Practices of sustainability and the enactment of their natures/cultures: Ecosystem services, rights of nature, and geoengineering

Frank Adloff and Iris Hilbrich
University of Hamburg, Germany

Abstract
Possible trajectories of sustainability are based on different concepts of nature. The article starts out from three trajectories of sustainability (modernization, transformation and control) and reconstructs one characteristic practice for each path with its specific conceptions of nature. The notion that nature provides human societies with relevant ecosystem services is typical of the path of modernization. Nature is reified and monetarized here, with regard to its utility for human societies. Practices of transformation, in contrast, emphasize the intrinsic ethical value of nature. This becomes particularly apparent in discourses on the rights of nature, whose starting point can be found in Latin American indigenous discourses, among others. Control practices such as geoengineering are based on earth-systemic conceptions of nature, in which no distinction is made between natural and social systems. The aim is to control the earth system as a whole in order for human societies to remain viable. Practices of sustainability thus show different ontological understandings of nature (dualistic or monistic) on the one hand and (implicit) ethics and sacralizations (anthropocentric or biocentric) on the other. The three reconstructed natures/cultures have different ontological and ethical affinities and conflict with each other. They are linked to very different knowledge cultures and life-worlds, which answer very differently to the question of what is of value in a society and in nature and how these values ought to be protected.

Keywords
Anthropocene, ecosystem services, geoengineering, relational ontology, rights of nature, science and technology studies (STS), sustainability

Corresponding author:
Iris Hilbrich, University of Hamburg – DFG Centre for Advanced Studies “Futures of Sustainability”, Gorch-Fock-Wall 5-7, Hamburg, 20543, Germany.
Email: iris.hilbrich@uni-hamburg.de
Résumé
Les différentes trajectoires possibles vers la durabilité se basent sur différentes conceptions de la nature. Cet article se penche tout d’abord sur trois trajectoires de durabilité (modernisation, transformation et contrôle) et reconstruit une pratique caractéristique de chaque approche à l’aide de ses conceptions spécifiques de la nature. L’idée que la nature fournit aux sociétés humaines les services écosystémiques qui leur sont nécessaires est typique de la trajectoire que constitue la modernisation. La nature y est réifiée et monétarisée, en fonction de son utilité pour les sociétés humaines. Cela apparaît de façon particulièrement saillante dans les discours sur les droits de la nature, dont le point de départ peut être retrouvé dans les discours des peuples autochtones d’Amérique Latine, entre autres. Les pratiques de contrôle, telles que la géo-ingénierie, se basent sur des conceptions de la nature dans lesquelles la planète est comprise comme un système, au sein duquel aucune distinction n’est faite entre les systèmes naturels et sociaux. Le but est de contrôler le système-terre comme un tout afin que les sociétés humaines demeurent viables. Les pratiques relatives au développement durable mettent donc en évidence différentes façons de comprendre ontologiquement la nature (de façon dualiste ou moniste) d’une part, et différentes éthiques (implicites) et formes de sacralisations (anthropocentrée ou biocentrée) d’autre part. Les trois natures/cultures qui sont reconstruites ici ont donc des affinités ontologiques et éthiques différentes et sont en conflit les unes avec les autres. Elles sont liées à des cultures de savoir différentes et à divers mondes de la vie, ce qui implique des réponses divergentes à la question suivante : qu’est-ce qui, au sein d’une société et dans la nature, a de la valeur et comment ces valeurs doivent-elles être protégées ?

Mots-clés
Anthropocène, droits de la nature, durabilité, études des sciences et technologies, géo-ingénierie, ontologie relationnelle, services écosystémiques

Introduction
Global warming and the loss of biodiversity will pose enormous challenges for human societies in the coming decades and centuries. When dealing with the associated social and ecological crises, how the relationship between societies and nature is shaped in the age of the Anthropocene will be of great importance (cf. Klinenberg et al., 2020). Different understandings of nature imply different social relationships with nature. Thus, different notions of sustainability are also shaped by very different concepts of nature. Consequently, introducing aspects of ecological sustainability into socio-political debates is not a singular process – instead there is a multiplicity of ecological considerations, as Anders Blok points out rightly: ‘In short, there is not one, but several, common ecological worlds’ (2013: 494). At this point, the question arises whether there are only different perspectives on one singular nature, or whether the different understandings of nature can be interpreted in different ways. This problem also touches on ontological questions and some concern the scope of sociology. So far, social constructivist perspectives and a
subject-object dichotomy have dominated sociology. The typical view of sociology is that people have different ideas about the reality of nature, while the ‘true reality’ of nature is left to the natural sciences. An alternative position to this is (as it has mainly been found in the field of Science and Technology Studies (STS)) that different realities are put into effect by different practices. In the first case, typical of sociology as a discipline, epistemological questions are being asked and it is assumed that there is one nature, but many cultures, i.e. perspectives on nature. This is the model of modern Western naturalism (cf. Descola, 2013). Following the second, more radical approach, one deals with ontological questions, and consequently there is no longer just one world, but several enacted worlds (Law, 2014; Mol, 2003). We follow Michel Callon (1984), Bruno Latour (1986) and others in this tradition, in their assumption that both the natural and social sciences produce different versions of the natural and the social.

