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Abstract. While economists have been contributing to the discussion of various aspects of sustainability for decades, it is just recently that the term “sustainability economics” was used explicitly in the ecological, environmental, and resource economics community. Yet, the contributions that use the term “sustainability economics” do not refer to any explicit definition of the term, and are not obviously joined by common or unifying characteristics, such as subject focus, methodology, or institutional background. The question thus arises: What is “sustainability economics”? In this essay, we make an attempt at systematically defining and delineating what “sustainability economics” could be in terms of its normative foundation, aims, subject matter, ontology, epistemology, and genuine research agenda.

Keywords: economics, efficiency, epistemology, fairness, future, justice, human-nature-relationship, ontology, philosophy of science, sustainability, uncertainty

JEL-Classification: Q0, D63, B0

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1. Introduction

With climate change, biodiversity loss, a global water crisis, and many other manifestations of global environmental change becoming more and more apparent, there is a widespread and increasing feeling among both economists and society at large that economics should address issues of *sustainability*. Sustainability is a normative notion about the way how humans should act towards nature, and how they are responsible towards one another and future generations.¹ While there are some contributions of economists to the discussion of specific aspects of sustainability, so far neither a unifying idea (notion, concept) nor concrete structures (scientific community, institutions, curricula, conferences, etc.) of something like *sustainability economics* do exist – at least not to any significant extent.^{2, 3}

Interpreting the existing economic contributions in view of the overall idea of sustainability, we argue that the emerging field of sustainability economics can be defined by four core attributes:

1. Subject focus on the relationship between humans and nature.
2. Orientation towards the long-term and inherently uncertain future.
3. Normative foundation in the idea of justice, between humans of current and future generations as well as between humans and nature.
4. Concern for economic efficiency, understood as non-wastefulness, in the allocation of natural goods and services as well as their human-made substitutes and complements.

In this essay, we take this preliminary definition as a starting point for a systematic discussion of the question: “What is sustainability economics?” In particular, we develop a concrete and operational notion of sustainability economics from the above four core attributes, which are largely normative in nature, and the societal need and demand for something like sustainability economics. That is, we propose a normatively rooted vision of what sustainability economics *should* be, rather than giving a descriptive survey of the contributions that *do actually* already exist.⁴ In particular, we discuss the aims, subject matter, ontology, epistemology, and genuine research agenda of sustainability economics.

¹ The need for inter- and transdisciplinary scientific research on sustainability, and the specific characteristics of such research that follow from the particular subject focus, is acknowledged by the recent formation of so-called *sustainability science* (Kates et al. 2001, Clark and Dickson 2003, Clark 2007).

² For instance, there is no entry on „sustainability economics“ in wikipedia (as of March 24, 2009); Google yields only 15,700 hits for “sustainability economics”, as compared to 3,184,000 hits for “environmental economics”, “resource economics”, or “environmental and resource economics”, and 1,520,000 hits for “ecological economics” (as of March 24, 2009).

³ The term “sustainability economics” has been used just recently by Söderbaum (2007, 2008) and Ayres (2008), and a little earlier in German by Manstetten and Faber (1999). The German Federal Ministry of Education and Research currently makes an ambitious attempt at developing something like “sustainability economics” (and calling it explicitly by that term) within a major research program on “Economics for Sustainability” (www.wi-n.org/en/index.php). Yet, all these uses of the term seem to be ad-hoc and isolated.

⁴ See, for example, Pezzey and Toman (2002) for a collection of influential contributions to “The Economics of Sustainability”, and Illge und Schwarze (2009) for an empirical analysis of the opinions held by economists about “sustainability” and “economics”.

2. Normative foundation of sustainability economics

Terminologically, “sustainability economics” derives from the combination of the two terms “sustainability” and “economics”. We therefore ask, what are the normative foundations of these two?

Sustainability

The vision of sustainability aims at *justice* in the domain of human-nature-relationships and in view of the long-term and inherently uncertain future. This includes three specific relationships (Becker 2009: 23ff.): (i) justice between humans of different generations (“intergenerational” justice), (ii) justice between different humans of the present generation (“intragenerational” justice), and (iii) justice between humans and nature (“physiocentric ethics”).

