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ORIGINAL ARTICLE

How can science support the 2030 Agenda for Sustainable Development? Four tasks to tackle the normative dimension of sustainability

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Abstract
The UN 2030 Agenda for Sustainable Development stresses the fundamental role science should play in implementing the 17 Sustainable Development Goals endorsed by the global community. But how can and should researchers respond to this societal demand on science? We argue that answering this question requires systematic engagement with the fundamental normative dimensions of the 2030 Agenda and those of the scientific community—and with the implications these dimensions have for research and practice. We suggest that the production of knowledge relevant to sustainable development entails analytic engagement with norms and values through four tasks. First, to unravel and critically reflect on the ethical values involved in sustainability, values should increasingly become an empirical and theoretical object of sustainability research. Second, to ensure that research on social–ecological systems is related to sustainability values, researchers should reflect on and spell out what sustainability values guide their research, taking into account possible interdependencies, synergies, and trade-offs. Third, to find common ground on what sustainability means for specific situations, scientists should engage in deliberative learning processes with societal actors, with a view to jointly reflecting on existing development visions and creating new, contextualized ones. Fourth, this implies that researchers and scientific disciplines must clarify their own ethical and epistemic values, as this defines accountability and shapes identification of problems, research questions, and results. We believe that ignoring these tasks, whether one is in favor or critical of the 2030 Agenda, will undermine the credibility and relevance of scientific contributions for sustainable development.

Keywords 2030 Agenda · Sustainability research · Normative dimension · Science–society interactions

Introduction

What does it mean for scientists to contribute to the 2030 Agenda? In 2015, the General Assembly of the United Nations (UN) adopted the Resolution "Transforming our world: the 2030 Agenda for Sustainable Development" (United Nations 2015). The vision presented for "transforming our world for the better" is based on five values (the "5 Ps": People, Planet, Prosperity, Peace, and Partnership) and 17 Sustainable Development Goals (SDGs). It is the result of over two years of intense public engagement with civil society around the world.

The 2030 Agenda stresses the fundamental role that science must play in creating the knowledge needed for realizing this vision of sustainability.[1] Previous international policy documents [e.g., the Brundtland report (WCED 1987)] already stressed the key role of science for sustainable development. But the current call in the 2030 Agenda represents a fundamental shift in the dialogue between science and policy: until recently, the understanding was that scientists analyzed the earth system's processes and dynamics

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[1] The role of science is mainly highlighted in the chapter on means of implementation. It stresses, for example, that the new science-led UN global sustainable development report shall inform the high-level political forum and provide a strong evidence-based instrument for policymakers.

and urged policymakers to come up with responses. The 2030 Agenda assigns a new role to science, responding to a long-term claim from scientists concerned with sustainable development: to generate knowledge that helps humanity achieve the sustainability vision set out in the 17 SDGs. According to the Policy Brief by the Scientific Advisory Board of the UN Secretary-General, "science will be one of the most critical means of implementation for the Agenda 2030", and "science is a driver and enabler of inclusive and people-centered sustainable development" (Scientific Advisory Board 2016).[2]

But how can and should researchers respond to this societal demand on science? What roles should science play in the implementation of the 2030 Agenda? What kind of research is appropriate for implementing the 2030 Agenda? Different actors from science and society tend to answer these questions in different ways. For example, some highlight the potential of more effective collaboration between science and society for operationalizing sustainable development (e.g., Schmalzbauer and Visbeck 2016), while others stress the risks for science of accepting research agendas defined by such highly political processes as the negotiation of the 2030 Agenda (e.g., Strohschneider 2014).

Whatever the risks or potential benefits of engagement, science can hardly afford to ignore the significance of the 2030 Agenda's history and global status. The question is not whether the scientific community will engage with this mandate—be it from a position of support for the 2030 Agenda, or critique, or both—but how. We argue that at the most basic level, engagement with the mandate of the 2030 Agenda—and, indeed, with sustainable development more broadly—necessarily entails a systematic reflection on how to deal with the Agenda's inherently normative nature and the latent assumptions that inform sustainable development (Ziegler and Ott 2011). Two interrelated normative questions or issues need to be tackled by science for sustainable development: first, how is the normative dimension of the 2030 Agenda articulated and what values and norms define the concept of sustainability (Schmieg et al. 2018)? And second, what are the normative assumptions that define what it means to do "good science", and what are appropriate roles for scientists in this regard (Pohl et al. 2010; Ravetz and Funtowicz 2015)? Ignoring these core normative concerns undermines both the credibility and the usefulness of scientific research for sustainable development (Kaiser 2015). Conversely, we argue, a more systematic, purposive, and reflexive engagement with these normative dimensions is a precondition for the production of meaningful knowledge for advancing sustainable development and the 2030 Agenda.

The overall goal of this article is to explore ways in which the practice of research for the 2030 Agenda can be adapted to more adequately account for the normative dimensions of sustainability; and to propose four concrete tasks (see Sect. 3).

