis through structural adjustment measures, reduction of state services	Global and sustainable environmental policy, economic growth, peacekeeping, continuing basic needs strategy, participation	Bringing together various crisis phenomena (financial crisis, climate change, biodiversity crisis, etc.) and examining their complex interrelations; search for integrated solutions
Theories	Modernization theories (stage theories)	Dependency theories versus modernization theories	Market liberalism and neoliberalism	- Theories of sustainable development - Neoclassical growth theory - Postcolonial theories - Capability approach - Post-development theories	Additional resilience theories, post-growth theories

	1950s/60s	1970s	1980s	1990s	Since 2008
Goals	Geopolitical classification of the "Third World"; containment of communism, modernization of agriculture, rapid industrialization and technological progress, opening up of new markets	Aid for self-help, appropriate technologies, rural development, promotion of women	Increase in exports, balanced state budgets	Paradigm shift in development aid towards development cooperation, environmental and social compatibility of development, ensuring access to resources and infrastructure for all	
Consequences	Economic dependence and indebtedness increase, income disparities widen, poverty rises, ecological damage due to overuse and inappropriate technologies, undemocratic regimes are supported for geopolitical reasons	Selective progress in education and health, problems of debt and environmental damage	Living standards of the poorest population groups deteriorate severely, environmental exploitation, debt spiral, increase of dependency of the Global South on Global North countries	Focus shifts from purely economic development to human development; industrialized countries are obliged to implement sustainable development; emergence of a global development partnership	

Development theories

Modernization theory (1950s–1980s) emphasizes the transition from traditional societies to modern, industrialized societies as the basis for development. For proponents of modernization theory, the countries of the Global South are developing in the same direction as industrialized countries, but at a much slower pace. Modernization theory values economic growth, technological progress, and institutional adjustments. It is often associated with stage theories, which emerged in the 1950s and 1960s. Stage theories view development as a gradual process characterized by clearly defined stages or phases of development, with emphasis on economic growth and modernization. Prominent proponents include Walt Rostow, who identified five stages of development in his work, The Stages of

Economic Growth: A Non-Communist Manifesto (i.e. traditional society, preconditions for take-off, take-off, drive to maturity, and mass consumption).
Dependency theory (1970s and 1980s) emphasizes the structural dependence and inequality between developed and developing countries. It argues that developing countries are trapped in an unjust global economic system and remain dependent on developed countries.
Neoclassical growth theory (as of the 1990s) focuses on the connection between capital accumulation, technological progress, and economic growth. It emphasizes free markets, trade, and investment as drivers of development.
Postcolonial theories (as of the 1990s) emphasize the historical and structural inequality between former colonial powers and colonies. They argue that development can only be achieved through a critical examination of the legacy of colonialism.
Sen's Capability approach (as of the 1990s) emphasizes the importance of freedom, social justice, and human development. It emphasizes the necessity to improve the opportunities and capabilities of people in order to achieve development.
Post-development theories (as of the 1990s) criticize linear development models that impose Western ideas of progress, emphasizing instead local practices and values. Prominent thinkers in this field include Arturo Escobar, who critically reflects on the idea of development in his work Encountering Development: The Making and Unmaking of the Third World, and Vandana Shiva, whose Decolonizing the North calls for a sustainable and fairer development policy in the Global South that reduces the influence of the Global North.

1.8 Sustainability models

1.8.1 Three dimensions of sustainability

The established three-sector model of sustainability, introduced in the 1987 Brundtland Report, s eeks to balance environmental, economic, and social concerns. This model, which later also became known as the "triple bottom line" model, emphasized that economic development should be profitable while ensuring that environmental and social impacts remain neutral. On closer inspection, however, the model – initially depicted as a building with three pillars – has a major weakness. While it was intended to suggest that if any one pillar was weak, the system as a whole would be unsustainable - it could be argued that removing one of the pillars – or even the two outer pillars – would not make the building collapse if the remaining pillar(s) were strong enough. Despite its widespread use and overall success, the model struggles with transparency and equity. For example, measuring economic success requires quantitative indicators, while it's hard to find similar metrics for social well-being, especially emotional aspects. Some critics argue that the model prioritizes conventional economic thinking, neglecting important social aspects. An overemphasis on human economic systems can also prevent us from seeing our dependence on non-human ecological systems.

1.8.2 Sustainability as an intersection

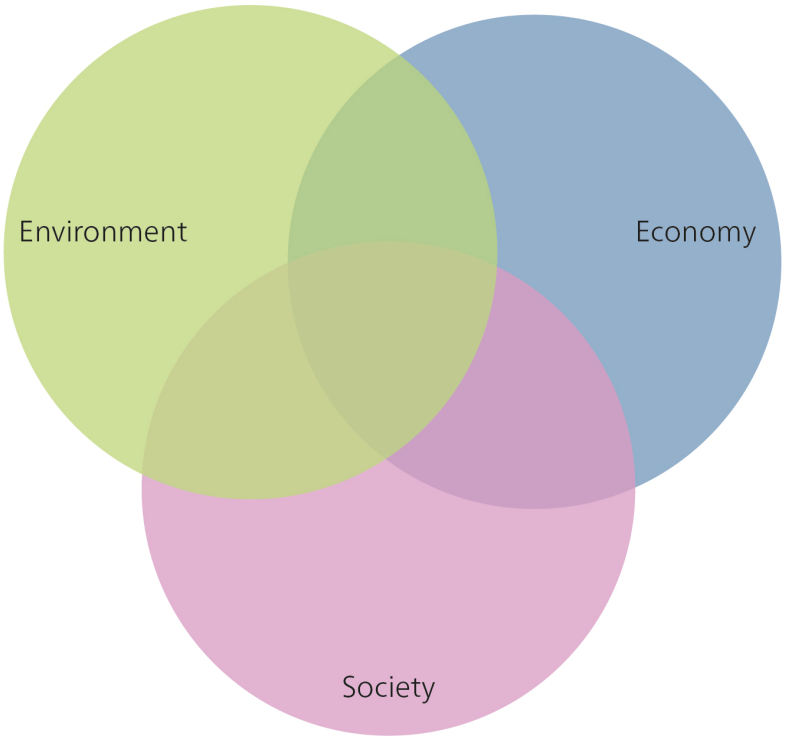

Figure 1.9: Sustainability as an intersection. Source: Own illustration.

