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East of nature. Accounting for the environments of social sciences

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ABSTRACT

At the core of ecological economics is the image of the economy as an open system embedded in the natural environment whose carrying capacity is limited. The present paper revisits this image by drawing upon the constructivist implications of Luhmann's social systems theory. To Luhmann, the modern society consists of a multitude of social systems each bringing forth and observing their own environments. If the Luhmannian vision is accepted, then ecological economics can be said to privilege the observational perspective of natural sciences. The unfortunate consequence of this privileging is the underestimation of a broad range of multidimensional sustainability risks which are foregrounded by the numerous alternative observational perspectives which are just as legitimate. It is argued that, rather than relativizing the sustainability concerns of the modern ecological economics, the Luhmannian perspective generalizes and radicalizes them. In doing so, the latter perspective opens new possibilities not only for navigating these risks but also for envisioning new resources and solutions.

1. Introduction

The understanding of the present-day sustainability challenges, as well as the practice of sustainability accounting, rest on specific assumptions about the relationship of the economy to its outer environment. For many ecological economists, these assumptions are centred around the idea that the economy is an open system embedded in the environment which is usefully classified into societal and natural. Karl William Kapp (1985, p. 152), an early contributor to the ecological economics literature, seminally attributed the phenomenon of social costs not only to the corporate decision-making under capitalism, but also to "the open-system character of the economy". This open system character of the economy has many implications, such as materiality and the relevance of multiple time-space scales, each calling for a multidisciplinary approach (Luzzati, 2009; Luzzati, 2010a, 2010b). Most importantly for the present purposes, the open systems character that makes the economy susceptible to the limits of the environmental carrying capacity. The vision of the economy as an open system embedded in a finite environment seems to also underlie, e.g., Elkington (1997) triple bottom line concept. As Elkington explained, "sustainable development involves the simultaneous pursuit of economic prosperity, environmental quality, and social equity. Companies aiming for sustainability need to perform not against a single, financial bottom line but against the triple bottom line" (ibid, p. 397). The logic of the environmental embeddedness of the economy seems straightforward and impeccable. If the environmental carrying capacity is limited, and if systems populating this environment overstrain this carrying capacity, it is logical that they are in trouble (Luzzati et al., 2014, p. 100). This trouble, or sustainability risks, can be given an alternative formulation suggested by Niklas Luhmann's theory of social systems.

While ecological economics was admittedly not a central concern to Luhmann, he devoted a 1989 book to the ongoing ecological crisis, which he took to be a specific illustration of the more general theme of the precariousness of the relations of social systems, of all types, to their outer environments.

To Luhmann, system-environment relations are precarious because of the fact that the main function of social systems is to reduce, externalize, or blind out the complexity of their environment. While the complexity-reducing function is highly valuable for boundedly rational individuals, it exposes social systems themselves to sustainability risks. Thus, Luhmann (1989, p. 62) came to the conclusion that "the key to the ecological problems, as far as the economy is concerned, resides in the language of prices… The economy cannot react to disturbances that are not expressed in this language". This argument strikes a chord with much of the ecological economics literature (Valentinov, 2014a, 2014b), despite this literature's systems-theoretic focus on open systems

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(e.g., Kapp, 1985; Luzzati, 2009, 2010a) rather than on the operational closure which is a mainstay of Luhmann's thought.

Yet, what may turn out to be problematic for ecological economics is Luhmann's social systems theory. He believed social systems to construct their own environments in the course of their functioning. This means that, apart from this functioning, and apart from the ways systems observe reality, the nature of the environments in which the systems are embedded cannot be specified. Against this backdrop, the key research question of the present paper pertains to the clarification of the nature of sustainability risks from the point of view of his social systems theory. Luhmann designates the modern society as polycontextural, or, as Roth et al. (2019) explain, "constructed by alternative and contingent observational perspectives that may be mutually conflicting and discrepant". From this perspective, a polycontextural society does not have any single, fixed, and definitely known environment. Instead, there is a multitude of social systems each bringing forth their own environments.

Contrast this implication with those of Elkington's (1997) triple bottom line concept. Elkington rightly assumed that the practice of the traditional bottom line rested on problematic assumptions about the nature of the relations of the economy with its outer environment, both societal and natural. Elkington has questioned these assumptions and replaced them by his own, thus substituting one type of certainty for another. The essential Luhmannian insight, however, is that in a polycontextural society, such certainty does not exist at all. Instead, there is a multitude of social systems each bringing forth their own environments.

Consequently, if the focus on any type of the environment happens to be dominant or privileged, the role of the other possible and equally legitimate types of environments, and the sustainability risks associated therewith, most likely will be underestimated. Insofar as ecological economists can be said to privilege a certain observational perspective on the natural and societal environment, their professional knowledge, profound as it is, may yet turn out to be dangerously one-sided.