Aspects (i) and (ii), for instance, are expressed in the widely accepted definition given by the Brundtland-Commission (WCED 1987: 43):

“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of ‘needs’, in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment’s ability to meet present and future needs.”

While (i) and (ii) reflect an anthropocentric idea of justice and, hence, sustainability, according to which nature matters for humans exclusively for its instrumental value in satisfying human needs, sustainability is often taken to also include aspect (iii), i.e. the idea of justice towards nature for its intrinsic value (Sober 1986, DesJardins 2005).⁵ This interpretation of sustainability implies nature conservation for its own sake (Norton 1987, 2005).

In the context of sustainability, the abstract and general idea of “justice” needs to be specified. Using, for example, the classification of different conceptions of justice given by Dobson (1998: Chap. 3) one would need to specify the community (dispensers, recipients), the basic structure, the objects, and the basic principle of justice. In particular, this specification needs to be with regard to the long-term and inherently uncertain future. For example, one could specify the notion of “justice” underlying the normative vision of sustainability as basic-needs-oriented distributive justice among humans concerning ecosystem services over the next few hundred years. Alternatively, one could adopt a notion of procedural, say discursive, justice concerning the design of institutions governing access to, and use of, ecosystem services.

While the vision of sustainability fundamentally aims at justice, it does so in the particular domain of human-nature-relationships and in view of the long-term and inherently uncertain future. Therefore, one needs to be aware that besides sustainability there exist other legitimate societal goals, including goals of justice in other specific areas of human life, e.g. labor or education.

⁵ While many economic contributions use a purely anthropocentric notion of sustainability (aspects i and ii), the view that non-human beings have rights in their own (aspect iii) is widely accepted by the general public. The protection of basic animal rights is anchored, for example, in the German Constitution.

Economics

While *justice* is the normative foundation of sustainability, (modern) economics is aimed at the normative goal of an ever better *satisfaction of human needs and wants*. Over and beyond the basic human needs, this explicitly includes the subjective desires and preferences (“wants”) that individuals hold. It also includes present and future generations of humans.

The normative goal of satisfaction of individual needs and wants can be rooted in the modern political philosophy of liberalism, according to which individuals are free to pursue their own happiness as long as, and insofar as, they do not infringe on the same liberty of others. The goal of satisfaction of individual human needs and wants has been operationalized through different criteria, starting with classical utilitarianism (as proposed by Jeremy Bentham, James Mill and John Stuart Mill), which holds that the sum of utilities of all individuals should be maximized. Later, welfarism and Pareto-efficiency have evolved in the very same liberal spirit.⁶

With the satisfaction of the needs and wants of many individuals as the normative goal, modern economics has developed a focus on *efficiency*, that is non-wastefulness, in the use of scarce resources to achieve this goal. Efficiency has almost gained the status of a normative goal in itself. For example, this is expressed in the definition by Lionel Robbins (1932: 15), according to which

economics “studies human behaviour as a relationship between [given] ends and scarce means which have alternative uses.”

This definition, while pointing to efficiency, emphasizes another idea that is constitutive to modern economics, namely that scarce resources may be used in alternative ways, so that using them in any particular way carries opportunity costs. In this modern understanding, it remains open what the “ends” are to be. Any given end that humans pursue with the help of scarce resources that have alternative uses, in principle, makes an economic issue, and efficiency appears as the goal at which economics is aimed.⁷

But, of course, efficiency cannot be taken as a normative goal in itself. Efficiency is a secondary goal that is justified by its reference to a primary, elementary normative goal. In order to normatively root and ethically legitimate economics one therefore needs to specify an ethically legitimate end. For instance, the satisfaction of individual human needs and wants typically serves as the normative goal of economics. Sustainability, interpreted as inter- and intragenerational justice and justice towards nature, also specifies such an ethically legitimate end.⁸

⁶ The liberal premise of modern economics, that individual preferences cannot be criticized but are to be accepted when formulating individual-based societal goals, can be challenged on ethical grounds (e.g. Sen 1999, Hausman and McPherson 2007). It can also be defended on ethical grounds (e.g. Hayek 1948, Stigler and Becker 1977). For the moment, we accept this position and take the satisfaction of individual human needs and wants to be a legitimate normative goal that may stand on equal footing with other normative goals such as sustainability or justice in general.