The article focuses on three possible trajectories of sustainability (modernization, transformation and control, cf. Adloff and Neckel in this issue) and reconstructs one characteristic practice for each path with its specific conception of nature. The notion that nature provides human societies with relevant ecosystem services is typical of the path of modernization. Nature’s services are economically quantified here, with regard to their utility for human societies. Practices of transformation, in contrast, emphasize the intrinsic ethical value of nature. This becomes particularly apparent in discourses on the rights of nature, whose starting point can be found in Latin American indigenous discourses, among others. Control practices such as geoengineering rely on earth-systemic conceptions of nature, in which no distinction is made between natural and social systems. The aim is to control the earth system as a whole in order for human societies to remain viable. As we will show in the following by depicting these different practices, possible trajectories of sustainability are based on different concepts of nature. Moreover, ecosystem services, rights of nature and geoengineering are not firmly established and broadly institutionalized practices of sustainability. They are emerging and contested, and therefore show very well that the future of sustainability is open and multiple, so that we refer to the futures of sustainability in the plural (cf. Adloff and Neckel, 2019).

Finally, taking seriously the heterogeneity and multiplicity of concepts of nature and sustainability, our analysis aims to deepen our understanding of the relationality of natures and cultures in the plural. For Latour (1986), our reality is constituted only through the coupling of people with natural and, above all, technical things. Diverse natures/cultures are constantly being enacted and thus realized through practices. The achievement of Science and Technology Studies was, and still is, to have drawn attention to the complex networks of relationships and translation processes that arise when human and non-human actors and agents meet. The task of this article is to trace the genesis of these processes of translation.

**Nature as a valuable resource: Modernization via ecosystem services**

Since the late 1990s, ecosystem services have become a key concept in economics and environmental sciences. Their starting point is the observation that human societies depend on certain functions of nature for their well-being. The necessary basic stocks of nature can be described as natural capital assets, which can be differentiated into renewable and
non-renewable natural resources – such as clean air, water, metals, soils, etc. This capital yields returns, namely ecosystem services such as energy, plants or drinking water. Natural capital must be managed sustainably, as it is only available in finite quantities and should continue to yield returns in the future. Anne Guerry, Stephen Polasky, Jane Lubchenco et al. (2015: 7349) describe this relationship as follows: ‘For example, fish harvesting depends on the availability of fish stocks (natural capital) which depend on high-quality habitat (natural capital) [. . .].’ The analysis of natural capital and ecosystem services includes both ecological and economic perspectives (cf. Bateman and Mace, 2020). The analysis and evaluation of ecologically defined ecosystem services is based on economic principles: it is a matter of choices between different options for action. Each natural resource can be treated differently and each decision is associated with opportunity costs. ‘The choice between different options is in effect a trade-off between alternative benefits and costs, across different groups of people (winners and losers), and over space and time’ (2020: 2). The concept is now being applied by various governments, for example in Costa Rica, South Africa, the United Kingdom (UK) and Sweden.

For humans, ecosystems do not have an intrinsic value, but an instrumental value, direct or indirect, for human well-being (Farber et al., 2002). Examples include forests, which cool the climate, store and clean fresh water, deliver construction timber and firewood, provide genetic diversity and are recreational areas. Natural capital is valued for the services it provides; it is therefore a utilitarian and anthropocentric concept. Hence the concept of value is thus used in accordance with economic theory, which is concerned with the benefits generated by ecosystem services that can be presented in monetary terms as an exchange value. The value of ecosystem services can be represented in different ways: one can determine what people are or would be willing to pay for certain ecosystem services for instance. However, many ecosystem services cannot be traded on markets, so the economic value of natural resources is determined indirectly. For example, costs can be avoided if a mangrove forest prevents damage caused by coastal flooding. If the forest is cut down, replacement costs are incurred, since an artificial flood control must now be created. In another context, the costs arising, for example for keeping the oceans clean, which is necessary to sustain the ecosystem services of the oceans, can be calculated. Different valuation techniques are therefore used for different ecosystem services (2020: 388). The value of some ecosystem services has now been quantified quite precisely, while the valuation of others is still very controversial. For example, it is unclear how biodiversity values are to be dealt with, since the functions and services of biodiversity have not yet been sufficiently well researched. It is therefore not possible to assign values for individual components of biodiversity and neither for biodiversity as a whole. This shows how closely economic and biological analyses are to be interlinked.

The fundamental question to be answered in the context of an instrumental assessment of nature is which components of natural capital can be replaced by other forms of capital. Natural processes of water purification, for example, can be replaced by physical and chemical processes. Nonetheless, it is questionable whether the aesthetic enjoyment of observing wild animals can be replaced by visiting zoological gardens and natural history museums, or watching TV footage of wild animals. Whether biodiversity can be
replaced and by what is therefore still largely unclear. The question, however, of whether replacing is also normatively worth and right, or whether it has an intrinsic value (as the protagonists of the transformation path claim), remains unresolved. Furthermore, some ecosystem services are so fundamental that they go beyond the direct instrumental framework of the approach. Evolutionary processes, water cycles, erosion, decomposition, nutrient cycles are so fundamental in their functions that they have to be regarded as a condition for the possibility of life on earth, and not as merely instrumental (and thus in principle replaceable) services (Mace, 2019: 64). However, economics seems to be divided on this issue. The majority of adherents of ecological economics share the opinion ‘that natural capital can ultimately not be substituted by human-made capital’ (Illge and Schwarze, 2009: 601), while representatives of neoclassical environmental economics consider that it can represent greater prospects for substitutability.