A model displaying the three sectors as a Venn diagram (overlapping rings or circles, sometimes known as the intersection or triad model) offers an alternative to the separate pillars, emphasizing the interconnectedness of the three dimensions. This model illustrates that there can be a closer connection between two areas, and that the boundaries are fluid.

1.8.3 Nested sustainable development

Giddings et al. (2002) challenge the idea of separate spheres for the economy, society, and environment. They propose a "nested" model, where the economy is seen as part of society, which in turn is embedded in the environment. This model, they argue, ensures that economic decisions are always constrained by social and environmental factors. Global ecosystems form the basis for social systems (i.e. society). Embedded therein is the economy, which serves society's needs. A potential drawback of this model, however, is that if the economy is the starting point for all sustainability considerations, there's a risk of prioritizing it over social and environmental considerations.¨

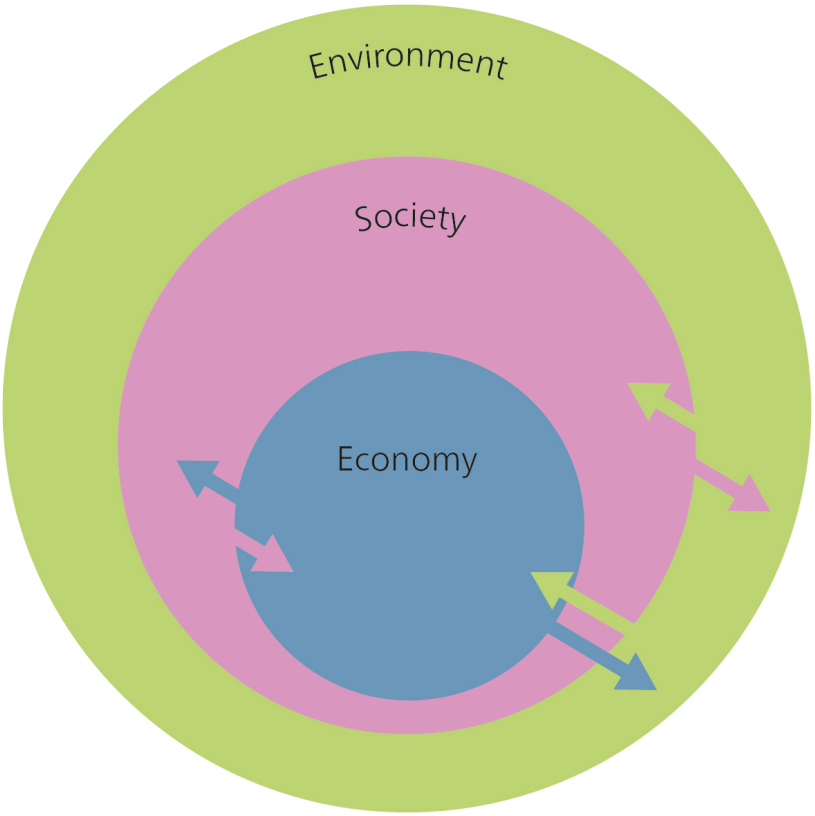

Figure 1.10: The nested model of sustainability. Source: Own illustration adapted from Giddings (2002: 192).

1.8.4 A four-dimensional model of sustainability

One problem with the three-sector model of sustainability is that that it's unclear what falls within the broad "social" sphere. It has therefore been suggested that a fourth dimension be added, to emphasize certain aspects that might otherwise remain hidden in the social sector. For example, Jon Hawkes, an Australian cultural commentator , has suggested adding "cultural vitality" as a fourth pillar of sustainability, in addition to environmental, economic, and social concerns.

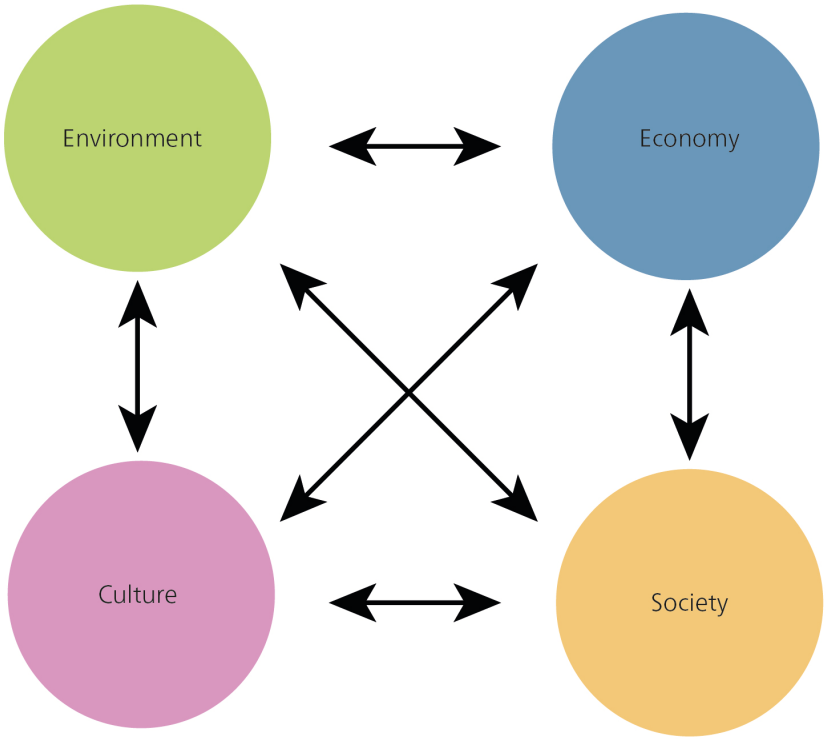

Figure 1.11: Four-dimensional model of sustainability. Source: Own illustration, adapted from Hawkes, 2004.

Cultural sustainability is often seen as a part of social sustainability. Sometimes the term "sociocultural sustainability" is also used. In this context, "culture" refers to aspects such as equity, opportunities for participation, awareness of sustainability, and general operating and behavioural models (Murphy, 2017). It's clear that the social and cultural dimensions are closely linked. Cultural processes influence our social lives and how we view social sustainability, like the value we place on equality as a social goal. In turn, social structures and institutions influence cultural practices and judgements. Despite this strong connection, cultural and social sustainability can also be seen as separate dimensions or perspectives of sustainability.