⁷ In this interpretation, “what most distinguishes economics as a discipline [...] is not its subject matter but its approach [i.e. the assumption of maximizing behavior]” (Becker 1978: 5). To give an extreme example, if some person intended to commit a crime, e.g. to rob a bank, and this person had one scarce resource, say a shotgun loaded with one single bullet, that can potentially be used in alternative ways for the bank robbery, e.g. for taking a hostage or for opening the strongroom’s lock, then the question of how exactly to use the shotgun in order to maximize the haul from the bank robbery would be an economic problem *sensu* Robbins.

⁸ Alternative notions of economics give rise to alternative interpretations of sustainability economics. For example (Manstetten and Klauer 2009), the traditional Aristotelian notion of *oikonomia* (from Greek “οἶκος[oikos]”=house, “νόμος[nomos]”=rule, law) denotes the task of good housekeeping. It is about the establishment of rules and procedures, and the assignment of duties and responsibilities, for how to use scarce

Sustainability economics

Bringing the normative foundations of “sustainability” and “economics” (in its modern interpretation) together, one might say that sustainability economics is normatively founded in the idea of efficiency, that is non-wastefulness, in the use of scarce resources for achieving the two normative goals of (1) the satisfaction of the needs and wants of individual humans *and* (2) justice, including inter- and intragenerational justice and justice towards nature, in the setting of human-nature relationships over the long-term and inherently uncertain future.

Considerations of efficiency in the allocation of scarce resources then refer to three basic alternatives: (a) scarce resources may be used in alternative ways to achieve one of the normative goals of sustainability economics, say intergenerational justice properly specified; (b) scarce resources may be used to achieve alternative normative goals of sustainability economics, say intra- and intergenerational justice; and (c) scarce resources may be used to achieve some normative goal of sustainability economics or alternatively some other legitimate societal goal. As there may be trade-offs and opportunity costs in basically these three ways, “efficiency” means that no scarce resources should be wasted in these respects. While economics has developed a clear, differentiated and operational idea of how to measure efficiency with respect to the satisfaction of the needs and wants of many individuals, it remains to be clarified what “waste” or “non-wasteful” means with respect to the achievement of justice.

3. Subject matter and aims of sustainability economics

The *subject matter* of sustainability economics are human-nature systems in which scarce natural resources, goods and services, as well as their human-made substitutes and complements, are being employed over a long time and, consequently, under uncertainty. With the normative orientation described in the previous section, the *basic question* of sustainability economics may then be cast as follows:

How can we understand and manage the relationships between humans and nature over the long run so that scarce natural resources, goods and services, as well as their human-made substitutes and complements, are being used efficiently for the satisfaction of human needs and wants and in a just manner?

Briefly put, sustainability economics studies joint problems of efficiency *and* justice. This is in contrast to, say, environmental and resource economics which traditionally focuses on problems of efficiency, or environmental ethics which traditionally focuses on problems of justice.

The formulation given above of the basic question indicates that the *aims* of sustainability economics are twofold:

resources and for how to share those. In the Aristotelian system, economics is part of ethics, as it is about the question “What should one do?” In particular, good housekeeping is a responsibility that one has towards future generations, so it inherently is oriented towards the future, and essentially deals with the challenges of continuity and of handing over assets to the next generation. Economics, in the Aristotelian understanding, aims at justice, as the ultimate task of good housekeeping is to provide the citizen with the economic freedom that is necessary to participate in the political process, the aim of which is the just order of society. So, while the modern notion of economics due to Robbins – when used as the basis for sustainability economics – leaves the ends to be pursued efficiently to be specified, the Aristotelian notion of economics already includes an idea of what ends are to be achieved.

1. Understanding. That is, sustainability economics has a cognitive interest.
2. Management. That is, sustainability economics has an action interest.

While the aim of understanding makes sustainability economics indeed a science, the latter – the interest to change and manage human-environment-systems in view of a vision of sustainability – clearly sets sustainability economics apart from the traditional ideal of positive and value-free sciences. So, sustainability economics is neither a purely positive science, nor is it a purely normative endeavor, but it is what has been called “relevant science”.⁹

4. Ontology of sustainability economics

Sustainability economics – like all other scientific endeavors and fields of human action – is based on a specific basic understanding of the world. The basic structure of reality, that is the systematic of basic types of entities (objects, properties, processes) and their structural relationships – is not universal and a priori given, but it derives from the specific perspective of sustainability economics on the world. It therefore differs from the basic understanding of the world of other scientific approaches and fields of human action.

