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.

Reading guide

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Introduction

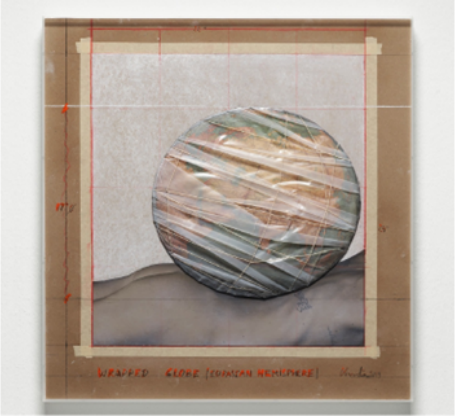

Figure 1: “Wrapped Globe (Eurasian Hemisphere)” by Christo (2019)

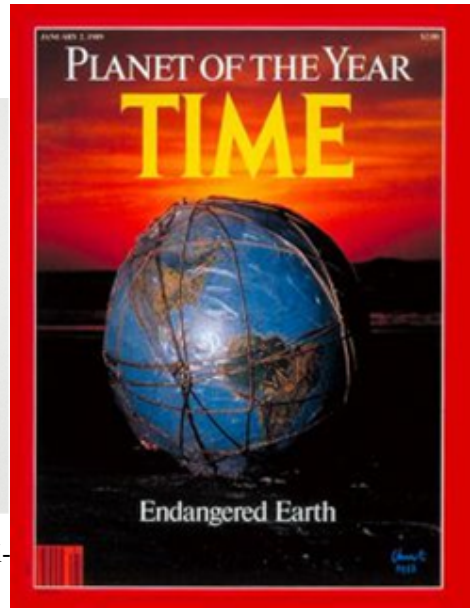

Figure 2: “Planet of the Year” Times Magazine Cover (1989)

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.

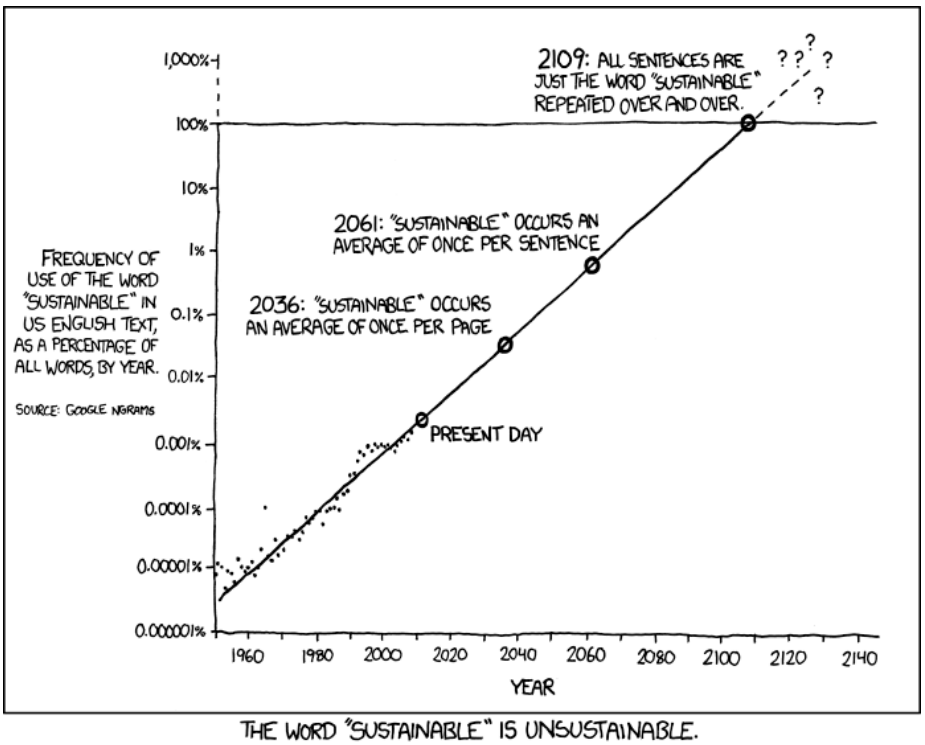

Figure 1.1: Frequency of use of the word "sustainable" in US English texts, as a percentage of all words per year, based on data from Google Ngrams. Source: https://xkcd.com/1007/