Culture does not have its own Sustainable Development Goal (SDG). In the 2030 Agenda, culture is mentioned in relation to "civilization", "diversity", "interculturality", "cultural heritage", and "tourism", under the following four SDGs: quality education (SDG 4), decent work and economic growth (SDG 8), sustainable cities and communities (SDG 11), and responsible consumption and production (SDG 12) (Duxbury et al., 2017).

The concept of cultural sustainability can be interpreted in different ways: as the fourth dimension of sustainability, as culture for sustainability, and as culture as sustainability. The interpretation of "culture as sustainability" requires a new way of thinking and a new paradigm in relation to sustainability. In this view, culture itself is transformed to-

wards sustainability. Cultural sustainability here means thinking about what needs to be preserved, what needs to change, and how we can implement these changes. This interpretation – viewing culture as sustainable development – defines culture in the broadest sense as a comprehensive lifestyle and a continuously changing process. Our social order (such as capitalism and democracy), our values, and our ways of working are all cultural products. Culture thus encompasses all the other dimensions of sustainability and transforming it becomes a key concern or paradigm for sustainability.

The definition of cultural sustainability contains several important aspects: Firstly, it emphasizes the importance of intellectual growth and responsibility. This means acquiring knowledge, developing a better understanding of important issues, and participating in educational activities and events. It also means acting not only as individuals, but also as members of different communities. All problematic and unsustainable structures and operating models have been created and developed by humans. We humans, therefore, also have the opportunity to change them.

Cultural sustainability is required, for example, for a "Great Transformation" as advocated by Uwe Schneidewind (2018). In his work, Schneidewind emphasizes the need for comprehensive change in all dimensions of society, including culture, in order to achieve sustainable development. Recognizing cultural sustainability as a central paradigm of sustainability supports the vision of a comprehensive transformation that goes beyond technological and economic solutions and strives for a fundamental societal change of course.

1.9 Weak and strong sustainability

The academic debate on sustainability distinguishes between weak and strong sustainability (see e.g. Ott, 2020). Neither concept can easily be dismissed, as both rely on assumptions that are difficult to refute. In practice, both concepts are considered partially true, with evidence both in favour and against. The key difference between weak and strong sustainability is the question of what we should sustain, and the degree to which what forms of capital can be substituted. This concerns, in particular, the following three forms of capital: natural capital, manufactured capital , and human capital.

Natural capital: the natural resources and ecosystems that are key to human well-being and sustainable development. These include land, water, air, biodiversity, and renewable energy. Natural capital is the basis for many economic activities, and it provides essential ecosystem services such as food, the purification of water and air, and cultural and aesthetic benefits.

Manufactured capital: the material resources and infrastructure used in production and economic activity. This includes buildings, machinery, technological equipment, means of transport, and physical infrastructure. Manufactured capital is closely linked to economic growth and productivity, and plays an important role in economic development.

Human capital: the knowledge, skills, level of education, health, and creative abilities of people in a society. It encompasses individual and collective knowledge as well as the skills needed for economic productivity and social progress. Human capital is important for innovation, labour productivity, social participation, and the ability of a society to tackle challenges and to adapt.

1.9.1 Weak sustainability

Weak sustainability can be considered the "soft" or flexible option. Supporters of weak sustainability believe that an action is sustainable if it offers an advantage to the overall system, or at least does not reduce its quality. Weak sustainability can therefore be seen as a basic requirement of sustainability, in that it aims to maintain a certain level of well-being/quality of life or to ensure equality. The concept of weak sustainability "assumes the extensive and, at least in principle, unlimited […] substitutability of all types of capital" (Ott & Döring, 2004: 41) and is thus based on the premise of neoclassical economics. Proponents of weak sustainability believe that natural capital can be substituted with other forms of capital. They emphasize the concept of "total capital", arguing that the specific make-up of the capital inherited by future generations is irrelevant, as long as overall benefits and well-being are sustained. This aligns with neoclassical utility theory, according to which it is irrelevant how utility is generated.

Weak sustainability supporters therefore believe that measures can be considered sustainable, even if they are carried out at the expense of natural capital – as long as this loss is compensated for by an increase in human or manufactured capital. This could justify the extraction of raw materials such as coal or excessive crude oil. And Carlowitz's Silvicultura oeconomica forest, could, in principle, also be replaceable or degradable, provided that its natural and cultural functions can be fulfilled in other ways by future generations. This understanding of sustainability emphasizes the importance of technological progress for sustainable development.

Evaluating measures based on weak sustainability is challenging, due to the inherent complexities and numerous assumptions involved. This goes beyond fundamental questions about sustainability, such as "What is a good life?", or "How do we measure the level of well-being?". A key challenge lies in assigning a monetary valuation to different types of capital, especially those lacking a clear market price. To operationalize this, what factors should be taken into account? What is the value of natural beauty? What is the value of a rare bird or a whale? Buller's The Value of a Whale (2022) impressively outlines the problems we face in trying to put a price on elements of nature.

Critics of the concept of weak sustainability point to several limitations. Firstly, they question the assumption that natural resources can be endlessly replaced by reproducible capital. Secondly, they doubt whether an increase in goods can truly compensate for the loss of environmental quality. Finally, concerns exist about our ability to develop new resources and the potential for exceeding critical threshold values. These criticisms have paved the way for the concept of "strong sustainability".

1.9.2 Strong sustainability

In contrast to weak sustainability, strong sustainability emphasizes the preservation of natural capital. Proponents of this eco-centric theory are less optimistic about our ability to substitute natural resources with manufactured ones, believing these resource types to have limited interchangeability (Daly, 1990; 1999; Ott 2001, Ott & Döring 2004). They argue that the individual elements of natural capital should be kept as constant as possible, to prevent, for example, species extinction.