These explorations and proposed tasks are founded both on existing literature and the current state of knowledge as well as on a structured reflection on the potentials and limitations of our own empirical research in the fields of sustainable water governance and international sustainability research. Our paper is thus the result of the work of "reflective practitioners" (Schön 1983) of science for sustainable development.

In the following sections, we first introduce theoretical considerations; then we elaborate on what the four practice-oriented tasks imply, and what their application would mean for research contributing to the 2030 Agenda. Each task is illustrated by examples from our own research with respect to theoretical and practical aspects of the task, and we reflect on limitations when tackling an issue from the perspective of one task only. For tasks 1–3, we draw on a case in Switzerland relating to sustainable water governance, and for task 4 on an experience of reflexive interactions between researchers.

Theoretical considerations

In this article, we use the term 'normative' as an umbrella term for all kinds of issues concerning values and value statements. Values are understood as "reference points for evaluating things as good or bad. Values are rationally and emotionally binding and they give long-term orientation and motivation" (Value Isobars 2011, in Kaiser 2015; p. 157). Values can be operationalized through principles, which we define as "normative statements that are meant to guide action" (Kaiser 2015; p. 158). Neither values nor principles, however, prescribe specific actions.

Challenges for researchers dealing with sustainability

It has often been highlighted that sustainability is not only a scientific concept describing and explaining earth system processes and dynamics, but also a fundamentally normative one (e.g., Okereke 2006; Luks and Siebenhuner 2007; Wiesmann and Messerli 2007; Christen and Schmidt 2012). Based on a critique of problematic development trends related to the (over)use, (mis)distribution, and (mis)governance of natural resources, the concept involves values and principles that specify what a more desirable future should

[2] Though they also stress that science should not be reduced to a means of implementation but also include basic research and education.

look like. In other words, it includes ethical values and principles that define what kind of development is considered as problematic ("bad"), and what development pathways are more desirable ("good"). From this perspective, sustainability can be regarded as a normative compass for development.

If researchers want to generate knowledge that is relevant to achieving sustainable development, they need to engage analytically with this normative compass. In other words, the guiding orientation for their research is not just their curiosity—contrary to what is assumed by many advocates of basic research (Stokes 1997)—but also the relevance of this work to sustainability (Kläy et al. 2015). Hence, the selection of research topics and questions, the identification of meaningful categories, indicators, and thresholds, and the interpretation of results all depend not only on the state of the art in certain research fields, but also on sustainability values.

However, using sustainability values as a normative compass comes with important and interrelated challenges for researchers who want to contribute to implementation of the 2030 Agenda. The first challenge relates to the ethical values underlying the 2030 Agenda (see Sect. 2.2.), the second to the epistemological values of doing good science (see Sect. 2.3).

First challenge: the normative and contested character of the 2030 Agenda

The 2030 Agenda represents today's most relevant globally negotiated normative agenda for sustainability. Its ambition is expressed in the 17 SDGs, which include goals such as conserving life on land and below water; combating climate change; and promoting productive employment, quality education, gender equity, clean energy, and sustainable agriculture (United Nations 2015). Their development builds on a history of political negotiation of basic principles such as human rights or intra- and intergenerational justice, with milestones such as the Declaration of Human Rights (1948), the United Nations Conference on the Human–Environment (1972), the Brundtland Report (1987), the Earth Summit in Rio de Janeiro (1992), and Rio + 20 (2012).

While the adoption of the 2030 Agenda can be considered a turning point in defining what sustainability means on a global scale, core elements of sustainability remain hotly contested—not only at the conceptual level (Spaiser et al. 2017; Kothari et al. 2014; Chassagne 2018), but particularly when it comes to agreeing on actions to achieve the desired transformations in specific global, national, or local contexts (Ziegler and Ott 2011; Schneider and Rist 2014). Both at the conceptual level and at the point when sustainability concepts are operationalized on the ground, differing values across society play a central role. The resulting differences in valuations among societal actors, and the higher valuation of some targets over others, are core issues at the heart of the 2030 Agenda. For example, the straightforward question "Does the establishment of a hydropower plant in a Swiss mountain valley advance the 2030 Agenda?" is not easily answered. Proponents argue that hydroelectricity is a renewable source of energy (compared to other sources such as coal and nuclear), and that the hydropower dam contributes to energy security and economic development of the whole country and beyond (SDGs 7 and 8). Moreover, the dam enables storage of water for the valley's domestic and agricultural uses in dry periods (SDGs 2 and 6). However, other actors stress the need to preserve the pristine character of the river, landscape, and related ecosystems, particularly since this particular river is the last free-flowing stream in the area (SDG 15). The relative importance of each of the values varies greatly across society, with little consensus on which values should be privileged over others.

Thus, to use the 2030 Agenda as a normative compass for development, important issues need to be clarified, particularly with regard to differing social values and the relative importance of SDG targets where trade-offs occur.