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

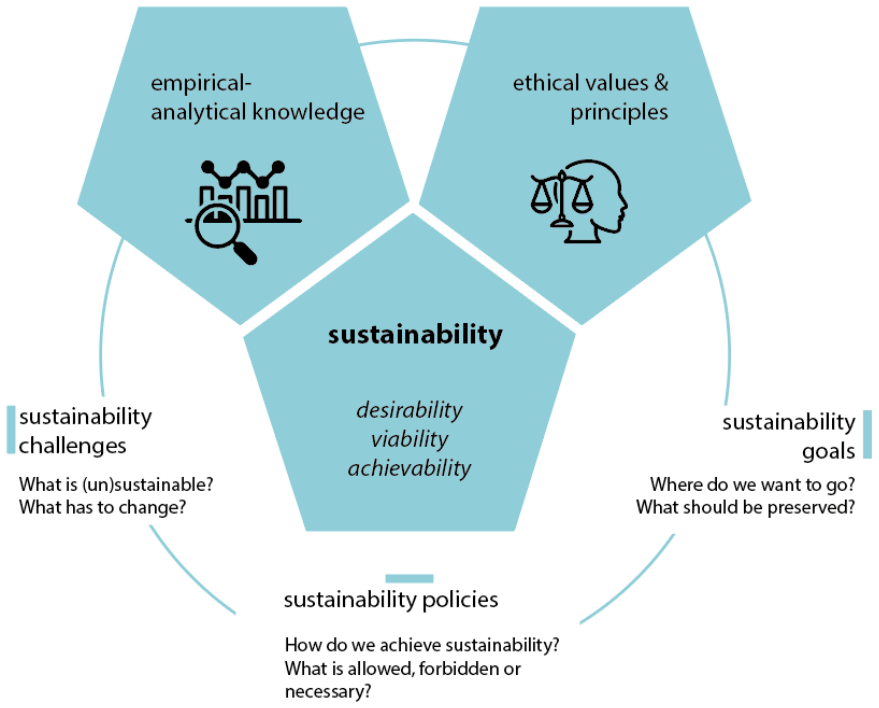

Figure 1.2: Sustainable Development as a normative concept (Own illustration).

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.

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).

The Great Acceleration described the exponential growth dynamics that occurred after 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. Figures 6 and 7 describe 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.

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 pressing 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 (Figures 6 and 7) 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 as a scientific discipline

What does "sustainable" mean? We could argue that sustainability means the existence and functioning – for as long as possible – of structures of various degrees of complexity. There are, in fact, many structures in the world that have existed for relatively long periods of time, such as atoms, certain ecosystems, life on Earth as a whole, or planetary systems and galaxies. But why are some structures relatively stable and able to exist "sustainably", despite being exposed to regular disturbances that jeopardize their existence or function? Are there principles or mechanisms that could explain the continued existence of these diverse systems? And if so – could human societies learn from these principles?

As early as the mid-20th century, scientists began to recognize that fundamental principles connect all aspects of existence, shaping the universe's order and dynamics. A key figure in this field was Karl Ludwig von Bertalanffy (1901–1972). His research began with his reflections on the "formation of form" in nature (1928), which he further developed in publications on the structure of life (1937), molecules and organisms (1940), and biology (1949). In 1950, he introduced a theory of open systems in physics and biology, a concept that significantly influenced the development of biophysics, fluid equilibrium, and modern developmental theories. His seminal work, "General System Theory", was published in 1968.

Systems theory laid the foundation for a revolutionary world view that not only provided explanations for the development and function of so-called systems, but also integrated isolated knowledge from various disciplines. In 1975, in a significant contribution to systems theory, Ervin Laszlo distinguished between seven different system types (physico-chemical and biological systems, organ systems, socio-ecological and socio-cultural systems, and organizational and technical systems). Today, systems theory forms the basis for models for the development of complex systems and for cybernetics, which deals with the control of systems. The Club of Rome report used systems theory to analyse the growth of processes in the context of positive feedback.

1.3.1 Systemic effects: Escalation and feedback

In systems theory, the mechanisms of positive and negative feedback are used to explain the dynamics and stability of systems. Positive feedback reinforces changes in a system, while negative feedback tends to balance changes, returning the system to a stable state.