The concept of ecosystem services is not uncontroversial and is regularly criticized (for an overview see Jax et al., 2013; Lele et al., 2013; Schröter, 2014). First, the anthropocentric and utilitarian approach, which excludes intrinsic values of nature, is ethically criticized. Secondly, from an ecological perspective, the extent to which the ecosystem services approach is actually capable of providing good arguments for biodiversity conservation is questioned. Thirdly, criticism is directed at the economic valuation of natural entities, with particular emphasis on the danger of an increasing commodification of nature. Nevertheless, critics also claim the concept of ecosystem services to be useful in various respects: especially in raising awareness of the dependency of human well-being on natural systems and in ‘facilitat[ing] communication between different disciplines and interest groups’ (Jax et al., 2013: 265).

The aim of a broad institutionalization of natural capital accounting would be to initiate processes of sustainable development. In concrete terms, this means that decisions should be taken which internalize previously externalized costs and, in aggregate, increase social values. To this end, positive or negative incentives should be created for private resource owners – positive ones, for example, in the form of payments for ecosystem services or subsidies, negative ones in the form of taxes or regulations (cf. Bateman and Mace, 2020). The concept of ecosystem services does not rely solely on markets and prices, but aims to fundamentally change economic systems in such a way that the ‘provision of nonmarketed ecosystem services or the sustainable use of natural capital that supports these services’ is rewarded (Guerry et al., 2015: 7352). Accordingly, a study on land use in the UK shows that strict environmental regulations would significantly increase the value of ecosystem services (Bateman et al., 2013).

The concept of ecosystem services thus combines ecological expertise with economic value assessments. Although the approach is individualistic (it is about the sum of individual benefits) and a large number of partial ecological aspects needs to be analyzed, in the end it leads to the emergence of an aggregated value of nature. Isolated individual values as well as ecosystem services are aggregated to the ‘value of nature’. Guerry et al. (2015: 7349) also speak of the overarching goal of: ‘increasing awareness of the interdependence of nature and people’. A nature-whole arises here as an effect of aggregation (cf. Farber et al., 2002: 389). The genesis of preferences and values is thus lost from view, and it is also impossible to understand how value ties depend on social or
certain natural entities: ‘For example, the value of forests to a community whose social system, folklore, etc. are intimately dependent on them is more than the sum of independent personal values’ (2002: 389). For instance, not only indigenous cultures often make no distinction between human and non-human systems but also traditional or organic farmers, gardeners, landscape designers, pet owners and many other groups within modern societies – but the concept of ecosystem services works with this fundamental distinction. Instead of showing the interdependence between human and non-human systems, as intended, the concept of ecosystem services of nature may lead to a reification of nature – and the dichotomy between society and nature risks being reaffirmed.

Transforming the relationship between nature and society: Ethics and rights of nature

In the path of transformation, social actors are concerned with overcoming existing social structures to create a society that should refrain from exploiting people and nature. The aim is to create a post-capitalist society that also enters into a different relationship with nature. In the transformation discourses, nature is not just regarded as a resource to be protected, but in many cases attempts are made to escape anthropocentric models of sustainability. Maintaining the habitability of planet earth for all forms of life is demanded. For example, biodiversity should not be protected solely based on human interests, but ecosystems and species should be given their own ethical or even legal value.

These views of mainly civil society actors are connected to some positions in the field of ethics of nature. Overcoming the ontological culture-nature divide and starting from the capacity of non-human beings to act, the step of seeing nature as having a moral value in its own right is not far off. In the field of ethics, there has been a detailed discussion for years about the question whether people only owe respect to other people or also to nature, i.e. to plants, animals, rivers, mountains etc. For example, the question whether animals may be killed and consumed, species eradicated or rivers and seas polluted because this is beneficial to people is investigated, or whether natural entities have their own dignity and moral value (Krebs, 1997). At least for some (domestic) animals (just think of cats, horses and dogs) it is already true that many people do not consider them as things, but approach them in the second person (‘you’). They are not merely the object of human observation, but also beings with whom people interact and who, in their interaction, bring their individuality to bear (Habermas, 1997). Hence, they have at least partial actor status from which obligations towards the animal can be derived.

A more radical ethics of nature – such as the deep ecology of Arne Næss or the land ethic of Aldo Leopold – emphasizes the intrinsic value of ecosystems or considers people and non-human life forms as one community (cf. Soulé, 1985). The starting point for these approaches is the thesis that humans are not independent beings. People are not only dependent on other people, but also on physical, biochemical and biological systems, between which there are close interdependencies (Boisvert, 2010). The interrelationships with and dependencies on others are emphasized with the aim of allowing new collectives to grow out of them, based on a new sense of kinship (Donna Haraway’s
chapter ‘Making kin’ (2016)). According to these environmental ethics, the role of affects and their associated values is crucial. Some animals display a charisma (Lorimer, 2007) from which ethical values and ideals are derived. People feel charismatically affected by some species, feel connected with them and sacralize these beings (cf. Joas, 2019). Natural objects thus become quasi-subjects as ends-in-themselves (cf. Blok, 2013: 504).

It is therefore a matter of a specific dimension of experience, of dealing with nature in the second person. In everyday life, nature is not only experienced as a resource, thing or mechanism. The experience of nature as a sacred entity and quasi-person has accompanied Western modernity from the very beginning. This is most clearly expressed in romantic cultural strands (cf. Rosa, 2019: chapter 11). We find this thread in everyday perception, in aesthetic experiences, in the aesthetics of nature or in variants of ecological thinking (cf. Choné et al., 2017). However, this form of experience has not entered the mainstream of scientific world observation and description since it normally lies beyond its methodological scope.