Table 1.2: Weak and Strong Sustainability. Source: Derived from Eblinghaus & Stickler 1998; Dobson 2002; Rieckmann 2004; Steurer 2001; Michelsen et al. 2016

Category	Very Weak Sustainability	Weak Sustainability	Strong Sustainability	Very Strong Sustainability
What should be preserved?	Total capital	Essential natural capital	Non-renewable natural capital	Nature has its own value
Why?	Maximization of economic profit and individual welfare (GDP)	+ Limitation of environmental damage and resource scarcity	Ensuring long-term living conditions for humans and nature	+ Respect for all forms of life and duties toward nature
How? (Policies)	Growth orientation through promotion of technology and innovation	Environmental regulations, resource efficiency, renewable energies	+ Conservation measures, ecological restoration, sustainable agriculture	
Substitutability	In principle unlimited, natural resources can be replaced by technology and trade	Partly possible, but limited substitutability of ecosystem services	Limited, critical threshold for environmental changes	Low, recognition of unique values and relationships
Ethics	Anthropocentric, short-term benefits take priority	Anthropocentric with stronger consideration of environmental interests	Pathocentrism, recognition of intrinsic value of nature	Biocentrism, ecological integrity, ethical responsibility toward nature

While neoclassical economists are confident about substitution, proponents of strong sustainability emphasize the importance of prevention and anticipation, rather than aftercare and reaction. For example, reacting to the hole in the ozone layer by using sun cream, protective clothing, or medical aftercare fails to tackle the cause of the problem. Similarly, technological approaches such as geo-engineering are criticized for merely treating problems superficially. Geo-engineering refers to technical interventions in geochemical or biogeochemical cycles, for example to slow down climate change or ocean acidification.

Until now, reducing pollution has mainly focused on end-of-pipe technologies, such as flue gas cleaning systems on factory chimneys or catalytic converters in cars. But this also meant that we put off tackling long-term environmental problems, such as climate change or biodiversity loss, as long as their effects were not immediately apparent. This phenomenon is linked to the concept of externalization, in which environmental and social costs are shifted outwards, as described by Lessenich (2018). This means

that pricing only takes into account the economic costs, partly because they are easier to quantify, while the social and environmental costs of providing goods and services are omitted or externalized, leading to distortions in market prices.

1.10 Sustainability strategies as principles of sustainable development

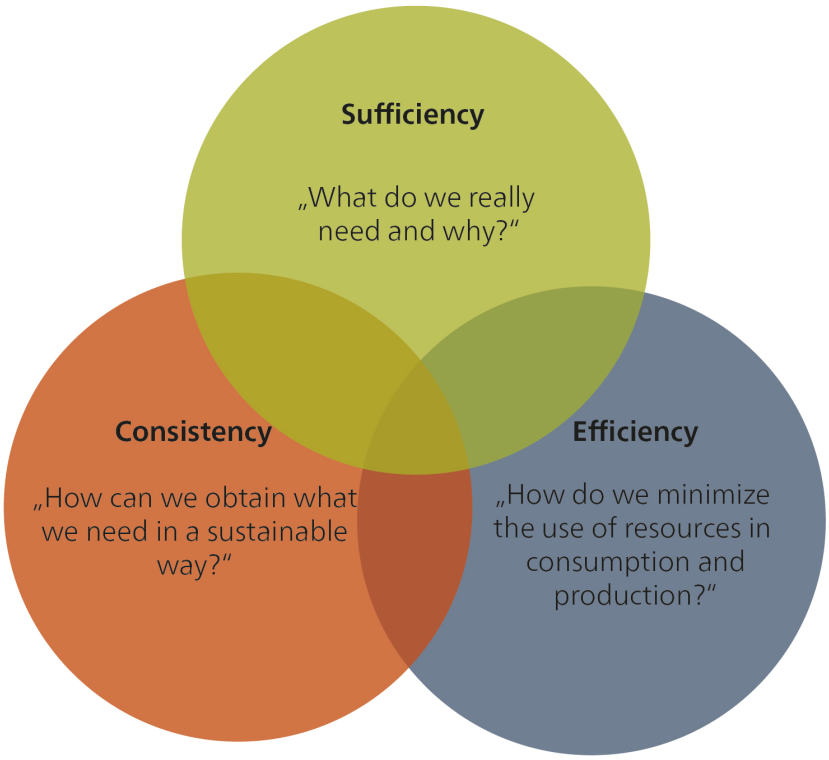

Figure 1.12: Sustainability strategies (Own illustration).

1.10.1 Efficiency strategy

The efficiency strategy focuses on minimizing resource use (i.e. raw materials and energy) in manufacturing or service provision. This translates to reducing material consumption (material intensity), energy consumption (energy intensity), and emissions of harmful substances such as CO2. Also known as “eco-efficiency”, this strategy is attractive to business and society, as it can reduce costs, resource use, and environmental impact. Implementing the efficiency strategy starts with improving production processes, primarily through technological advancements. Proponents believe it’s possible to double prosperity while halving natural resource use (Weizsäcker et al. 1995).

However, critics of the efficiency strategy are less optimistic, and caution against overestimating its impact on sustainable economic activity. They point to "rebound effects", which can reduce or even wipe out the gains from efficiency increases (Paech 2012; Santarius 2014).

Putting Efficiency Strategies into Action: Examples

Energy-efficient lighting: Replacing conventional lightbulbs with energy-efficient LED bulbs lowers electricity use and helps reduce the demand for energy.
Fuel-efficient vehicles: The development of more fuel-efficient hybrid or electric vehicles can lead to lower fuel consumption and road transport emissions.
Efficient building technology: Installing smart HVAC (heating, ventilation, and air conditioning) systems in buildings helps to reduce energy consumption for heating and cooling.
Efficient water use: The use of water-saving fittings and systems in households and industrial companies reduces water consumption and minimizes waste.

1.10.2 Consistency strategy

While the efficiency strategy focuses on quantity (reducing resource use while achieving greater output), the consistency strategy (from the Latin con = together + sistere = to stop) strives to reconcile nature and technology by using resources repeatedly instead of only once. Instead of fossil fuel-based resources, products, and technologies, it seeks to use materials that are compatible with natural material cycles and processes. Also referred to as "eco-effectiveness", this concept follows the principle of "cradle to cradle" rather than "cradle to grave", and is based on the idea that intelligent systems generate only products, not waste. This can be achieved in two ways: Materials can either be biodegradable (e.g. a shampoo made with natural ingredients) or they can be designed with "technical nutrients" that remain in the technical cycle. This means that a disused product doesn't end up in the rubbish, but instead enters the next cycle of use, for example through upcycling (e.g. reusing a computer casing or converting into, say, a shelving system). Like the efficiency strategy, the consistency strategy also starts by looking at how production processes can be optimized. Many believe that the consistency strategy has greater potential than the efficiency strategy, in terms of problem solving and achieving far-reaching changes.