An example of positive feedback in relation to the accelerated melting of Artic Sea ice is what is known as albedo amplification. The Arctic ice reflects much of the solar radiation back into space, resulting in less absorption of heat by the ocean. However, when the ice melts, less sunlight is reflected, as the seawater, which is darker, absorbs more heat. This warms the seawater further and the remaining ice melts more rapidly. This process is self-reinforcing, as less ice leads to a lower albedo, which in turn leads to greater absorption of sunlight and further melting. This positive feedback has serious consequences on the climate system, as the dwindling Arctic Sea ice can lead to a faster sea level rise and to changes in oceanic and atmospheric circulation patterns. The extent and speed of this occurrence took scientists by surprise (Stroeve et al. 2007).

An example of negative feedback is a thermostat that regulates the temperature in a room. If the room temperature rises above the set maximum, the thermostat recognizes

this and activates the air conditioning to lower the temperature. As soon as the temperature reaches the set value, the thermostat switches off the air conditioning. This control circuit ensures that the room temperature is maintained at a constant level. Positive and negative feedback often work together and can cause complex behaviour in systems. Understanding these feedback mechanisms makes it possible to better understand and predict the interactions and behaviour of systems.

1.4 Sustainability science: Origins and understanding

An emerging awareness – influenced not least by the publication, The Limits to Growth (Meadows et al. 1972) – led to increased research into global environmental problems. Three major international research programmes are particularly noteworthy here: 1) the International Geosphere-Biosphere Programme (IGBP) from 1987 to 2015; 2) the World Climate Research Programme (WCRP), founded in 1980; and 3) the International Research Programme on Biodiversity (DIVERSITAS), founded in 1991 and renamed in 2014 to Future Earth. Not only did these programmes initiate important basic research – they also provided an important impetus for greater consideration of the results in policy, as reflected, for example, in the UN's Brundtland Report and Agenda 21. Notably, these research programmes systematically brought together previously separate disciplines of the natural sciences for the first time, although they still largely neglected the interaction between society and the environment. As the interconnectedness of these topics began to gain traction, several research projects promoting their integration were launched, particularly in the US.

> "A new field of sustainability science is emerging that seeks to understand the fundamental character of interactions between nature and society. Such an understanding must encompass the interaction of global processes with the ecological and social characteristics of particular places and sectors." Kates et al. 2001

The concept of sustainability science was officially introduced in 2001 at the "Challenges of a Changing Earth" congress in Amsterdam, by the International Council for Science (ICSU), the above-mentioned IGBP, the International Human Dimensions Programme on Global Environmental Change (IHDP), and the above-mentioned WCRP. The German-language term "Nachhaltigkeitswissenschaft" (sustainability science) can be traced back to a translation from English.

1.4.1 Understanding sustainability science

An often used motto – "society has problems – universities have disciplines" – epitomizes the conventional structure of science into various disciplines. However, disciplinary science appears to be inadequately equipped to meet the challenges of sustainable development. Two main approaches to understanding sustainability science have emerged: on the one hand, it is seen as an independent discipline with its own theories and methods; on the other, as an amalgamation of different disciplines focusing on a common theme (Clark and Dickson 2003). While the first approach is not yet considered accurate, there is broad agreement that sustainability science should be seen as a

platform that brings together science, practice, and visions – and incorporates contributions from the entire spectrum of natural, economic, and social sciences (Martens 2006, p. 38).

Sustainability science is distinct in two key ways. First, unlike traditional ("Mode 1") research, it isn't driven by an original scientific programme. Instead, it is guided by the normative concept of sustainability, using this as a framework for scientific analysis. Second, as a distinct type of problem-oriented research, it differs from both basic and applied research. Clark (2007) introduced the term "use-inspired basic research", which seeks to strike a balance by seeking new knowledge while also considering its potential applications.

Mode-1 science	Mode-2 science
Academic	Academic and social
Mono-disciplinary	Trans- and interdisciplinary
Technocratic	Participative
Certain	Uncertain
Predictive	Exploratory

Figure 1.3: Mode 1 and Mode 2 science (Gibbons et al., 1995; Martens, 2006)

1.4.2 Empirica-analytical vs normative

As sustainable development is a normative model, it is important to distinguish between descriptive (empirical-analytical) research and prescriptive (normative) research. Descriptive statements describe the current state ("is"), while normative statements describe the ideal state ("ought"). In everyday life, the distinction between "is" and "ought" is often not recognized, but it is crucial for science.