To put it succinctly, the moderns live in two worlds (cf. Latour, 2013): on the one hand, they draw on formal, scientifically acquired knowledge, and on the other hand, people constantly make practical experiences that are far from always being congruent with scientific knowledge (cf. Feenberg, 2013). Life-world experiences that are incongruent with scientific knowledge, however, live an epistemic shadowy existence in the modern age. Since they resemble the perception of the world of the non-moderns, these experiences often remain marginal and precarious in official discourses (cf. Caillé et al., 2013; Santos, 2014).

The approach of civil society movements that strive for an ecologization of modernity in this sense is closely linked to Latin American discourses and especially to indigenous cosmologies that do not follow the separation of nature and society (cf. Ulloa, 2015, 2017). New hybrids of Western and indigenous thinking have been intensively discussed in Latin America in recent years and even incorporated into laws. For example, Article 71 of Ecuador’s 2008 constitution grants nature the right to exist, to preserve and maintain its vital cycles, its structure, its functions and evolutionary processes. At the same time, every person, community and nation is explicitly given the opportunity to claim the rights of nature from state institutions. The idea of rights of nature is a hybrid phenomenon, as the Western idea of (human) rights is combined with indigenous ideas of nature. While in the Western model nature cannot claim any rights of its own, in Ecuador the cultural topos of pachamama (Mother Nature) or buen vivir, which is of indigenous origin, has been used as a basis for constitutional debates in recent years in dialogue with international NGOs (cf. Vanhulst and Beling, 2017; Gutmann, 2019). Buen vivir draws on indigenous stocks of knowledge mainly from the Andes, which are of communal and non-capitalist origin, and outlines a social and ecological concept of development and of the good life (Acosta, 2013).

Recently, more and more voices are calling for a different approach to nature, primarily by granting natural entities the status of legal entities. Animals have always been subject to the law, whether as food, production factor, source of income, transmitter of disease or parasite (Peters and Stucki, 2016). However, animals are increasingly considered under the guise of protection. In Germany, for example, the legal equation of animal and matter has been abolished, and animal protection can be found as a state objective in
the German constitution (article 20a of the Grundgesetz, the constitution of Germany). In addition, it also seems basically possible to recognize natural entities (e.g. regional ecosystems) as legal entities in the German legal system (Fischer-Lescano, 2018). This raises the question whether only individuals (i.e. the individual pig or cow) can be legally protected, or whether collective entities such as species or habitats, such as a river delta, can also be granted legal status.

Central to these debates is the contribution of the US-American lawyer Christopher Stone (1972), who decades ago developed the idea of a right of appeal for animals and natural entities such as rivers or ecosystems: ‘I am quite seriously proposing that we give legal rights to forests, oceans, rivers and so-called ‘natural objects’ in the environment’ (1972: 456). As soon as ‘things’ are given rights, they are personified and gradually appreciated in themselves – and not only for the benefits they bring to people. Following on from this, there is a current debate on whether and how the concept of ‘nature as a legal entity’ should be further developed. Since non-humans cannot speak for themselves in the same way as humans, non-human living beings and ecosystems would then have to be legally or politically represented (cf. Ahlhaus and Niesen, 2015). This is not surprising, since a multitude of things must be represented and ‘spoken for’, be it laws, companies, nation states or God. The goal of these efforts is a social transformation that also aims at a different understanding of property and ownership (cf. Degens in this volume). If the status of the legal entity were to be extended, the nation-states’ claims to possess sovereignty over a territory and to be able to exploit its natural ‘resources’ would be restricted.

A number of civil society actors around the world are now campaigning for binding and enforceable nature rights. ClientEarth, for instance, is a leading organization in this field, which brings major environmental cases to court. It was founded in 2008 and aims to fight for the right to a healthy environment. The organization successfully issued numerous cases against governments in Europe (see clientearth.org). Whether an ecologization of societies can be achieved by means of rights of nature is currently still a largely unresolved question. The introduction of natural entities as legal entities could lead to unintended effects. If different legal positions compete with each other, social conflicts can be aggravated, since each legal entity always wants to defend or extend its own rights first. Eventually, the human-nature dichotomy can even intensify when nature as a legal subject appears alongside human legal subjects (Gutmann, 2019: 616). By contrast, conventional environmental law formulates environmental concerns from the perspective of human interests.

**Planetary experiments: Geoengineered control of the earth system**

Within the ideal-typical path of control, sustainability problems are to be solved primarily through government policies and interventionist practices. Following this trajectory of sustainability, the year 2006 marks a radical discursive shift within the climate debate: as a means of reacting to anthropogenic changes, Paul Crutzen (who coined the term Anthropocene) proposed technological interventions of control, which are negotiated under the term geoengineering or climate engineering (Crutzen, 2006). Although the idea of manipulating the climate goes far beyond current debates on climate change – the first
documented attempts to manipulate the weather were made during the Cold War in the 1950s (see e.g. Yusoff, 2013) – Crutzen’s call is now seen as a crucial starting point for extensive academic and public debates on climate intervention technologies (c.f. Boettcher and Schäfer, 2017). Since 2009, the Royal Society officially defines geoengineering as ‘deliberate large-scale manipulation of the planetary environment to counteract anthropogenic climate change’ (Shepherd, 2009: 1).