However, critics believe the theory has limited applicability. For example, Gerolf Hanke and Benjamin West (2013) argue that it can't be applied equally to every type of good, and that implementing technologies to achieve it would require significant investment in production facilities and logistics. They also note that recycling processes themselves are associated with increased energy consumption, in accordance with the law of entropy:

> "Every material economic process results in an increase in entropy, i.e. roughly simplified, that the elements on the material level are distributed more and more evenly, which ultimately only means that things and bodies wear out and a new concentration requires an ever-increasing amount of energy." Translated from Hanke and West (2013, p. X)

A special feature of the Earth's ecosystem is solar energy, which provides a constant supply of energy from the outside and counteracts the increase in entropy on Earth. But we still need what is known as "grey energy" to manufacture energy generation systems, e.g. biofuel systems, solar cells, electric car batteries, and wind turbines. Consistency strategies can incentivize industry to strive for a reduction in resource consumption and emissions.

Putting Consistency Strategies into Action: Examples

Renewable energy systems: The transition from fossil fuels to renewable energy sources such as solar energy, wind energy, and hydropower is an effort to align energy production with the natural rhythms and cycles of the environment.
Recyclable electronics: Designing electronic devices in a way that makes it easy to repair, upgrade and recycle them, in order to minimize resource consumption and environmental impact.
Sustainable construction: Constructing buildings using sustainable materials that have a low environmental impact and can be reused or recycled at the end of their useful life.

1.10.3 Sufficiency strategy

The concept of sufficiency, rooted in the Latin word sufficere (to suffice), challenges our assumptions about how much we need for a good life. It promotes a reduction in resource and energy consumption by focusing on decreasing demand for resource-intensive goods and services. Sufficiency, which could also be described as frugality or adequacy, is critical of the constant creation of new needs by technology and advertising amid a limited supply of natural resources. Sufficiency urges us not to chase after every newly created need, and to fulfil our needs without consumption. While efficiency and consistency strategies focus on production, sufficiency focuses on consumption, albeit not exclusively: sufficiency can be practised to varying degrees and at different levels, from small changes in behaviour (sharing instead of buying) to significant changes in lifestyle (giving up air travel). Although it starts at an individual level, sufficiency can be applied at various levels, such as by companies (sufficiency-oriented product design) and governments (sufficiency policies). Sufficiency therefore seeks the right balance: How much do we need for a good life? And what do we not need?

Critics believe the sufficiency strategy has only limited potential and is unlikely to find broad sociocultural acceptance. However, proponents see it as crucial for sustainability policy, especially where efficiency and consistency strategies fall short. The concept of a post-growth economy draws on the principles of the sufficiency strategy.

Putting Sufficiency Strategies into Action: Examples

Sharing and communal use: Platforms and initiatives for sharing objects, tools, or vehicles make it possible to use resources more efficiently and reduce the number of products manufactured.
Plant-based diet: Switching to a predominantly plant-based diet reduces resource consumption, e.g. of water and land, compared to meat production.

Reduction in working hours: A reduction in working hours can lead to a lower consumption of resources, as less energy and materials are required for the production of goods and services.
Local consumption: Supporting local producers and markets helps to reduce transport routes and emissions.

1.10.4 Rebound effects: The flipside of efficiency

Figure 1.13: Rebound effect illustrated using the example of the automotive industry. Source: @fietsprofessor on LinkedIn.

"Any intelligent fool can make things bigger, more complex, and more violent. It takes a touch of genius — and a lot of courage to move in the opposite direction." E.F. Schumacher (1973)

Critics of the efficiency principle warn of the rebound effect, also known as the Jevons paradox (Jevons 1865/1965) . This phenomenon occurs when efficiency improvements lead to lower prices for goods and services, thus increasing demand and negating the initial benefits of lower resource use.

Take this simple example: If passenger cars become cheaper due to improvements in efficiency, then people may choose a larger model when they next purchase a car. In addition, a fuel-efficient car is cheaper to run, as it requires less fuel per kilometre. This usually incentivizes people to drive more (either by making more frequent journeys or travelling longer distances) and reduce their use of public transport or their bicycle. As a result, efficiency gains that are technically possible are often not realized in practice, as the product in question is used more frequently or more intensively. Apart from the direct change in the use of the product (direct rebound), there may be additional changes in consumer behaviour that affect the environment. In this example, this could mean that the money saved on purchasing or using the car is spent on air travel instead (indirect rebound), which in turn cancels out some of the environmental benefits.

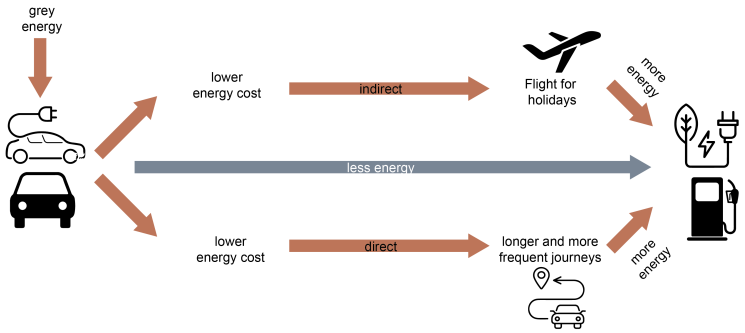

Figure 1.14: Indirect and direct rebound effects of energy-saving passenger cars (Own illustration).

To understand the rebound effect, the literature focuses on the following three areas: 1) financial factors, 2) socio-psychological influences, and 3) regulatory effects, which we analyse in more detail below.

1. Financial factors are a major cause of the rebound effect. When efficiency leads to cost savings, financial resources are freed up. This can lead to people either consuming more of the same product (direct rebound effect) or investing in alternative goods (indirect rebound effect). The financial rebound effect can be based on several factors, including:
    - The income effect: when efficiency leads to real income gains for consumers, it can result in a direct or indirect rebound effect.
    - The reinvestment effect: when companies use cost savings to expand their production or invest in other products.
    - The market price effect: the macroeconomic effect in which demand in one sector stimulates demand in other sectors. For example, as cars become more efficient, demand for fuel may fall, making fuel cheaper and affecting demand in other energy-consuming sectors.