As sustainability economics is not yet established, it does not have an established ontology either. For the systematic development of sustainability economics, one needs ontological clarification with regard to the specific subject matter and aims of sustainability economics of, in particular, the following questions:¹⁰

What is the human being?

How and to what extent is the human being as a biological being determined by, and dependent upon, nature (homo biologicus)? How and to what extent is a human being characterized by its relationship to nature (homo ecologicus)? How and to what extent does an individually acting human being follow its self-interest (homo oeconomicus)? How and to what extent is a human individual determined by, and dependent upon, social relationships (homo sociologicus)? How and to what extent does a human being act in, or on behalf of, a community as a citizen or politician with an orientation towards justice (homo politicus)? How and to what extent is a human human being free? What is the relationship between these different dimensions of human being?

What is nature?

How and to what extent is nature as a socio-economic construct in human-environment-systems dependent upon and characterized by human relationships to humans (human needs, cultural perceptions, etc.)? How and to what extent is nature a means to achieve human ends (instrumental value)? How and to what extent does nature have its own dignity (intrinsic value)? How can one conceptualize and describe nature in terms of both its instrumental and its intrinsic role (entities and structural relationships)?

What is the economy?

⁹ This is perfectly in line with the aims and resulting character of related academic fields, such as ecological economics (Funtowicz and Ravetz 1994, 2003, Müller 2003, Baumgärtner et al. 2008) or sustainability science (Kates et al. 2001, Clark and Dickson 2003, Clark 2007).

¹⁰ Pioneering contributions to the ontological foundation of sustainability economics include Faber and Manstetten (2003, 2007), Becker et al. (2005) and Becker (2006).

How do different notions of “human being” and “nature” imply a necessity for “economy”, that is economizing in dealing with the scarcities that nature imposes on the enhancement of human well-being? How do human beings keep the “house” of nature (oikonomia of nature)? What is/would be a proper “housekeeping”? What distinguishes economizing from others dimensions of human action? How is it related to these other dimensions? What forms and structures of “economy” can be distinguished? How can each of these be conceptualized and described (entities and structural relationships)?

5. Epistemology of sustainability economics

As sustainability economics deals with the long-term future, which is inherently uncertain to a large extent and, beyond that, to a significant extent principally unknown, there are epistemological questions that are relevant in light of both the cognitive interest (understanding) and the action interest (management) of sustainability economics:

- What is knowledge?
- What can we know? What can't we know?
- How can we know?

These questions are very general. However, they all have a specific and genuine sustainability-economic content, due to the specific aims and subject matter of sustainability economics. For example, the imperative of responsibility towards future generations requires the present generation to adequately act in the face of both scarce resources and uncertainty about future preferences as well as about the future consequences of today's actions. In order to specify that requirement, the following questions have to be answered: What knowledge to take into account into today's decisions? How? And how to deal with the remaining uncertainties? Furthermore, responsibility towards future generations also generally implies a responsibility to acquire knowledge in order to alleviate these uncertainties. But how exactly to acquire knowledge, about what, and to what extent?

The answers to these epistemological questions, and many more, in the specific and genuine context of sustainability economics, need to be explored.

6. Genuine sustainability-economic research questions

What has been said so far implies a number of specific and genuine sustainability-economic research questions that may be grouped into larger research fields.