It is important to note that "is" and "ought" statements have different qualities and focus areas, and they cannot simply be linked without further explanation. This understanding forms the basis of Hume's law, which declares that normative statements about "what ought to be" cannot be derived from descriptive statements about "what is". To give an extreme example: The fact that around 24,000 people starve to death every day does not allow any conclusions to be drawn as to whether this is good or bad. Without an evaluation, no normative statement can be made about whether this should be prevented. Hume pointed out that many scientists of his time often neglected this crucial distinction, and this is still the case today:

> "In every system of morality, which I have hitherto met with, I have always remark'd, that the author proceeds for some time in the ordinary ways of reasoning, and establishes the being of a God, or makes observations concerning human affairs; when of a sudden I am surpriz'd to find, that instead of the usual copulations of propositions, is, and is not, I meet with no proposition that is not connected with an ought, or an ought not. This change is imperceptible; but is however, of the last consequence. For as this ought, or ought not, expresses some new relation or affirmation, 'tis necessary that it shou'd be observ'd and explain'd; and at the same time that a reason

> should be given; for what seems altogether inconceivable, how this new relation can be a deduction from others, which are entirely different from it… [I] am persuaded, that a small attention wou'd subvert all the vulgar systems of morality, and let us see, that the distinction of vice and virtue is not founded merely on the relations of objects, nor is perceiv'd by reason."
> Hume, David: "A Treatise of Human Nature", Book 3, Part 1, Section 1

The realization that is and ought statements differ does not mean that scientists cannot make ought statements. Rather, it means that due to the epistemological differences between the two categories, certain rules must apply when they are linked. Hume tried to establish the relationship between these two statement types through so-called "bridge principles". Max Weber further formalized these considerations by replacing the bridge principles with the concept of "value relations". Weber's call for value freedom (or value neutrality) in empirical science stems from his observation that there is a clear distinction between factual questions ("is") and value questions ("ought") (Weber 1999, p. 245f, 509f). He argued that it is not the task of the empirical sciences to make value judgements. If scientists fail to make the analytical distinction between their personal values and their research goals, this could jeopardize the ability of science to produce verifiable and meaningful results (Weber 1999, p. 150f; Strauss 1953). In turn, this could lead to a blurring of the boundaries between scientific knowledge and knowledge from politics, religion, or everyday discussions. Weber's call for value freedom in empirical science was often misunderstood (Jonas 1980, p.189f; Weber 1999, p. 499f). It does not mean that research should do without values. (Non-scientific) values have a place in empirical research, particularly in the context of sustainable development, in the following ways:

- **Values can be an object of inquiry (research object):** Values play a key role in the field of environmental and sustainability psychology, for example. In discussions about lifestyles and subjective well-being, researchers study the personal values and beliefs of individuals.
- **Values influence the choice of research topic:** Values influence the selection of research objects and questions (epistemological interest), and thus the direction of research. This is particularly relevant in application-oriented and transdisciplinary research, where the needs and information of relevant social actors are integrated into the research process, for example through *joint problem framing* or *participatory vision development* (Schneider et al., 2019).
- **Value interpretations should be clearly stated:** Researchers can create value relationships, or make value interpretations (cf. Weber 1999, p. 522). A value interpretation, based on the hermeneutic method, concretizes the meaning of overarching value concepts and derives logical values and norms from them. For example, researchers can analyse the SDGs by examining the values underlying sustainable development. Other examples include norms derived from the concept of justice – such as the norm of human responsibility towards our environment, our social environment, and ourselves (see SRU 1994, p. 51; Michelsen 2014, p. 25; Schneider et al, 2019). It is important to make the original value explicit.
- **Developing the means to achieve a normative goal:** Sustainable development research often relies on value judgements to guide its pursuit of evidence-based

solutions. This is comparable to political science, where normative theories aim to construct an optimal – i.e. just – form of government, based on the positive evaluation of what constitutes a just society. Science cannot prove the value of justice, but it can develop strategies and means to achieve this desired goal. This relationship between ends and means represents a logical connection between values and normative statements. The ultimate goal, or end, is determined by extra-scientific values. The researchers have to clearly state this relationship, and formulate their means accordingly. For example, an end–means connection could look like this: "To achieve goal X, Y is the most successful means under conditions b1, b2, and b3". Sustainable development can be considered as an extra-scientifically given fundamental norm. For example, if research wants to make statements about how sustainable development can be achieved through solar energy, it could proceed as follows: "Switching to solar production could be a promising way of achieving sustainable development. This would organize production and distribution according to the needs of many people, minimize social inequalities, and create conditions for individual well-being."