The technologies differ greatly but are basically divided into two groups. On the one hand, there is a focus on so-called Carbon Dioxide Removal (CDR), the separation and partial storage of CO₂ from the atmosphere by technical equipment or by human-induced natural processes such as afforestation or ocean fertilization. On the other hand, some technologies that are being researched aim at reducing solar radiation: the so-called Solar Radiation Management (SRM). Suggestions for SRMs include, for example, mirrors in space, the brightening of sea clouds, the introduction of particles into the stratosphere or an increase in the reflectivity of crops.

SRM technologies in particular are under criticism for their hubris, as their effects would vary greatly from region to region and as the uncertainties are too big and the risks not calculable. For example, the spatial distribution of precipitation and temperatures, including the monsoon, could change. In addition, earth’s temperature would rise again rapidly if the use of SRMs were to be terminated abruptly. These interventions are therefore often discussed as emergency measures against impending catastrophic climate impacts (cf. Wiertz, 2015). While geoengineering was initially considered an innovative technology that still needed to be tested in its application, especially CDR-technologies, it represents now an indispensable part of the scenarios for measures against global warming. No scenario from the Intergovernmental Panel on Climate Change (IPCC) now dispenses with the presentation of negative emissions, i.e. geoengineering and other technologies seem necessary to cap global warming to 1.5 degrees Celsius (cf. McLaren and Markusson, 2020), although the technologies needed are by no means fully developed yet.

Countless measurements and data flow into geoengineering models, which are processed in specific ways to create simulations of processes, intended to draw an adequate picture of past climates as well as to generate models of future developments. Considering global warming or planetary boundaries, this involves the entire globe. However, the scenarios and modeling of the earth system are based on local data that must be linked and aggregated to global dimensions. Technologies and instruments are put to scale according to a large whole. A ‘global view’ (like the view of the earth from space) of climate does not exist. Scientists do not have a global and direct access to the climate; it cannot be viewed from the outside as a whole. Innumerable local measurements and observations, and diverse model formations are processed towards the idea of a global climate change. Initially, there are only diverse local perspectives, which have been raised to a higher, global level through integrative modeling. Earth system sciences succeed in linking measurement instruments, satellites, drillings and water samples with globalizing mathematical models.

A pioneering approach was to design the earth system as consisting of several subsystems. The influential Bretherton diagram from 1986 distinguishes and integrates for instance ocean dynamics, atmospheric dynamics, terrestrial ecosystems and human
activities. It incorporates several fields of scientific inquiry. Thus, it shows that various
disciplines such as geology, biology, physics, and chemistry as well as the social sciences
are needed to fully understand the climate (cf. Schellnhuber, 1999). Since then, this dia-
gram has become much more complex. Currently, there are about two dozen climate mod-
els. These models are usually shown to the public as naturalistic landscape images in which
human influences and ‘repair measures’ like geoengineering are linked systemically to
other components of the earth system. This way, they make climate simulations and earth
systemic processes visible and discussable. Thereby, they not only present scientific rela-
tionships, but also change the idea of possible futures of the earth (Schneider, 2018: 212ff.).
The mathematization of natural and social phenomena is transformed into an overall pic-
ture of the role of man in nature. At the same time, it is imagined how man can intervene
and control this technological nature-whole to achieve a ‘good Anthropocene’.

Both the complex mathematical models and the simplified landscape images allow
nature to emerge as a whole. Although there is no ontological separation between nature
and man (on the contrary: human societies are completely integrated into the earth sys-
tem), the earth system appears like a precisely functioning clockwork, consisting of indi-
vidual calculable components meshing like gear wheels. This way, the modelers’
knowledge of the underlying assumptions, uncertainties and simplifications that are
incorporated into the models are invisibilized (ibid.: 233). The results of the modeling
process appear as ‘nature’, but are in fact artificial laboratory translations into mathemat-
ical language. In these computer laboratories, experiments can be conducted with differ-
ent futures of the earth system (cf. Rothe, 2020: 150ff.). Knowledge of nature here is
synonymous with nature experiments and laboratory knowledge. Simulated worlds
appear as natural reality, and technologies that do not yet exist can appear as solutions to
problems of global warming.

Prominent representatives of geoengineering gather under the term ‘ecomodernism’ (cf.
Symons, 2019). Parts of this movement, which is guided by the idea of a ‘good
Anthropocene’, view the power of technological innovation of Homo sapiens and a gradual
decoupling of man’s dependence on nature as the solution to urgent climate and environ-
mental problems (cf. Hamilton, 2013). Their ideas were published in an Ecomodernist
Manifesto (ECM) in 2015, which rejects the idea that human societies should be in har-
mony with nature. Instead, technologies make it possible to free oneself from dependence
on nature (Asafu-Adjaye et al., 2015: 6–9). Leading scientists, who are significantly
involved in the development of geoengineering technologies, are also associated with the
ECM program and the leading North American Breakthrough Institute, an environmental
research center, located in Oakland, and which is associated with ecomodernism.

For ecomodernists, climate-related and social problems can be transformed into tech-
nological problems and technological solutions (see Nordmann, 2014). Thus, geoengi-
neering reduces existing value and nature conceptions in society to a technologically
malleable nature (cf. Feenberg, 2005). This becomes particularly apparent in ecomod-
ernist discussions of the ‘good, or even great, Anthropocene’ (Asafu-Adjaye, et al., 2015:
6). Proponents of geoengineering make reference to a technologically formable nature
and see the solution to the climate problem in the establishment of new technologies
through trust in the innovative power of Homo sapiens (cf. Keith, 2013; Asafu-Adjaye,
et al., 2015). In this sense, geoengineering appears as a practice that not only functions
as a potential response to climate change, but produces its own worlds beyond the separation of nature and society (cf. Szerszynski, 2010, 2017b).