Research field #1: *Interpretation, concretization and operationalization of the normative vision of sustainability economics*

- Development of concrete notions of efficiency and justice for human-nature systems and corresponding ethics that explicitly deal with the long-term and inherently uncertain future
- Clarification of the relationships among the different normative goals and identification of potential conflicts and trade-offs, including an ethical critique, with respect to the norm of justice, of individual preferences and claims from which criteria of efficiency are constructed

- Development of operational qualitative and quantitative indicators of the normative goals, and (context-specific) determination of adequate targets and tolerable windows for the indicators, including the identification of data needs for the empirical evaluation of indicators and build-up of suitable systems for data collection, processing and reporting (“sustainability accounting”)

Research field #2: *Description and analysis of human-environment-systems on multiple spatial scales over the long run and under uncertainty*

- Combination of real (e.g. bio-physical, energy-matter) and value (e.g. monetary) descriptions and analysis of human-environment interactions, e.g. thermodynamic-economic and ecological-economic modeling and analysis
- Analysis of dynamical human-environment-systems, taking into account joint production, flow-stock dynamics, interactions and feedbacks, dissipative structures, and the emergence of system properties such as thresholds, critical loads, tipping points, carrying capacity, and limited resilience in social, environmental and coupled human-environment systems
- Different types, degrees and patterns of uncertainty in dynamic human-environment-systems
- Conditions and mechanisms that affect social, economic and political stability of human-environment systems, and analysis of stability patterns, vulnerability and systemic risks
- Conditions and mechanisms that affect transformability of human-environment systems, and analysis of patterns of anthropogenic change

Research field #3: *Institutions, policy instruments and governance*

The overall research question of this field is how – that is, through what regulating structures and processes – can one attain the normative objectives of sustainability economics (cf. research field #1) in an adequately specified human-environment-system (cf. research field #2)?

- Who bears responsibility for sustainability, that is: for what entities, to what extent, and towards what authority? What does this imply for the assignment and limitation of power, duties, and liability among political, economic and citizen actors?
- What is the specific sustainability-economic legitimacy – i.e. with regard to efficiency and justice – of institutions such as markets or “the state”, political structures and processes, and policy instruments?
- How do the concepts of individual freedom, pursuance of happiness and a good life relate to individual or collective responsibilities towards future generations and nature? Are there ethical and/or economic limits to human actions towards nature and to individual choice of the means of a good life?
- How to deal with the tension between the two seemingly opposite aspects of (i) preservation (of nature and of desirable social states) and (ii) development (through innovation and change) in a dynamic system, which are both inherent in the idea of sustainability? What are institutions, policy instruments and governance structures that foster, beyond the attainment of particular and specific targets in terms of system

states, the viability and adaptability of joint human-environment systems, which secures the social, political and economic ability to (re)act in those systems?

- Design of decision making processes and governance structures allowing for adequately dealing with the wide scope, complexity and inherent uncertainty and ignorance that corresponds to the subject matter and aims of sustainability economics
- Effectiveness of political, legal, economic and social steering and control instruments with regard to the specific sustainability-economic goals of efficiency and justice

7. Conclusion: Characteristic properties and foci of sustainability economics

From our discussion of the normative foundation, subject matter and aims, ontology and epistemology of sustainability economics, it is apparent that sustainability economics is characterized by particular properties and foci that distinguish this field of science and management from others in the area of general economics or general sustainability science.

First, the subject focus is on the relationship between humans and nature. This implies a systemic perspective on the relationships between humans and nature which covers multiple and interacting spatial scales, from local to global, and includes the analysis of feedbacks, interactions and the emergence of systemic properties. It also implies an interdisciplinary approach which is characterized by methodological openness towards those methods that suit the aims and subject focus of sustainability economics.

Second, as sustainability is, by any definition, about the long run, sustainability economics has to consider the long-term future which is inherently uncertain. Any study in the field of sustainability economics has to take uncertainty seriously.

Third, sustainability economics is based on an ethical justification of a vision of the future, combining the two normative goals of (1) the satisfaction of human needs and wants *and* (2) justice, including inter- and intragenerational justice and justice towards nature, with the idea of efficiency, that is non-wastefulness in the use of scarce natural and human resources that have alternative uses.

Fourth, sustainability economics has both a cognitive and a management interest, which may mutually influence each other. It aims at providing knowledge and guidance for actions to attain the objectives of justice and satisfaction of human needs and wants efficiently. Sustainability economics is thus relevant, transdisciplinary science.

The challenge for future research in sustainability economics is to overcome the arbitrariness with which, so far, one or the other aspect of the issue is addressed in a rather ad-hoc manner, and to systematically embed individual contributions to the issue into the larger set-up of sustainability economics, defined by a unifying idea of its normative foundation, aims, subject matter, ontology, epistemology, and genuine research agenda.

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