1.5 Types of knowledge for sustainability research

Sustainability research focuses on challenges that threaten the long-term safeguarding of social development conditions. In the context of SD as a challenge for society as a whole, the Forum for Climate and Global Change of the Swiss Academy of Sciences has described three different types of knowledge (ProClim 1997): systems, target, and transformation. These three knowledge types take place at three fundamental levels: 1) the analytical level, which aims to generate systems knowledge; 2) the normative level, which develops target and orientation knowledge; and 3) the operational level, which seeks to generate design or transformation knowledge The figure shows the three knowledge types in relation to empirical-analytical and normative research.

Systems knowledge refers to the understanding of the current state. In relation to sustainable development, research examines relevant structures and processes, describing and explaining their complexity and dynamics. It uses various methods, including qualitative and quantitative approaches, mixed methods, experiments, and systems dynamics approaches. It also uses forecasts, retrospectives, and scenario analyses. Most of the studies that generate systems knowledge fall within the field of empirical research.

Transformation knowledge is the knowledge of how we can get from the current state ("is") to the desired state ("ought"). This requires an integration of both systems and target knowledge. In other words, research is looking for demonstrably effective solutions to the problems identified in the context of sustainable development. There are many methods to generate transformation knowledge. Research on transformations, i.e. the change in social organization at various levels, can be empirical as well as normative. Research focusing on past and present transformations is empirical, while research focusing on concrete goals is normative. Accordingly, the German Advisory Council on Global Change (WBGU), distinguishes between "transformation research" and "transformative research". Another concept that is emphasized in the context of transformations is "transformative education", which seeks to promote skills for a comprehensive and multi-layered understanding of change (Schneidewind 2013). As such, transformative education aims to strengthen society's ability to reflect on issues, for example

in terms of observation and in actively shaping transformation processes.

Target knowledge refers to the knowledge of what should be achieved and what should be avoided. Normative research is particularly important in this context. It is about interpreting and concretizing the values of sustainable development and deriving further standards. Research into the definition of threshold values is just as relevant as methods for assessments and visioning processes (cf. Swart et al. 2004, Wiek and Iwaniec 2014). Target knowledge gives us the answer to the question of what we should transform. CDE's study programmes are primarily guided by the following concepts of target knowledge for a sustainable economic and social system:

- The principles of sustainable development
- The 2030 Agenda and the SDGs (2015)
- The WBGU's Flagship Report "World in Transition: A Social Contract for Sustainability" (2011)
- The Global Sustainable Development Report GSDR (2019)

Part II

Approaches to Sustainability

Chapter 2

Approaches to Sustainability

2.1 Approaches

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 1) . 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.

2.2.1 Tipping points

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 Criticism and 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

list readings here

2.3 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").

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 Criticism and 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 Debates on great transformations

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.

2.4.1 Flagship WBGU report

A flagship report by the German Advisory Council on Global Change (WBGU), World in Transition, is an important publication that addresses the challenges and opportunities of a sustainable transformation of society. It was first published in 1994 and has since been updated several times. The report analyses global environmental changes, including climate change, biodiversity loss, and resource consumption, and proposes concrete policies and social change to promote sustainable development.

World in Transition is significant to debates on the great transformation, as it argues for a far-reaching transformation of business, policy, and society. This vision extends beyond mere adaptation, demanding fundamental shifts in the structures and patterns of economic activity and daily life. The report underscores the urgency of driving forward the transition to a climate-friendly and environmentally sound economy and way of living. It emphasizes the critical role of a comprehensive sustainability policy. Finally, it identifies innovation, technology, education, institutional reforms, and international cooperation as key levers for achieving sustainable development.

In Chapter 8, World in Transition distinguishes between two concepts: "transformation research and education" and "transformative research and education". These concepts are key to promoting fundamental change towards sustainability.

Transformation research analyses processes of change, particularly in the context of sustainable development. It seeks to understand the dynamics and complexity of transformations, and to identify possible courses of action for a sustainable future. Transformation research offers an inter- and transdisciplinary perspective, and it involves different actors and stakeholders in the research process.

Transformation education is education that aims to impart the knowledge, skills, and values needed to achieve a sustainable transformation of society. It includes formal and informal educational measures that enable people to actively participate in transformation processes and to promote sustainable thinking and action.

Transformative research not only generates knowledge but also goes a step further, by actively striving for change towards sustainability. It thus aims to influence social practice and develop solutions and innovations for sustainable development. Transformative research works closely with partners from practice, and strives to translate knowledge into action.

Transformative education fosters a shift in mindsets, values, and behaviour towards sustainability. It goes beyond imparting knowledge, by also promoting critical awareness, empathy, and action for sustainable changes in society.