In a geotechnically-changed world, nature is more than just co-dependent on human activities. Geoengineering technologies are the culmination of a mechanistic image of nature that has long existed in human history (see e.g. Szerszynski, 2018). In particular, more extreme climate-technological interventions such as Solar Radiation Management refer to the image of a nature, i.e. the earth system, that can be shaped, managed and controlled. As Bronislaw Szerszynski (2017a) points out, the geoengineering climate architect is an idealized imaginary figure who knows in advance what shape he or she wants to give to the climate and who can bring the natural processes into a desired form. This way of thinking about the production of climates is based on the central importance of computer models in climate science, including geoengineering research, which, as a result, reproduces the climate as pure information, as a form freed from matter (2017a). This dematerialized formal climate can then be presented as something that can be recombined with matter and thus become reality (2017a). Nature thus appears as a kind of blind force without conscience (cf. Thiele, 2019) that can be steered and engineered. Consequently, humanity can be seen as the ‘arbiter of planetary life’ (2019: 469).

Relational ontologies and multiple natures

In his influential analysis of naturalism, Philippe Descola (2013) starts from a longstanding, stable ontological difference between subject and object, culture and nature in the West. He points out that the West is deeply influenced by the controversy between materialism and mentalism. On the one hand, Western modernity tries to trace everything considered naturalistically to material processes (this is the view of the natural sciences, parts of psychology and philosophy). On the other hand, a symbolic idealism is advocated, which assumes that we can only access the world through signs and language.

The idea of a mechanical nature had already been developed in the 17th century for example by Francis Bacon (Birch, 1951). But this nature, which has become autonomous, does not yet have a counterpart (Descola, 2013). It was not until the end of the 19th century that the idea was born that human collectives differ from each other in customs, languages, religions and mentalities, i.e. in what we have since called ‘culture’ in the humanities and social sciences. At the time when the discipline of sociology was founded, an awareness of the great variety and variability of cultural traditions and cultural patterns emerged (cf. Adloff et al., 2014). From now on ‘culture’ no longer only appears in the singular. And through the separation of humans and non-humans, Western naturalism has constituted nature as a space, which, on the one hand, is regarded as a technical field of experimentation and seemingly inexhaustible store of resources and, on the other hand, has mainly fallen outside the field of cultural and social sciences.

Sociology has largely followed the standard ontological model outlined above. Nevertheless, there have been some significant contributions in the history of sociology concerning the question of how social relations to nature can be reflected sociologically. One only need to think of Karl Marx (1990; see also Moore, 2015), Ulrich Beck (1992) and Niklas Luhmann (1989). However, most influential theories – such as those of Max Weber, Émile Durkheim, Jürgen Habermas, Pierre Bourdieu or Michel Foucault – have
not placed any particular emphasis on taking a closer look at the mediation of society and nature. They analyze human societies that clearly stand out from the stable background of nature. One outstanding exception is STS, hereby especially the work of Bruno Latour. As it is well known, he advocates the thesis of a modern ‘purifying work’, which led to a strict separation between objects of nature and the world of the social on the level of scientific discourse. In fact, he argues, these worlds are practically closely interwoven (Latour, 1993). According to this view, the separation of nature and society, as it is present in modernity’s self-image, has never taken place in this way. Due to the prevailing way of thinking of the separation of nature and culture, the moderns cannot see how every change in nature also changes the social order; the same applies vice versa. For this reason, Latour has suggested to emphasize those entanglements with the concept of natures/cultures instead of highlighting their separation. This denotes collectives consisting of human actors and non-human (biotic or abiotic) entities. Thus, nature does not exist – defined by universal science – in the singular. Moreover, both human and non-human actors or entities are involved in the construction of these collectives in the sense of a generalized principle of symmetry (see especially Callon, 1984). Neither nature nor society alone can be used as independent variables for explanations. The separation of two areas (nature vs. culture) is then not the starting point of the analysis, but rather the aim is to explain how such separations are produced socially. Especially for the analysis of hybrid entities such as climate change (a quasi-natural phenomenon produced and observed by human technologies), we need research programs which are located at the interface of nature and culture and which overcome disciplinary divisions between natural and cultural sciences.13

We therefore follow John Law and Bruno Latour in their attempt to bring about an ontology of relationality. While constructivism presupposes a stable ‘outside’ nature as a reality that can be viewed from different perspectives, according to a relational ontology realities are enacted and co-produced (Law, 2014). This way there are many natures/cultures as our analysis of different practices of sustainability has shown. In this sense, Western modernity (and not only indigenous societies) is also based on multinaturalism (cf. Danowski and Viveiros de Castro, 2016). At the same time, Western modernity finds it extremely difficult to adequately describe these practices. Modernity is based on the ‘assumption that nature is a single reality separate from culture and that nature is given’ (Law and Lien, 2018: 131). Therefore, while multiple natures practically exist, it is difficult to recognize and acknowledge them. Bruno Latour (2013) has called this operation of veiling ‘double click’ in allusion to the computer mouse: one apparently abstains from mediation, from translation, no longer traces the scientific chains of reference, and takes a shortcut that suggests that there is an unmediated view of the world, in our case of nature as a whole and as an exterior entity. Double-clicking is thus the mode of operation that creates entities such as ‘nature’ as a whole and in the singular. The practical association of human and non-human entities is ignored and the ontological plurality of the world is veiled. The term double-click also implies two things: the doubling of the world through dualistic thinking and the illusion of the world being accessible without mediation or circumstance.