The extent and intensity of the financial rebound effect depends on factors such as price elasticity and consumer behaviour. While this happens at the individual level, it can cumulate into a macroeconomic market price effect with far-reaching consequences.

2. Socio-psychological influences include the “mental accounting” of individual consumers. For example, consumers who have purchased an efficient product may “allow themselves” to consume more. This is why increases in the efficiency of products that were previously considered harmful to the environment can, paradoxically, lead to an increase in consumption. This direct rebound effect is often referred to in social psychology as the “moral hazard effect”. If the decision to increase consumption is not made rationally, this is known as the “moral leaking effect”. For example, if you drive more after buying a resource-efficient car, because the purchase alone is perceived as environmentally conscious. The

indirect rebound effect can also be attributed to socio-psychological factors. The "moral licensing effect" states that the purchase of resource-efficient products can lead to an increase in the consumption of other products that may be harmful to the environment. For example, when the purchase of a fuel-efficient car is used to justify more frequent air travel.

3. Sometimes, government regulations or incentives to promote efficient technologies can have unintended consequences – this is what we mean by the "regulatory effect". For example, if people are encouraged to purchase large electrical appliances devices due to government incentives for energy-efficient models. Such incentives may result in more frequent purchases of appliances, which – even if the newer model is more efficient than the old – partially cancels out the energy-savings effect. Furthermore, the introduction of efficiency technologies leads to new capacities and infrastructures, which can result in the creation of new markets. Wind turbines, for example, promote the development of new infrastructures and jobs, but at the same time require considerable resources. In addition, consumers who purchase a more efficient product may not necessarily discard their old product. Some end up using both products, which can lead to increased overall consumption (Santarius, 2012).

Rebound-effects

The **direct rebound effect** occurs when improved energy efficiency makes it cheaper to consume a resource, leading people to consume more of it. For example, a more fuel-efficient car would be cheaper to run. This might encourage people to drive more, partially or completely cancelling out the energy savings from the efficiency increase.
The **indirect rebound effect** occurs when energy savings or resource efficiency gains in one area lead to the use of the freed-up resource in other area. This reduces the overall savings achieved. For example, if the money saved from more energy-efficient living is used instead for more frequent flying.

1.10.5 How big is the rebound effect?

It is difficult to know exactly how big the rebound effect is: empirical estimates vary widely, depending on the methods used and the effects taken into account. It is particularly challenging to clearly distinguish rebound effects from growth or structural changes. The type of products and services offered also influences the level of the rebound effect. For example: If a more economical means of transport is used for the daily commute, such as a more efficient car, costs fall, but the available time remains limited. Therefore, you cannot commute as often or for as long as you like, because there are only 24 hours in a day. The rebound effect is therefore relatively small in this case. The situation is different for leisure activities, such as travelling by air. If costs fall due to more efficient aircraft or cheaper prices, there is a greater incentive to fly more often — for example, taking a second weekend trip instead of just one per year. As time is not such a tight constraint here, additional consumption can increase significantly — as can the rebound effect. Another important component is the degree of saturation with goods and services. Observations show that rebound effects tend to

be lower in high-income countries than in developing countries, where there is still a considerable need for additional consumption.

For example, the direct rebound effects associated with improvements in space heating efficiency might lead to 10-30% less energy savings than what's technically possible (e.g. Hediger et al., 2018). The rebound effects of transport vary even more. According to Anderson et al. (2019), the rebound effect related to private mobility might reduce potential savings by 7.5% in Denmark, 30% in Sweden, and 60% in Germany. In contrast, studies on lighting in private households have found very low rebound effects of less than 10% (Sorrell, 2007). This means that the actual energy savings for these services can be, on average, up to 25% less than what is technically possible and predicted. However, the exact magnitude of the rebound depends on the specific context and can be reduced by choosing appropriate measures.

Sometimes, albeit rarely, the savings may be overcompensated. This is known as the "backfire" effect. However, this is an exception and the "backfire" effect is not a pure rebound effect, as it is linked to the effects of growth and structural change. A good example is digitalization, which can lead to short- and medium-term backfire effects (Peng et al., 2023).

Part II

Approaches to Sustainability

Chapter 2

Approaches to Sustainability

2.1 Approaches to Sustainable Development

Christoph Bader

The world is facing numerous challenges of sustainable development, including pressing environmental problems and social inequalities. Scientists, researchers, and activists are seeking innovative approaches to enable sustainable and equitable change. This chapter examines some of these approaches, which offer a complete rethink of current paradigms. Approaches discussed in this chapter:

- Planetary boundaries framework
- Doughnut economics
- Approaches to a "great transformation"
- Green economy
- Post-growth approaches
- Implementing the 2030 Agenda

2.2 Debates about planetary boundaries

In 1798, British economist Thomas Robert Malthus published his influential essay, *An Essay on the Principle of Population*. Malthus's core idea was that population growth would surpass Earth's ability to produce food, sparking a debate on planetary carrying capacity that continues today. *The Limits to Growth* (1972), a report by the Club of Rome, built on Malthus's ideas. It went beyond just food supply to consider a broader range of factors in calculating a planetary limit. These factors included resource availability, environmental pollution, and industrial output. The report remains relevant from an environmental point of view, as it challenges the assumptions of limitless growth, even though its specific predictions haven't quite come true.

A significant development in sustainability science is the planetary boundaries concept, introduced in 2009. Unlike earlier theories focused solely on population limits, this framework uses Earth system science parameters. Researchers identified the Holocene epoch as a baseline, as this was a period of remarkable stability for human development. Significant deviations from this ideal state could push humanity towards uncertain "tipping points" – critical thresholds that can either interrupt previous progress, alter its course, or even accelerate it in unintended ways. An example might be the extinction of megafauna at the end of the last ice age, potentially linked to human arrival in the Americas. The planetary boundaries concept promotes the precautionary principle, urging action to minimize potential harm to both humans and the environment.

The concept, which puts forward nine planetary boundaries, was first introduced by Johan Rockström et al. (2009). It was updated by Will Steffen et al. (2015). A recent update by Richardson et al. (2023) shows that six out of nine planetary boundaries have already been transgressed.