Second challenge: normativity in science

The second challenge relates to the following question: how can the research community engage with the 2030 Agenda as a normative compass for research, given the long-established predominance of the understanding that science should separate facts from values—one of the most important foundations and epistemological ideals of modern science (Potthast 2015)? This ideal states that science is responsible for the production of facts to inform decision making, while politics is understood as the realm within which competing values and knowledge claims are negotiated (Pielke 2007). The ideal of value-free science was stressed particularly by the sociologist (1864–1920), who argued that researchers should play a neutral role in service for society and maintain an equidistance to normative issues (Winckelmann 1985).

One of the foundations for this claim is the is–ought divide highlighted by David Hume (1711–1776) in the age of the Enlightenment. Hume (1739) asserted that what is normative—or "what ought to be"—cannot be derived alone from "what currently is": rather, what ought to be is related to personal and societal values and preferences. In the present case of the 2030 Agenda, the SDG 2 "zero hunger" is a value position, stating that nobody should suffer from hunger. It cannot be derived directly from an empirical analysis investigating the current situation of hungry people. Consequently, many natural and social scientists tend to consider the production of scientific knowledge as objective and value-free, and for that reason they avoid explicit normative ethical statements in their research.

However, scholars in science studies, philosophy, and social sciences in general have extensively discussed the appropriateness of the fact–value split in science (e.g., Churchman 1979; Davydova and Sharrock 2003; Fleck 1979; Putnam 2002; Ravetz and Funtowicz 2015; Ziegler and Ott 2011). They have argued that in practice, the distinction between facts and values is very difficult to make and often fuzzy. As put by Kaiser (2015; p. 153), "even when something looks like a fact, if one looks closer one discovers a sea of uncertainty and different weightings around it". Investigating scientific knowledge production processes, scholars such as Fleck [1979 (first published in 1935)], Kuhn (1979), and Berger and Luckmann (2004) demonstrated that scientific facts are socially constructed by specific groups of researchers ("thought styles" in Fleck's terminology) and culturally embedded in the values and belief systems of their times. Indeed, as shown by Wuelser (2014), many sustainability researchers who intend to clearly separate their research from values nonetheless tend to make a number of implicit value judgments that are necessary for framing their project and interpreting their results.

Reflecting on these insights, new approaches to science have been developed, such as action research (Bradbury 2015), Mode 2 knowledge production (Nowotny et al. 2001), transdisciplinary research (Hirsch Hadorn et al. 2006), and post-normal science (Ravetz and Funtowicz 2015). Arguing that science is never value-free, these scholars often make a distinction between ethical and epistemological values involved in science. The influence of epistemological values—values that define what it means to do good science—is generally less contested. Values such as curiosity, honesty, humility with regard to what one can consider evidence, and skepticism belong to the most broadly accepted epistemological values among scientists. Hence, attributing the term "scientific" to an issue is a value-based judgement in itself, founded on a specific set of epistemological values (Kaiser 2015).

Moreover, while there are good arguments for separating ethical from epistemic considerations, such a separation also runs the risk of making science lose its relevance to society's needs and interests, and may even result in overtly negative social outcomes (e.g., Mittelstraß 2015; Wuelser 2014). Kaiser (2015) has pointed out that when modern science came into being, there was an obvious need for a de-ideologization of knowledge, due to what was widely seen as an unhealthy and counterproductive contestation over "final truths" stemming from entrenched and often overtly political or religious ideologies. Today, the idea of value-free science has become so dominant that its protagonists tend to overlook the values that effectively shape science, such as competition and market orientation (Kläy et al. 2015). Considering the tremendous challenges resulting from unsustainable development, we see a new need for a counterweight in terms of social responsibility (Kaiser 2015).

We therefore believe that research in the field of sustainability cannot completely outsource questions about ethical values to the realm of politics. Rather than trying to (unsuccessfully) outsource these questions, science must find a way of addressing them and incorporating them in a systematic and reflexive way (Ison 2008; Kläy et al. 2015; and Miller et al. 2008; Mitchell et al. 2015; Ziegler and Ott 2011). Although some researchers have already argued, often persuasively, for such a reorientation in science (Grunwald 2015; Kläy et al. 2015; Miller et al. 2014; Popa et al. 2015; Schmieg et al. 2018; Wiesmann and Messerli 2007), debate within the sustainability science community has been very limited, leading to misunderstandings with regard to the relation between facts and values, the relation between objectivity and subjectivity, and the roles these aspects play in the practice of scientific enquiry.

To deal with value questions in sustainability science in a more appropriate way, we found Potthast (2015) concept of "epistemic-moral hybrids" particularly helpful. Epistemic-moral hybrids are defined as "historically contingent specific blends of scientific practices and normative agendas" (Potthast 2015; p. 143). Potthast stresses that although factual and ethical issues are often merged (particularly in contested situations), they nevertheless belong to two different realms. With this position, he occupies a middle ground between those scholars defending a strict separation between ethical and epistemic issues, and those denying that it is possible to separate them. He argues that "acknowledging the presence of moral issues also within 'the world of facts' will make them communicable—and open to deliberation" (Potthast 2015; p. 130).