The WBGU believes that the state should take on tasks that are not adequately performed by individuals or the private sector. It recognizes that the state plays a deci-

sive role in creating framework conditions and shaping political measures to promote sustainable development. The state can drive innovative solutions, steer investments, establish regulations, and implement policies that enable a sustainable transformation.

> "The important thing for Government is not to do things which individuals are doing already, and to do them a little bit better or a little worse; but to do those things which at present are not done at all."
>
> — John M. Keynes, The End of Laissez-Faire, 1926

However, the WBGU also emphasizes that effective government intervention should take place in collaboration with other actors and stakeholders, including civil society, the private sector, and academia. Jointly shaping a sustainable future is about creating partnerships and involving different expertise.

2.4.2 Schneidewind's "art of the future"

The German economist and politician, Uwe Schneidewind, discusses the concept of the great transformation in his 2018 book, Die grosse Transformation: Eine Einführung in die Kunst des gesellschaftlichen Wandels, which translates as The Great Transformation: An Introduction to the Art of Social Change. Schneidewind points out that a great transformation isn't dictated by the unstoppable development dynamics of modern societies or by a technocratic blueprint for an ecologically just society. Instead, he sees it as a process that should be actively shaped by many actors. As such, it's important to have a clearly defined normative compass and to develop the ability to navigate complex social, cultural, economic, and technological processes. He describes this ability as the "art of the future" – the skill of making desirable futures possible – and thus builds a bridge to Harald Welzer's FUTURZWEI. Welzer, a psychologist and sociologist, emphasizes the importance of imagination, creativity, and engagement in bringing about transformative change and developing alternative visions of the future.

2.4.3 Global Sustainable Development Report (GSDR)

In September 2019, the first Global Sustainable Development Report (GSDR) was published by a group of 15 independent scientists appointed by the UN Secretary-General. Intended for publication every four years, the aim of the GSDR is to synthesize existing knowledge and identify pathways to achieving the Sustainable Development Goals (SDGs). The latest report (2023) highlights the significant gap between current progress and achieving the SDGs. Building on the 2019 report, it introduces capacity building as a new lever to accelerate progress.

The GSDR proposes six key areas, or "entry points", with the highest potential to drive the large-scale and swift transformations needed. To initiate these transformations, active and multifaceted collaboration is crucial among actors from diverse fields: governance, business and finance, individual and collective action, and science and technology.

2.4.4 Criticism and conclusion

- consider it necessary and possible to steer social development towards sustainability.
- are holistic concepts for managing social development. They propose entry points at various areas of society and at several levels of action.
- propose key areas with a major leverage effect (e.g. the WBGU proposes an energy transition, urban transition, land use transition, and transformative education and research).

Further readings

polanyi

2.4.5 Green economy

In a pioneering use of the term "green economy", David Pearce and Edward Barbier launched their groundbreaking Blueprint for a Green Economy series in 1989. The series was the first to present economic frameworks and programmatic approaches for achieving the dual goals of economic prosperity and ecological well-being (Pearce et al. 1989, 1991, 1993; Pearce/Barbier 2000; Barbier/Markandya 2013). The green economy's core principle challenges the traditional view that economic growth and environmental well-being are inherently at odds. It proposes a paradigm shift, moving away from bans and restrictions. Instead, it advocates for economic incentives and strategies that promote environmental sustainability while fostering positive models of economic and technological development aligned with both ecological and social goals. In the run-up to Rio+20, the 2012 United Nations Conference on Sustainable Development, the green economy concept was finally developed into a guiding principle that shaped the debate (United Nations 2011a; 2011b; Bär et al. 2011; Creech et al. 2012). "Green economy" was one of two key themes of Rio +20; the other was the "institutional framework" for sustainable development. Accordingly, numerous documents on the green economy were published in 2011 and 2012, and a seminal definition of the term was published by the organizing agency of Rio+20, the United Nations Environment Programme (UNEP), in the report, Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication (UN 2011a, p. 31; UNEP 2011, p. 16). The OECD also contributed its own response to the financial crisis with its resolution on "Green Growth" (OECD 2009a).