The planetary boundaries framework identifies nine critical Earth system processes. These processes regulate the planet's stability and include, for example, land system change and ocean acidification (see all planetary boundaries here: Figure **??**). Each boundary has an inner circle, within which it can operate safely ("safe operating space") and an outer circle, which represents increased uncertainty.

The latest update to the planetary boundaries framework paints a concerning picture. We're close to overstepping the safe operating space for ocean acidification, and regional atmospheric aerosol loading has already crossed its boundary. In a positive development, stratospheric ozone levels show some signs of recovery. However, the overall situation is alarming. The boundaries previously identified as transgressed (climate change, biosphere integrity (genetic diversity), land system change, and biogeochemical flows [N and P]) have all seen a worsening of their transgression since 2015.

The study added human appropriation of net primary production as a control variable for the functional component of biosphere integrity, arguing that this boundary has also been exceeded. In addition, the significant transgression of the planetary boundaries for phosphorus and nitrogen cycles, along with genetic biodiversity, raise the risk of fatal consequences.

Two of the nine planetary boundaries – biosphere integrity and climate change – are considered "core boundaries". These core systems encompass processes from many other subsystems and operate at a global scale. Reaching tipping points in these core systems could therefore push the entire Earth system into a new state.

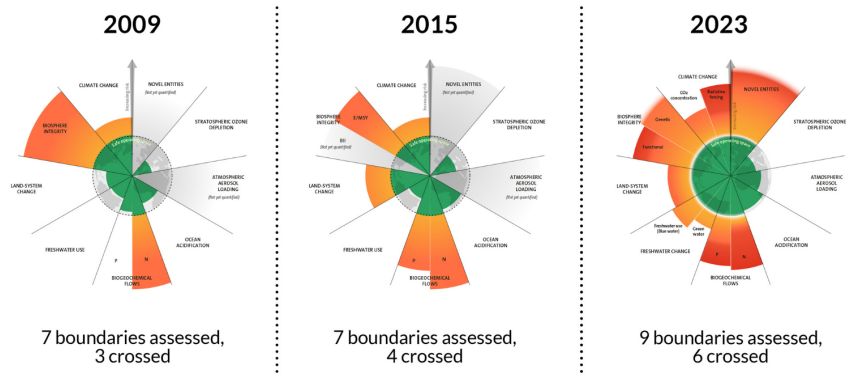

Figure 2.1: Development of control variables for all nine planetary boundaries (Source: UNEP (2021b))

2.2.1 Tipping points of the Earth's climate system

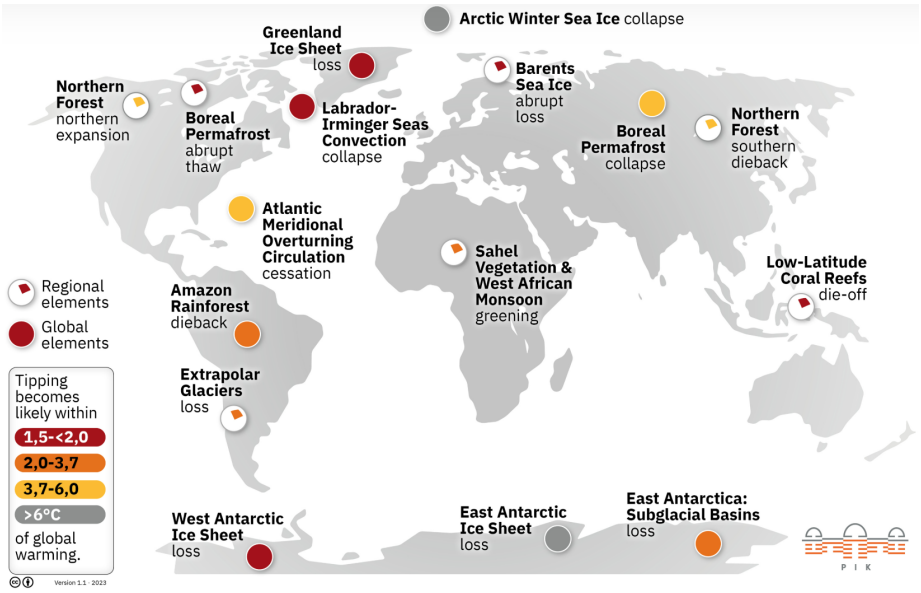

Figure 2.2: Tipping points (Source:)

Tipping points in the Earth's climate system are critical thresholds that, when crossed, can cause abrupt and often irreversible changes in the climate system. These tipping points can destabilize the climate and lead to accelerated climate change. Examples of tipping points include the melting of the Greenland ice sheet, the collapse of the Amazon rainforest, the thawing of permafrost soils, and changes in the Gulf Stream. If these tipping points are reached or exceeded, they can trigger self-reinforcing feedback effects that lead to further warming and an intensification of climate change.

The concept of tipping points emphasizes the urgency of limiting global warming and reducing greenhouse gas emissions. If we exceed the tipping points, it will become increasingly difficult to control climate change and minimize its effects.

2.2.2 Quantifying planetary boundaries

A recent development within the planetary boundaries framework is the concept of "safe and just Earth system boundaries (ESBs)" for the following domains: climate, the biosphere, water and nutrient cycles, and aerosols at global and subglobal scales (Rockström et al., 2023). The ESBs are based on modelling and literature review, and account for uncertainty through different levels of likelihood. Staying within the ESBs protects stability and equity between species and future generations, although current generations, especially vulnerable groups, could still suffer harm. The authors therefore suggest stricter boundaries in some cases, and the addition of local standards to protect current generations and ecosystems. For example, they identify safe ESBs for warming (see Rockström et al. 2023, Fig. 1 and Table 1). These are based on reducing the probability of triggering climate tipping points, maintaining biosphere and cryosphere functions, and considering climate variability of the Holocene (<0.5-1.0°C) and earlier interglacial periods (<1.5-2°C).