Four tasks to incorporate the normative dimension of sustainability into research

The challenges described in the previous section are not easy to tackle by research for sustainable development. We argue for a practice-oriented approach and propose that the community of sustainability scientists as a whole engage with four partly iterative, cumulative tasks:

- First, to unravel and critically reflect on the ethical values involved in sustainability, values should increasingly become an empirical and theoretical object of sustainability research.
- Second, to ensure that research on social–ecological systems is related to sustainability values, researchers should reflect on and spell out what sustainability values guide their research, taking into account possible interdependencies, synergies, and trade-offs.

Table 1 Overview of the four levels at which the normative dimension of sustainability can be incorporated into research

Tasks	Examples	Relation between values and research	Main methodological approaches
Unraveling and reflecting on the ethical values involved in sustainability	Values and valuations of different stakeholders Values underlying sustainability discourses Power issues Philosophical foundations	Values are the empirical and theoretical object of research	Methods developed in the social and political sciences and the humanities
Spelling out what sustainability values guide research	Values described in the scientific literature Values defined by 'legitimate' societal actors Values of different stakeholder groups	Values are the reference point	Disciplinary and interdisciplinary research addressing sustainability
Finding common ground on what sustainability means in specific contexts	Participatory problem framing Participatory vision development	Values are deliberated	Transdisciplinary research and social learning with societal actors; deliberation and co-production of knowledge
Reflexive clarification of researchers' own normative and epistemological ground	Individual and disciplinary values and understandings of knowing	Own values are the subject of reflection, offering an orientation	Self-reflection and social learning within and beyond academia; ethics of science

- Third, to find common ground on what sustainability means for specific situations, scientists should engage in deliberative learning processes with societal actors, with a view to jointly reflecting on existing development visions and creating new, contextualized ones.
- Fourth, this implies that researchers and scientific disciplines must clarify their own ethical and epistemic values, as this defines accountability and shapes identification of problems, research questions, and results.

Each task proposes a different approach to dealing with the epistemic-moral hybrid character of sustainability. While a particular research project may fruitfully focus on one or two tasks only, we consider task four to be indispensable for all researchers engaged in sustainable development.

Table 1 provides an overview of the four tasks, what they might imply, the significance that values have for a research activity, and main approaches to tackling them.

First task: unraveling and clarifying the ethical values involved in sustainability

Our first proposed task consists of disentangling and clarifying the ethical values involved in sustainability. Understanding sustainability as an epistemic-moral hybrid requires us to disentangle the ethical and epistemic dimensions of the concept. As convincingly argued by Miller et al. (2014; p. 241), unless values underlying the idea of sustainable development are understood and articulated, "the unavoidable political dimension of sustainability will remain hidden behind scientific assertions, thus preventing necessary democratic deliberation and convergence on more sustainable pathways". This also implies the need to analyze different actors' distinct sustainability values (Schneider 2015; Piso et al. 2016) and the power relations involved in negotiating sustainability agendas (Rist et al. 2006, Stirling 2012). Scientists can contribute to this task by making values an explicit empirical and theoretical object of sustainability research.

So far, the literature contains few inquiries into sustainability values, compared to the wealth of research on social–ecological systems dynamics. Therefore, from our perspective, mapping, inquiring into, and explaining ethical values and principles of sustainable development—as well as of stakeholders' normative assumptions, worldviews and power relations—should be a key object of future sustainability research (Christen and Schmidt, 2012; Kläy et al. 2015; Miller et al. 2014; Schmieg et al. 2018; Ziegler and Ott 2011). Strengthening the analysis of values means, in particular, a better integration of the disciplinary perspectives of the social sciences and humanities into sustainability sciences. These disciplines have a long tradition of analyzing values as a theoretical and empirical object of research (Brosch and Sander 2015; Kaiser 2015; Meisch et al. 2015).

Implications for the 2030 Agenda

To better understand and critically reflect on the 2030 Agenda's normative dimensions is key not only to further substantiating and contextualizing it, but also to critically examining it, to develop a reflexive position towards its normative

demands and often latent commitments. Research might include, but is not limited to, the following areas:

Critical analysis of the global 2030 Agenda itself The 2030 Agenda represents a promising, globally negotiated, universal vision of sustainability. But it also needs critical exploration, particularly regarding the power dynamics involved in its development and the values and perspectives that were included or excluded in that process. For example, some countries criticize the Western character of the 2030 Agenda and propose alternative approaches to development altogether, such as the "buen vivir" concept in Bolivia (Chassagne 2018) and "swaraj" in India (Kothari et al. 2014). Hence, there is a need for analysis of the various assumptions and normative commitments to procedural and distributive justice latent in the Agenda's formulation, and of their practical and material implications for global transformation towards sustainability. Key questions about whose voices were influential in the formulation of the 2030 Agenda, whose perspectives were taken into account, and who stands to win or to lose are as urgent as they are complex.