> Note
>
> "UNEP defines a green economy as one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. In its simplest expression, a green economy can be thought of as one which is low carbon, resource efficient and socially inclusive. In a green economy, growth in income and employment should be driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services." (UNEP 2011, p. 2)

While Rio+20 cemented the concept of a green economy, the need for a fundamental global change in thinking was already widely accepted. It had become clear that while environmental protection measures cost money, they also have a positive economic impact by creating jobs (see e.g. UBA 2008) and sparking innovation in technological efficiency advancements (cf. e.g. Weizsäcker et al. 1995). The green economy concept systematizes such findings and calls for programmes to overcome the apparent contradictions between economy and ecology, growth and resource conservation, as well as prosperity and environmental protection. The concept thus marks a significant paradigm shift. Adhering to planetary boundaries or ecological guidelines in a green economy (Rockström et al. 2009; Steffen et al. 2011; SRU 2011) does not necessarily mean forgoing economic growth and technological progress. Instead, the idea is that by harmonizing these apparently contradictory aims, we can achieve them even more efficiently. The EU Green Deal exemplifies this concept. The EU aims to be the first climate-neutral continent by 2050, aiming for a modern, resource-efficient, and competitive economy with net-zero greenhouse gas emissions. This plan seeks to decouple growth from resource use while ensuring a just transition that leaves no one behind.

2.4.6 Criticism and conclusion

The core thesis of the green economy is that environmental and economic goals are not contradictory. Instead, they can be reconciled through appropriate economic incentives and strategies. The green economy aims to foster both economic growth and environmental sustainability through public and private investment in low-emission, resource-efficient, and socially equitable economic systems.

Critics, however, have raised concerns about the effectiveness of green economy measures. They argue that the proposed technologies and incentives are insufficient to bring about the far-reaching systemic changes needed. An overemphasis on economic growth and technological solutions could potentially neglect essential structural and behavioural changes. And they warn that the global transition to a green economy could leave behind disadvantaged communities and developing countries, if their specific needs are not addressed.

2.5 Post-growth societies

The post-growth debate emerged from concerns raised in the 1970s, after publication of the influential Meadows Report, The Limits to Growth (1972). As previously mentioned, this report highlighted the Earth's finite capacity to sustain humanity in the face of unrestrained economic growth. The post-growth debate advocates qualitative growth or even zero growth, and criticizes the effects of the "modern" economy and lifestyles (e.g. Binswanger 1985). It argues that the compulsion for constant growth is making us exceed ecological limits and leading to negative social and ecological consequences. "Ecological economics" is an important concept in this respect, as it aims to develop alternative models and approaches for evaluating economic growth.

The dilemma in this debate is that most approaches to a sustainable economy assume that a growth-independent economy should not be profit-driven. However, capitalist economies are existentially dependent on growth (e.g. Binswanger 2019, Oberholzer

2021). This dilemma is key to the question of how to organize a successful transition from the current unsustainable system to a sustainable economic and social system. One main approach is to reduce dependencies on growth and promote alternative models that focus on sufficiency, without neglecting strategies that focus on efficiency and consistency. This requires changes in production and consumption patterns, in social norms, and in the political framework. The post-growth debate emphasizes the need for a comprehensive transformation that encompasses environmental, social, and economic dimensions – and aims to achieve a balance between human needs and planetary boundaries.

The concept of "sufficiency" is an integral part of the post-growth debate (Schneidewind & Zahrnt, 2013). Sufficiency aims to reduce overconsumption and promote alternative lifestyles, consumption habits, and production patterns. To promote widespread adoption of sufficiency, a legal and institutional framework that incentivizes and facilitates sufficiency-oriented practices is necessary.

A policy to promote sufficiency can actively shape our choices, through attractive sufficiency-oriented offers and services. It can also foster awareness and provide guidance for adopting sufficiency-oriented lifestyles and practices. This comprehensive approach aims to shift consumption towards what is necessary and meaningful, ultimately reducing excessive resource use.

2.5.1 Criticism and conclusion

Post-growth debates analyse and criticize modern society's dependency on economic growth, and the negative environmental and social effects of this growth. Rather than focus solely on technological progress and market forces, post-growth society theories strive for changes in society, structures, and institutional frameworks. Overall, post-growth debates emphasize the need for sustainable approaches to achieve a comprehensive transformation of the economy and society. Transformation to a post-growth society requires a reorientation of values, structures, and institutional frameworks. The challenge is to find ways to shape the transition to an economy independent of growth, while at the same time ensuring social justice and ecological sustainability.

Critics of post-growth debates argue that a rejection of economic growth could have a negative impact on prosperity and social progress. They fear that an economy independent of growth could lead to stagnating innovation, fewer jobs, and falling living standards. And they point out that a negative attitude towards economic growth can have potential negative effects. Constructively addressing the challenges of growth and developing viable alternatives are important aspects of enabling sustainable and equitable change.