Although nature and society are de facto intimately intertwined, all three practices of sustainability (modernization, transformation, control) can be ideal-typically described as creating certain separations of nature and society. These practices aim at closely
linking the two spheres and at the same time reproduce their separation. They can create an antagonistic counterpart, as in the path of control, where nature appears as a potentially dangerous enemy; a bearer of rights, as in the trajectory of transformation; or in modernization, nature can appear as a dirigible counterpart whose resources have to be sustained for future use. Consequently, the hybridity and multiplicity of the diverse natures/cultures is transferred into a uniform, holistic nature – a nature-whole (Asdal, 2008) – that faces society. This translation process, within which, for example, nature is translated into mathematical variables in climate models in the context of control practices, transforms – or even reduces – the existing complexity and entanglements of the practices.

Conclusions

Practices of sustainability thus show different ontological enactments of nature (dualistic or monistic) on the one hand and differing (explicit or implicit) ethics (anthropocentric or biocentric) on the other. The three reconstructed natures/cultures have different ontological and ethical affinities and conflict with each other. They are linked to very different knowledge cultures and life-worlds, which answer very differently to the question of what is of value in society and nature and how these values ought to be protected. In the field of ecosystem services, ecological and economic assessment practices are being mobilized. The aim is to modernize existing economic practices in the form of a revaluation of natural resources. This approach is anthropocentric and based on the Western nature-society dichotomy. In the path of transformation, affective and ethical ties are mobilized to establish relationships with natural entities. In the case study, this is combined with the attempt to grant natural entities an independent legal status. The logic of law is thus expanded to overcome previous practices of non-sustainability and to initiate a transformation of the relationship between society and nature. The actors of this path abandon anthropocentrism and attempt to overcome subject-object dichotomy both ethically and legally. Natural entities are to be ethically and legally included in societies but simultaneously a nature-whole is created again as a counterpart. Geoengineering is about controlling the earth system in the form of technical interventions to stop global warming. Ontologically it breaks with the subject-object dichotomy, but ethically it follows a strong anthropocentric program.

Despite the differences between the various practices, there is a link between modernization and control practices. Control in the form of geoengineering is considered a necessary measure when modernization is not fast or effective enough. Geoengineering should regulate the climate in such a way that natural capital assets and related ecosystem services can still be provided in the future. Likewise, the conditions for the possibility of ecosystem services should be preserved via geoengineering.

Granting a legal status to nature has a much weaker discursive status in comparison. There are no influential economic or state interests that could drive the project. It is primarily civil society actors who push the agenda forward. Moreover, it breaks with an anthropocentric ethic that is still firmly anchored in the culture of Western modernity. And, as we have seen, it is unclear whether rights of nature are conducive to a change of this anthropocentric ethic, as they may render (as an unintended consequence) the human-nature relationship antagonistic.
Although this was our starting point, nature does not exist as a totality, as it is constantly called upon in contemporary political and public discourses on sustainability (Asdal, 2008). We are not dealing with one nature, but with several nature-wholes. These have in fact only emerged in recent years in the course of the debates on the global ecological crisis (cf. Weingart et al., 2000). Nature-wholes are introduced to the political debates on climate change, biodiversity, etc. Comparing this with the situation some forty years ago, i.e. before the intensive discourse on global warming began, the situation is different now.

Kristin Asdal (2008) has shown that in Norway, nature conservation has always been related to concrete and local concerns. Nature as a whole did not become a thematic issue. ‘Instead, what was made present, real and visible were ‘the rivers on the southern part of the country’, ‘water quality’, ‘surveillance units’ and so on’ (2008: 126). It was only with the debate on acid rain in the 1980s that nature emerged as a relevant large-scale object of political imagination and intervention. It was no longer about this river, but ‘Nature’ was to be the ground(s) for which emissions should decrease’ (2008: 126). The reason for this was that generously-funded research was then able to collect a large amount of data nationwide and aggregate them into overall statements that were then put in relation to economic costs and benefits. A large number of ecologically-oriented actors took up these statements and created a nature-whole via-à-vis the economy. From the perspective of the environmental movements, the focus was now on the confrontation between ecology and nature. The effect was to create a counterpart – ‘a real, visible and obligatory entity’ (2008: 127). The discussion of various sustainability practices in this paper has shown that the discourses on global warming and loss of biodiversity are based on and reinforce these notions of nature-wholes. Since the problems are global in scope, large-scale concepts of nature have been placed in the picture accordingly.

Various actors and their translations produce nature-wholes: in politics, science, environmental movements, economics and law, and by relying on various valuation techniques, measurements, apparatuses, aggregation procedures and technologies. Nature-wholes have now been absorbed into society and are powerful entities that can no longer be ignored. To what extent this renewed dichotomization of society and nature can promote sustainability as a project is still completely open. Nature is these days a political counterpart, something to be protected, valued or regulated. Critics of Western ontological dualism such as Latour (2013) see the revival of such dualism in the form of abridged double-click aggregations as a political problem, that is, that the complex connections between society and nature are not made visible and discussable. Whether or not the creation of multiple nature-wholes actually contributes to perpetuating the status quo of unsustainability is still completely open and beyond the scope of this article. At least it can be said that the futures of sustainability are closely linked to the futures of multiple natures/cultures.