Investigation of sustainability values in different contexts As implementation of the 2030 Agenda is mainly done in specific contexts (regions, nations, states, towns, municipalities, etc.), research can contribute to the contextualization of the globally formulated 2030 Agenda by unraveling the meaning attributed to goals and targets and the priorities they are given by different people from different sectors, at different scales, and from different parts of the world.

Exploration of the 2030 Agenda's vision in the context of competing discourses The 2030 Agenda as a political agenda competes with other discourses globally, such as climate change denial, "America first" and similar far-right movements recently seen in Europe, and neoliberal economic paradigms of growth. Investigation of these broader debates, underlying value assumptions, and their relation to the concept of sustainability is crucial to implementing the 2030 Agenda.

Example and limitations

Schneider (2015) aimed to operationalize the sustainability concept for water governance in Switzerland. Based on 75 qualitative interviews, she investigated sustainability discourses of different local actors involved. This process enabled her to distinguish eight water-related sustainability values important to local actors. Some of these values referred to the physical availability of water (e.g., water as a habitat for plants and wildlife, or as a source of well-being, recreation, and economic benefits); others referred to governance practices (e.g., equity, limited costs); and yet others referred to inherent meanings (e.g., cultural identity, responsible use). But, the research also showed that these values often conflict with each other and that different actors prioritize them differently. For example, while some emphasized the preservation of aquatic habitats, others prioritized water extraction for hydropower production and economic purposes. It also became evident that in many cases, there are trade-offs between sustainability values such that improvement along one value dimension led to a reduction along another.

The example demonstrates that the identification and mapping of actors' sustainability values provides an important starting point when contextualizing the universal sustainability concept. Given the many trade-offs involved, however, defining what a more sustainable water future would look like in this specific case means linking these values to knowledge on social–ecological systems relations and institutions shaping sustainability issues (see task 2).

Second task: spelling out what sustainability values guide research

Accepting that sustainability is an epistemic-moral hybrid implies that natural and social scientists investigating social–ecological systems and human–nature interactions need to carefully engage with value questions. We argue that making explicit what sustainability values underlie one's research is an important task to assure an appropriate relation between research and values.

The significance of the issue is most evident when studies use sustainability as an explicit reference point, such as sustainability assessments (Binder, et al. 2010; Gibson 2006; Rametsteiner et al. 2011; Wiek and Larson 2012). In sustainability assessments, the status or development of certain systems is assessed and monitored using indicators and thresholds. If research projects choose indicators and thresholds without carefully relating them to specific sustainability values, they run the risk of "producing results that may be useless, miss the views and priorities of affected people, or even promote unsustainable propositions in the problem context" (Wuelser 2014; p. 264).

Tackling these normative questions in a systematic way is also important for researchers who refer to sustainability in a more general way (e.g., research on renewable energy production, soil protection, or water quality). In these cases, reflection about applicable sustainability values is necessary to identify the priority research areas, relevant knowledge gaps (as not all scientific knowledge gaps are also relevant to sustainable development), and research questions, and to draw appropriate conclusions.

However, how can scientists decide what sustainability values should guide their research, taking into account that sustainability values might be highly contested among different actor groups? The disciplinary and interdisciplinary scientific literature contains different options for selecting

appropriate sustainability values and related understandings. For example, some researchers outline reference frameworks for their sustainability studies by systematically reflecting on sustainability principles presented in the scientific literature (e.g., Wiek and Larson 2012); others refer to sustainability definitions generated by societal actors they perceive as legitimate for the relevant scale, for example, the sustainability strategies of national governments (Scheuchzer et al. 2012); and a third group of researchers highlights the importance of not privileging one sustainability definition over another, but calculating scenarios by considering different stakeholders' sustainability values (e.g., Reynard et al. 2014).

Implications for the 2030 Agenda

Using the 2030 Agenda as a reference point for research is not a trivial undertaking. We therefore suggest research activities at different levels:

Relating research on social–ecological systems to the 2030 Agenda As mentioned above, the 2030 Agenda is one of the most important global agendas for sustainable development. Endorsed by the United Nations, it may be considered a legitimate normative framework to guide research on social–ecological systems. Therefore, at its most basic level, researchers wanting to contribute to implementation of the Agenda should reflect on, and spell out, what SDGs they address in their research, but also where there might be possible synergies and trade-offs with other SDGs.

Specification and indicator development As the 2030 Agenda was developed through a largely political rather than a scientific process, the goals and targets—as well as the specific indicators developed to assess progress against these goals and targets—are formulated in a limited and somewhat inconsistent way (Schmalzbauer and Visbeck 2016). Most useful indices are still not measurable; consequently, neither scientists nor national statistical offices can apply them (Meyer et al. 2018). In addition to marshaling data collection and analytic efforts to respond to global indicators, we suggest that a key contribution of the research community would be to identify further indicators that are more rigorous and robust, and allow for more nuanced monitoring of progress towards achievement of the 2030 Agenda. However, to ensure that these indicators really represent the ethical values underlying the 2030 Agenda, these values first need to be unraveled and their mutual relations clarified (see task 1).