The functions of the cryosphere include the preservation of permafrost in the northern high latitudes, the preservation of polar ice sheets and mountain glaciers, and the minimization of sea ice loss. The authors conclude that global warming of more than 1.0°C above pre-industrial levels, which has already been exceeded (IPPC 2021), could trigger tipping effects such as the collapse of the Greenland ice sheet or a localized abrupt thawing of the boreal permafrost with a moderate probability (Armstrong et al. 2022). Global warming of one degree Celsius corresponds to the safe limit proposed in 1990 and the PB of 350 ppm CO2 (Steffen et al. 2015). With a warming of more than 1.5°C or 2.0°C, the likelihood of triggering tipping points increases to high or very high.

2.2.3 Climate resilience

Resilience describes the ability of a system to withstand disruptions, "bounce back", or recover from adversity. Originally used in psychology, resilience refers to the psychological robustness that an individual has actively acquired in dealing with challenges or stresses, particularly in childhood. In the context of ecosystems, resilience refers to the ability to absorb disturbances without a permanent systemic collapse, i.e. a collapse that would result in a different system regulated by new processes (Folke et al. 2010). More recently, the concept of resilience has been extended to social systems (see section on doughnut economics). Studies focus on which specific characteristics of a region need to be strengthened, to better prepare it for future crises and disasters related to climate change, terrorism, resource scarcity, or financial crises. The climate crisis, for example, requires both adaptation and mitigation measures. Resilience approaches offer a way of combining these two concepts rather than playing them off against each other.

Climate mitigation measures aim to reduce greenhouse gas emissions and curb climate change. Such measures include promoting renewable energies, improving energy efficiency, and expanding public transport. Resilience approaches emphasize the im-

portance of climate mitigation, as limiting the rise in temperature will help to reduce the intensity and frequency of extreme weather events.

Climate adaptation measures aim to make societies and ecosystems more resilient to the current and expected effects of climate change. Adaptation measures include the development of early warning systems for extreme weather events, coastal protection against rising sea levels, the reduction of heat stress (e.g. through more urban green spaces), runoff or infiltration areas to reduce the damaging effects of heavy rainfall events, or the adaptation of agricultural practices to changing climatic conditions. Resilience approaches emphasize the need for climate adaptation to protect communities and ecosystems from the negative effects of climate change.

2.2.4 Conclusion

The concept of planetary boundaries tries to reduce complex ecological relationships to a small number of quantifiable limits. These specific limits and indicators for planetary boundaries are based on scientific findings that are not always clear or consistent. The boundaries are therefore contested by some scholars, who question the accuracy and reliability of the data and models used. Despite this criticism, the planetary boundaries framework makes a valuable contribution to the debate on sustainable development and raises awareness of the limited resources and resilience of our planet. To summarize:

- The planetary boundaries framework focuses on the ecological/biophysical limits of the Earth's resilience, and thus the environmental dimension of sustainable development.
- These limits to resilience – the planetary boundaries – focus on environmental factors that are considered fundamental to human survival.
- In normative terms, the framework aims to maintain the stable Earth system ("state of equilibrium") of the Holocene, thereby mitigating threats to human survival.
- The planetary boundaries framework can be used to set concrete targets in the environmental dimension (e.g. at the global or national level).

Further readings

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Folke C, Carpenter SR, Walker B, Scheffer M, Chapin T, Rockström J. 2010. Resilience Thinking: Integrating Resilience, Adaptability and Transformability. *Ecology and Society*. 15(4).. https://www.jstor.org/stable/26268226.

2.3 From planetary boundaries to the doughnut model

Economist Kate Raworth's Doughnut Model is an innovative approach to sustainable development that recognizes social and environmental limits. This requires rejecting much of what has characterized 20th-century economics, as Raworth outlines in her 2017 book, *Doughnut Economics: Seven Ways to Think Like a 21st Century Economist*. Raworth depicts the ideal economy of the future in a simple image: a ring-shaped doughnut. The outer ring symbolizes an ecological ceiling that should not be crossed, as doing so would cause irreversible harm to the environment. The inner ring represents a social foundation covering people's basic needs, such as food, housing, and income. The challenge is to ensure that economic activities take place within this ring – the doughnut – to ensure the well-being of both humanity and the environment ("safe and just space for humanity").

Figure 2.3: Doughnut Model (Source:https://doughnuteconomics.org)

The philosophy of the doughnut approach is based on three core principles: equitable distribution of wealth, regeneration of the resources used by the economy, and creation of wealth for all people. None of these principles should have to depend on economic growth, says Raworth. In other words, we don't need to pursue unlimited growth for

the economy to flourish – instead, we should pursue development that is sustainable, balanced, and equitable. The transition to the doughnut model requires a fundamental change in the way we think and act. It's about moving from a growth paradigm to sustainable development, a development that takes social justice and environmental sustainability into equal account.

2.3.1 Conclusion

Despite the Doughnut Model's focus on the economy, critics say it doesn't discuss the underlying framework conditions (i.e. the structures, rules, and institutional organization of the economy) or how money is created and managed (i.e. the financial sector). The Doughnut Model focuses on what kind of economic activity is desirable (i.e. staying within the doughnut), but it doesn't explain how to get there. These points of criticism are being addressed by the Doughnut Economics Action Lab (DEAL), which provides tools and strategies to implement the Doughnut Model in real-world settings.

- The Doughnut model builds on the concept of planetary boundaries, adding a social dimension and including goals and degrees of goal achievement.
- In normative terms, the model prescribes that
  - social goals should be achieved without overstepping the planetary boundaries. The planetary boundaries provide the biophysical framework within which the social goals should be achieved.
  - when setting concrete goals, measures etc. at sub-global levels, the global social goals must also be taken into account.

2.4 The debate about the Great Transformation

Concepts of the "great transformation" refer to fundamental changes in social, economic, political, and ecological systems that are necessary to create a sustainable and just society.

"Great transformation" was a term used by Karl Polanyi in his 1944 analysis that the shift to a free market in the 19th century brought about profound social, economic, and political changes that fundamentally transformed people's lives and relationship with nature. Polanyi argued that unbridled market dynamics caused social and environmental problems, and that society needed to develop mechanisms to regulate and balance these problems. Similarly, today's concepts of the great transformation emphasize the importance of regulation, redistribution, and the development of alternative economic models to create a sustainable and just society. While Polanyi stressed the need for social protection measures and the importance of integrating markets into social structures, current concepts of the great transformation additionally aim to fundamentally change production and consumption patterns to reduce environmental impact.