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Notes

1. The Anthropocene is considered to be the new geochronological terrestrial epoch in which humanity has become one of the most important factors influencing biological, geological and atmospheric processes on Earth (see e.g. Steffen et al., 2007, 2011). Dipesh Chakrabarty (2009) points out that today the difference between natural and human history is no longer tenable, but collapsing. Many observers consider the year 1950 to be the beginning of the Anthropocene, since the second half of the 20th century has seen an accelerated emission of greenhouse gases and dramatic increases in energy, water and fertilizer consumption (Zalasiewicz et al., 2015; see also Adloff and Neckel, 2020).

2. In 1997, a famous paper by Robert Costanza, Ralph d’Arge, Rudolf de Groot et al. (1997) was published that estimated the value of ‘nature’ to be US$33 trillion. Needless to say, this estimate, as well as the entire project to determine the overall value of nature, has been criticized. Among other aspects, it was pointed out that the number had political rather than scientific significance (cf. Masood and Garwin, 1998).

3. Of course, this process can also run in the opposite direction if animals are actively ousted from society, for example, if pigeons or rats supposedly disturb the cityscape (see e.g. Brock et al., 2017).

4. Romantic understandings of nature often aim to preserve wilderness. The idea of wilderness worthy of protection only emerged late in history, in the United States for example at the end of the 19th century (think of Henry David Thoreau, for example). Paradoxically, these ideas run the risk of reproducing the dualistic world view (humans vs. nature), which is supposed to be criticized, by imagining true nature as free from human intervention. True wilderness can then only exist without people, so that the idea of nature conservation is directed against human existence, as it were, and completely overlooks the fact that people not only intervene in nature, but are also part of nature (cf. Cronon, 1995).

5. Other examples include personality rights of nature in Bolivia (2007) or court decisions in New Zealand or India in which rivers have been declared legal entities (cf. Fischer-Lescano, 2018). The legal entity and the nature of the entity in question never coincide completely: neither does the legal entity encompass the entire human being nor a natural entity in its entirety. The establishment of legal persons is a legal act, which should not be confused with the ontological statement that something or someone is a person.

6. This would also give new impetus to the old dichotomy of human society and wilderness (Cronon, 1995). It may also be possible to combine the economic valuation of ecosystem services with the approach of rights of nature. Marion Fourcade (2011) has shown for the United States of America (USA), for example, that monetarization of environmental issues can go hand in hand with an understanding of nature as wilderness.

7. In an assessment of the Intergovernmental Panel on Climate Change (IPCC) about mitigation scenarios, Arthur Petersen (2018) notes that especially the option of bioenergy production with carbon dioxide capture and storage (BECCS) has gained increasing importance for climate governance over the last years.

8. Both climate models and geoengineering (GE) models operate with known and unknown factors. However, Jack Stilgoe (2016) points to a significant difference, with his description of GE models as collective experimentation. Even more than with climate models, he argues, GE has so many unknown unknowns that it is a mere negotiation of ‘what is known and unknown’ (2016: 851).
9. See currently for example the International Max Planck Research School on Earth System Modelling (IMPRS-ESM) within the Max Planck Institute for Meteorology (Hamburg) that follows the same structural divisions.

10. Available at: https://static1.squarespace.com/static/5515d9f9e4b04d5c3198b7bb/t/552d37bb4b07a7dd69fcdbb/1429026747046/An+Ecomodernist+Manifesto.pdf

11. The historian Christophe Bonneuil (2015: 23) speaks in this regard of the earth system scientists as ‘scientific shepherds’ who, in the name of humanity, have a ‘good Anthropocene’ in mind. This control optimism of geoengineering is pushed to extremes by the idea of a future in which artificial intelligence takes over command of the earth system (Lovelock, 2019). The Anthropocene then comes to an end and we would enter the ‘Novacene’. However, for those in opposition to geoengineering, all these measures point to a dystopian future, which leaves the control of the world climate to a small technocratic elite and imagines the invasion of battles for geopolitical hegemony up to global war scenarios (cf. Klein, 2015).

12. It should be mentioned here again that our analysis follows the symmetry assumption of Science and Technology Studies (Callon, 1984). It is therefore not our intention to accuse natural scientists of having a ‘wrong’ or even harmful understanding of nature. Just as the social sciences design and enact a special version of society, the natural scientists involved in computer modeling produce certain versions of the natural. Unfortunately, extensive debates on philosophical aspects of climate modeling cannot be taken into account here (see e.g. Lloyd and Winsberg, 2018; Scott, 2018). Our take, admittedly executed in a broad-brush manner, is intended to contribute to an understanding of the translation processes that undertake the transformation of observing natural processes into complex models that finally enter the political field.

13. Not everyone will be convinced that the distinction between nature and culture cannot be the starting point for scientific analysis. But there should at least be a consensus that we have been experiencing the ‘end of nature’ for some years now (think of the above-mentioned discourse on the Anthropocene or the decoding of the human genome) (cf. Castree, 2016).

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Author biographies

Frank Adloff is a professor of sociology at the University of Hamburg and the co-director of the Humanities Centre for Advanced Studies ‘Futures of Sustainability’. His research focuses on social theory, civil society, conviviality, and sustainability. Among his last publications are Gifts of Cooperation, Mauss and Pragmatism (Routledge, 2016), Politik der Gabe (Nautilus, 2018) and Imaginationen von Nachhaltigkeit (Campus, 2020, co-editor).

Iris Hilbrich is a research associate at the Humanities Centre for Advanced Studies ‘Futures of Sustainability’ at the University of Hamburg. Her research interests include sustainability, science and technology studies, postcolonial studies, and participatory research.