Interlinkages, synergies, and trade-offs Pursuing multiple goals as formulated in the 2030 Agenda in a world increasingly connected across sectors, places, scales, and time leads to both multiple trade-offs and multiple co-benefits. Hence, there is a special need to comparatively assess the complex interactions between the SDGs at the social–ecological system level, and to investigate how these interactions might contribute to, or impede, implementation of the holistic idea of the 2030 Agenda. Such an analysis includes interrogation not only of possible synergies between various SDGs but also, and perhaps especially, of the likely trade-offs that will occur between different SDGs and related processes (ICSU 2017). Moreover, as the Agenda 2030 moves forward in practice, there is a critical need for systematic assessment of who benefits and who loses.

Example and limitations

Reynard et al. (2014) aimed at assessing the water sustainability of an Alpine region in Switzerland by considering interlinkages, synergies, and trade-offs between different sustainability visions. For this purpose, they used three different normative future scenarios that represented different actors' sustainability values. Each of the three scenarios prioritized different sets of values. The first scenario highlighted economic growth and its positive impacts for employment and income generation (SDG 8); the second focused, in particular, on optimizing water consumption (SDG 12); and the third stressed preservation of the ecosystems (SDG 14 and 15) and equality (SDG 10) (for more detail see also Schneider and Rist 2014). For each of the three scenarios, the researchers calculated implications on water availability and needs of different sectors (agriculture, household, hydropower, artificial snow production, golf course irrigation).

However, while this research provided interesting insights into interlinkages between sustainability goals and their respective impacts on the water system, the societal actors involved in water governance of the concerned region were not satisfied with the results, as they felt that none of the scenarios represented their own localized understanding of sustainability (Schneider and Rist 2014). Consequently, they asked the researchers to conduct a further sustainability assessment based on their own set of sustainability values. So far, the researchers have only been able to demonstrate the impacts of different scenarios by highlighting different sustainability values, but they have not succeeded in defining what could be a more sustainable water system in this region.

From this experience, we conclude that an informed decision process and the definition of what sustainability would mean in a specific context requires relating sustainability assessments to sustainability values shared by the actors involved (task 3).

Third task: finding common ground on what sustainability means in specific contexts

Finding common ground for what sustainability means in specific contexts is an important prerequisite for initiating

transformations that can lead to sustainability, as well as for creating a coherent normative reference for further research and action. For science, this means engaging with the values, perceptions, experiences, and sustainability needs of various societal actors—including those who are marginalized—and contributing to policy processes.

Some scientists argue that development of sustainability visions is not their task (e.g., Strohschneider 2014). But taking into account that defining sustainability involves both normative and analytic work (Potthast 2015; Rametsteiner et al. 2011), it is clear that scientists have much to contribute by participating in the elaboration of sustainability visions: They can act as honest brokers (Pielke 2007), enriching the dialogue through analytic knowledge that provides insights into the causes and consequences of certain interventions, and interlinkages, trade-offs, and synergies between specific sustainability goals. Scientists can investigate and make explicit the sustainability values of different actors (including the more silent actors), enabling them to further deliberate over these values, for example, in action research (Miller et al. 2014). They can also bring in openness, reflexivity, critical questioning, and thoroughness in appraising contributions inherent in "scientific thinking" more broadly. Moreover, they can act as facilitators of such dialogues, building on their reputation for honesty (Pohl et al. 2010).

Hence, disciplinary and interdisciplinary research must be complemented with collaborative approaches oriented towards mutual learning, deliberation, and co-production of knowledge and values together with the societal actors concerned by possible decisions based on new knowledge (Schneider and Rist 2014; Wiesmann and Messerli 2007).

However, when opening up knowledge production to different societal actors' perspectives and values, sensitivity to power issues is required (Lawhon and Murphy 2012). Structural power imbalances remain a real obstacle to inclusive and fair forms of knowledge co-production (Adger 2003, Ingalls and Stedman 2016). Knowledge, the distribution of knowledge, and the ability to negotiate in the face of diverging and competing knowledge claims, are unevenly distributed across society (Foucault 1984, Flynn 2007). To tackle this challenge, we should rely on the suggestion made by Habermas that there is a need to allow actors to shift from strategic action guided by individual interests to more communicative action shaped by mutual understanding (for more details about Habermas' modes of communication, see Rist et al. 2006).

Implications for the 2030 Agenda

To find common ground on the meaning of the 2030 Agenda on the global scale, as well as on local and national scales, we suggest three areas of work.

Contribution to further development of the 2030 Agenda at international level Negotiation of the 2030 Agenda was an intergovernmental process that included stakeholders in a systematic way. The scientific community was one stakeholder in these negotiations, but it did not fully utilize this important opportunity to support the process with state-of-the art scientific knowledge (Zondervan 2017). While the negotiation process for the 2030 Agenda has been completed, the annual High-Level Political Forum meetings on the SDGs, as well as other UN meetings about sustainable development, are further key opportunities to engage in this dialogue and bring in scientific knowledge and thinking.