Part III

Transforming (Un-)sustainable systems: Key areas and strategic approaches

Chapter 3

Environmental sustainability - Overview and normative orientation

The economy is integral not only to society, but also to nature. Humans are living beings and therefore reliant on material resources to fulfil their needs. They also require intact ecosystems and a climate suitable for human habitation. When we speak of "environmental sustainability", we generally mean the protection of the diversity and functioning of natural ecosystems and the services they provide for future generations. This is an anthropocentric definition, as it focuses on human activities and how these seek to ensure the long-term sustainability of nature for human benefit. This perspective is also reflected in our everyday language and our dualistic separation of "human" and "environment", a separation that goes back to the 19th century and persists to this day. For example, we separate science into "natural science" and "social science", and our analyses often conceptualize environmental damage as "externalities". Another understanding of environmental sustainability emphasizes the importance of maintaining the self-regulation of the Earth's climate system. This view highlights the interaction and feedback between various components of the Earth's climate system.

3.0.1 The normative dimension of environmental sustainability

Although our understanding of how ecosystems work is based on thoroughly researched empirical information (and therefore constitutes "systems knowledge"), environmental sustainability remains a normative concept. This means that it is based not only on scientific findings, but also on an ethical evaluation (cf. Figure xy). The various interpretations of environmental sustainability offer different answers to the question of what should be preserved, and why. Each approach to environmental sustainability therefore expresses the desired state of the ecological environment, both now and in the future – what aspects of nature should be preserved or survive from the present to the future. For example, when we talk about ecosystem services, the intention is often to preserve ecosystems in a way that continues to support and maintain our own welfare (in this sense, it is an anthropocentric perspective).

Figure

Ethical judgements and justifications shape which ecological properties and functions we preserve for future generations, and which we deem intrinsically valuable in nature. What constitutes a desirable state for ecosystems, and why? What aspects of the ecological environment deserve protection, and what is the aim of this protection? Is it necessary to keep ecosystems as pristine as possible, and how do we define "naturalness"? To what extent should we use ecosystems for human purposes without restriction, and are there areas that we should leave for organisms to use, with minimum human intervention? Interpretations of environmental sustainability depend on the goals being pursued: for whom, why, and how (cf. Figure 1.5).

Box: Specific examples of ethical assessments in the context of environmental sustainability Wildlife conservation: Should we intervene in natural wildlife populations to protect endangered species and maintain the balance of ecosystems? Or should we leave nature as untouched as possible, even if this means losing some species? Biotechnological interventions: Is it morally acceptable to use biotechnological methods, such as genetic engineering, to alter the ecological characteristics of organisms and potentially influence ecosystems? Conservation of endangered species: Should we focus on protecting and preserving endangered species to maintain biodiversity, or should we focus on preserving broadly available species that are more important for the human diet or the economy? Protecting ecosystems: Should we establish protected areas to preserve threatened ecosystems and species, even if this restricts local communities in their economic activities? How can we strike a balance between conservation and sustainable use?

3.1 Ecosystems, Ecosystem management, and Ecosystem services

An ecosystem is a group of living organisms and their physical surroundings that interact with each other. Ecosystems can range from small, like a flowerpot, to large, like an ocean. When similar ecosystems are found in a larger region with the same climate, they are called biomes. Energy and material flows are important for the functioning of an ecosystem. Some of these flows, such as the carbon cycle, take place at the global level, while others are more localized. Most ecosystems obtain their energy from the sun and can influence the Earth's climate through their interactions (Britannica). Ecosystem services are the benefits that humans derive from ecosystems such as mangrove forests, oceans, or wetlands. The services provided by ecosystems include the provision of clean water, the prevention of flooding, the promotion of crop growth, and the provision of places for leisure activities. The Millenium Ecosystem Assessment, published in 2005, divides ecosystem services into four categories (cf. green Box in Figure x): provisioning services, regulating services, cultural services, and supporting services (MEA, 2005). Note that the supporting services, which are primarily fundamental biophysical processes, enable and guarantee the other services in the first place.

Figure

Chapter 4

Social Sustainability

4.1 Social sustainability - Overview and normative orientation

Felix Poelsma, Christoph Bader

Chapter 5

Economic Sustainability

5.1 Economic sustainability - Overview and normative orientation

Nicolà Bezzola, Christoph Bader

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