Contextualization of the global 2030 Agenda in national and local contexts Researchers can contribute to translating the 2030 Agenda and the SDGs to specific contexts by engaging in debates (such as official dialogue processes organized by governments or civil society organizations), policy development, or advocacy. For example, they can help to identify what SDGs are relevant with regard to local challenges and what priorities for action might exist, considering current insights into social–ecological system dynamics (SDSN Australia/Pacific, 2017). Researchers can also point out when the state-centric modality of operationalizing the 2030 Agenda runs the risk of reproducing historic inequalities and further marginalizing under-represented actor groups.

Involvement of societal actors in research projects While it is important for researchers to participate in societal deliberation processes related to the 2030 Agenda, it is just as important to increasingly involve societal actors outside the academy in collaborative research projects. Systematic engagement with societal actors is essential to consider the plurality of societal value perspectives and to inform the kind of science that is needed to address the complex and pressing challenges that are at the heart of the 2030 Agenda. For example, societal actors can be involved in jointly assessing what sustainability challenges are most relevant and require further scientific inquiry (Wuelser 2014), or in connecting scientific research with sustainability values held by local actors in different sectors. They can also help co-develop novel sustainability visions for specific regions or sectors that contextualize the 2030 Agenda (Schneider and Rist 2014).

Example and limitations

Schneider and Rist (2014) aimed to contribute to a shared understanding of sustainability regarding water issues. For this purpose, they developed and evaluated a method for envisioning sustainable water futures based on deliberative learning among various water stakeholders with distinct and even conflicting sustainability values. The approach combined normative, explorative, and participatory scenario

elements. Applying the approach confirmed its high potential for establishing a meaningful and deliberative dialogue between all actors involved, and for enabling the generation of a joint vision for sustainable water governance.

However, some scientists involved felt that the vision thus developed did not fully represent their own understanding of sustainability, and they conducted a separate sustainability assessment based on their own set of sustainability indicators (the results are presented in Schneider and Rist 2014). By identifying suitable indicators and thresholds, they realized that they themselves had quite different views of what are relevant sustainability values (e.g., based on liberal or socialist understandings of equality), what can be considered as sustainable thresholds, how scientists could deal with value issues, and what role they could play in the science–society interface.

We conclude from these experiences that it is essential for researchers who work in the contested field of sustainable development to systematically reflect on their own normative assumptions (task 4).

Fourth task: reflexive clarification of researchers' own normative and epistemological ground

As argued in Sect. 2, the boundaries between facts and values are often blurred. Many concepts used in the field of sustainability science are epistemic-moral hybrids in Potthast's (2015) sense (e.g., biodiversity conservation, water protection, sufficiency, poverty eradication). Consequently, the very selection of a research field can be regarded as a normative decision. But as we have shown, many other normative decisions are involved when conducting research, for example, when scientists select indicators (what is included or excluded?) or define thresholds (what levels do we assume are sustainable?). But normative decisions are also involved when scientists decide whether a method can be considered scientific (Kaiser 2015), or consider what role is the right one for scientists in specific science–society interactions (Pohl et al. 2010).

Moreover, besides having discipline-based epistemological and ontological preferences, researchers, like other societal actors, hold ethical values about the world's development. All these values provide the lenses through which they see the world, "what we as researchers notice, what is hidden, what is chosen for inclusion within the boundaries of analysis, and how we as researchers respond to what we experience" (Mitchell et al. 2015).

Hence, we argue that scientists must adopt a self-reflexive approach (Popa et al. 2015; Van Mierlo et al. 2010) to deal with these multiple value decisions in a responsible way—and to avoid the risk of being instrumentalized by dominant actors or to blindly execute power without realizing it. They need to become aware of their implicit preferences, values, and epistemological assumptions, and of the impact of these values on their research practices (Mitchell et al. 2015; Ott and Kiteme 2016). This reflection should be part of various scholarly activities, including university teaching and project work (Herweg et al. 2017). Ziegler and Ott (2011) even suggest that large sustainability projects should include ethicists for thorough theoretical articulation of these questions and stimulation of deep questions.

Implications for the 2030 Agenda

Adopting a self-reflexive approach to value decisions involved in research activities related to the 2030 Agenda concerns different levels:

Clarification of own value assumptions Making values explicit and transparent is an important issue for all researchers, but particularly for those who work on the implementation of the value-laden 2030 Agenda (Kläy and Schneider 2015). It implies being aware of and self-reflexive about what values are important to oneself, how these values relate to the 2030 Agenda, and how they influence our own research practices. Even the identification of research priorities requires such reflection: against the background of limited research funds, should research focus on renewable energy production in the global North, or poverty eradication in the global South?

Reflexive debates within and between disciplines and research fields Disciplines have quite distinct assumptions about how to deal with value questions in research, what values should guide scientific knowledge production, and how science and society should interact (e.g., value-free/value-conscious, constructivist/positivist, empiric/hermeneutic, qualitative/quantitative, knowledge transfer/co-production of knowledge). Such differences should not be leveled out, as diversity in research is essential. When aiming to contribute to implementation of the 2030 Agenda, each discipline must systematically reflect on how they can and want to deal with the Agenda's normative dimension. Moreover, we believe that reflexive interactions within and between disciplines are necessary for productive thinking about how the current dominant paradigm of the fact–value split can be addressed in a more nuanced way.

Reflexive interactions between science and society Further, there is a critical need to explore these questions with a broader set of societal actors, as the latter also have variously shared and differentiated normative assumptions about what good science is and how it can contribute to sustainable development (Popa et al. 2015).

Example and limitations

Kläy et al. (2015) proposed an approach for reflexive interactions between different disciplines to address

epistemological and ethical issues relevant to research for sustainable development. The team operationalized the methodology at a workshop of the international conference on transformations towards sustainability, "Transformations 2017". The workshop aimed at reflecting on and deliberating over different researchers' understandings of science for sustainable development. The workshop fueled many interesting discussions. For example, there was a vivid and controversial discussion about the participants' ideas on value issues: some researchers formulated a clear normative objective, which they aimed to support with their research (e.g., biodiversity protection or poverty eradication). Others stressed the need to generate evidence for policymaking, but without pursuing a specific interest. Yet another group highlighted the value of basic science not directly concerned with societal relevance at all.

The opportunity to systematically reflect on their own underlying assumptions was considered useful by some of the participants. They appreciated the opportunity to increase their consciousness of values and the implications of these values on their scientific practices. Others found it more difficult to engage in the self-reflection process and were reluctant to expose and position themselves with their own values. Instead, they theorized about value questions from the perspective of "distant observers". We conclude from this experience that self-reflective processes on own value assumptions should ideally already be part of academic curricula, to enhance scientists' awareness and capabilities for the issues involved (Herweg et al. 2017).

Concluding remarks

The 2030 Agenda, along with its 5 Ps and 17 SDGs, sets out an aspirational vision for the future sustainability of our planet. It represents a critical shift in the orientation of policy toward science, providing a socially and politically negotiated mandate for the scientific community to contribute to the achievement of the SDGs. We have argued that critical interrogation of how science can deal with the inherent normative questions involved is fundamental to responding to this mandate. We propose that the scientific community willing to take on Agenda 2030 as a normative compass should address four tasks defined specifically to incorporate the normative dimension of sustainability into research in a more reflexive way.

The first task consists of unraveling and critically reflecting on the ethical values involved in different understandings of sustainability in general, and the 2030 Agenda in particular. Indeed, making explicit what values are included and which ones are excluded, will open these values to deliberation, identify blind spots, and ultimately sharpen the overall relevance of the 2030 Agenda as a normative compass for development. The second task requires spelling out what sustainability values guide specific research activities. Not only does this increase transparency regarding underlying values of research activities, it also ensures that the generated knowledge is truly relevant to sustainability frameworks such as the SDGs. In addition, the task helps scrutinize the impact of implementation of the SDGs on social–ecological system dynamics. The third task consists of finding common ground on what sustainability and implementation of the 2030 Agenda means in specific contexts. Scientists should engage in deliberative learning processes with societal actors, with a view to jointly reflecting on existing development visions and creating new, contextualized ones. Researchers' contributions can include providing knowledge on relevant SDGs, trade-offs, and synergies; critical questioning of who might win and who might lose as a result; as well as overall reflective capacity and rigor in thinking about the dynamics and complexity of issues involved. The fourth task requires that researchers and scientific disciplines must clarify their own ethical and epistemic values, as this defines accountability and shapes identification of problems, research questions, and results.

Such a systematic exploration of values is necessary for providing the research quality needed not only to achieve the 2030 Agenda in general, but also to leverage the strength of this global development agenda for deconstructing the structural inequalities that continue to undermine the potential for a more sustainable and equitable future. It is becoming increasingly clear that while there are important potentials for synergies between the various SDGs, there are also a number of important and unavoidable trade-offs, and the costs and benefits of these trade-offs will not be evenly distributed across society. How trade-off decisions are made, how costs and benefits are distributed within society, and who the winners and losers will be, are questions with moral and ethical implications. By providing knowledge that will be used to argue for or against a position, researchers are inevitably involved in these implications.

In short, we argue that disciplinary, interdisciplinary, and transdisciplinary research approaches are equally important for generating the knowledge needed to implement the 2030 Agenda, and that all researchers aiming to contribute to more sustainable development must more systematically reflect on how they can deal with the normative dimension of the endeavor. Reflections on one's own normative assumptions and roles as researchers are particularly important. To support this more actively, we also suggest integrating reflections on the normative dimension of sustainability more systematically in university education (e.g., graduate schools) and making such reflections part of existing exchanges among researchers from different disciplines (e.g., at conferences and faculty meetings).

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