The positive way of formulating the above contention is that the polycontextural regime of the modern society provides a space for a radical amplification and multiplication of sustainability concerns as the primary area of interest of many ecological economists. To make that case, the following sections reconsider the concept of nature underlying the ecological economics scholarship, contrast the notions of the environments embraced by the natural and social sciences, and on that basis, reconceptualize the triple bottom line approach in the emerging multienvironmental context. This reconceptualization opens new possibilities and envisions new resources for navigating sustainability risks. The paper concludes with a discussion of how these new possibilities and resources can be harnessed by strategic management tools.

2. The Nature of Nature

As a transdisciplinary field of study, "Ecological Economics addresses the relationships between ecosystems and economic systems in the broadest sense." (Costanza, 1989, p. 1) While the latter focus has early been complemented by or extended to a social systems perspective, the primary goal of ecological economics (EE) has always remained the "sustainable wellbeing of both humans and the rest of nature" (Costanza, 2020, p. 1); and in the pursuit of this worthy goal, the transdiscipline has consequently developed a high level of facility in incorporating and combining insights from economics, further social sciences, and the natural sciences. Yet, the implication that economics is a social science may also be contested for an economics that accentuates the word *ecological* and aims to "recast economics as a life science" (Røpke, 2004, p. 300; van Passel, 2007, p. 31; Costanza, 2020, p. 1).

There is hence a considerable tension between this organic view of economics and the increasingly popular demands for an advancement of its social sciences stream (Spash, 2011, 2012), as it seems hard to impossible to reconciliate those who "remain wary (…) that the basis of human social relations can be reduced to, and essentialized within, the natural world" (Hird, 2010, p. 738) with those convinced that "(d)etermining what is necessary for safeguarding environmental functions for future generations is a matter for the natural sciences." (Hueting and Reijnders, 2004, p. 255). In fact, the contradiction could hardly be more blatant: On the one hand, proponents of the natural sciences camp suggest (Ruth, 2006) and are criticised (van Hecken et al., 2015) for building economic laws, social institutions, and ethical standards on natural scientific insights. On the other hand, the social sciences camp is accused of culturally turning its back on precisely these insights (Hird, 2010) while holding that both money and nature, and hence the cornerstones of entire field, are social constructions (Fourcade, 2011). The fact of social construction may be derogatively registered by those who hold religious or metaphysical beliefs in the sanctity of nature as something primordial and antecedent to human activity (cf. Blancke et al., 2015). Yet, the understandings of naturalness can be often themselves unmasked as social constructions framed by the prevailing institutional structure (cf. Valentinov et al., 2019a, 2019b).

These and further severe contradictions notwithstanding, however, both streams of ecological economics agree on the general adequacy and utility of the attempted "integration and synthesis of economics and ecology – not the disciplines as they existed at the time, which were seen as too narrow in their conceptions of the issues – but of the study of economic and social systems embedded in and interdependent with their ecological life support systems" (Costanza, 2020, p. 2). Hence, the "recognition that the economy is embedded within society, which is embedded within the rest of nature" (ibid.) is widespread; and even if some reservation might apply to the implication that economy and society belong to the realm of nature, the convention to define sustainability along an economic, social, and ecological or environmental dimension (Basiago, 1995; European Commission, 2001) is well-established and has gained particular prominence under the "triple bottom line" label (Elkington, 1994, 1998; Mauerhofer, 2008; Ahi et al., 2018; Vatn, 2020) (see Fig. 1).[1]

As impactful, integrative, and intuitive this idea may be, it remains grounded in the assumption that the environment of society in general and the economy in particular is adequately referred to as nature.

In the subsequent sections of this article, we shall contest this basic assumption, reclaim a social scientific approach to the concepts of environment and ecology, reconceptualises nature as the environmental view of the social subsystem called natural sciences, and extend this regional nature-perspective to a broader concept of environment.

3. Reclaiming the Environments of Social Sciences

Starting from its roots in the 1960s (e.g., Boulding, 1966; Daly, 1968) and likely extending well into the anticipated future of the discipline (Costanza, 2020), ecological economics has always been open to systems thinking. Terms and ideas such as economic system, social system, system of life, ecosystem, or nature as system consequently belong to the basic conceptual equipment of the transdiscipline. Yet, the dominant systems-theoretical paradigm of the transdiscipline seems to be anchored in the open systems theory going back to the groundbreaking work of the biologist Ludwig von Bertalanffy (cf. von Bertalanffy, 1968). Interestingly, the discipline of biology has brought forth an alternative and in a sense opposite systems-theoretical paradigm, the theory of operationally closed, "autopoietic" systems. In this context, autopoiesis means that "everything that is used as a unit by the system is produced as a unit by the system itself" (Luhmann, 1990, p.

[1] More differentiated models distinguish between larger numbers of nested systems, e.g., from the outside in, physical environment, society, institutional-political system, and economy (Luzzati, 2010b, p. 53).

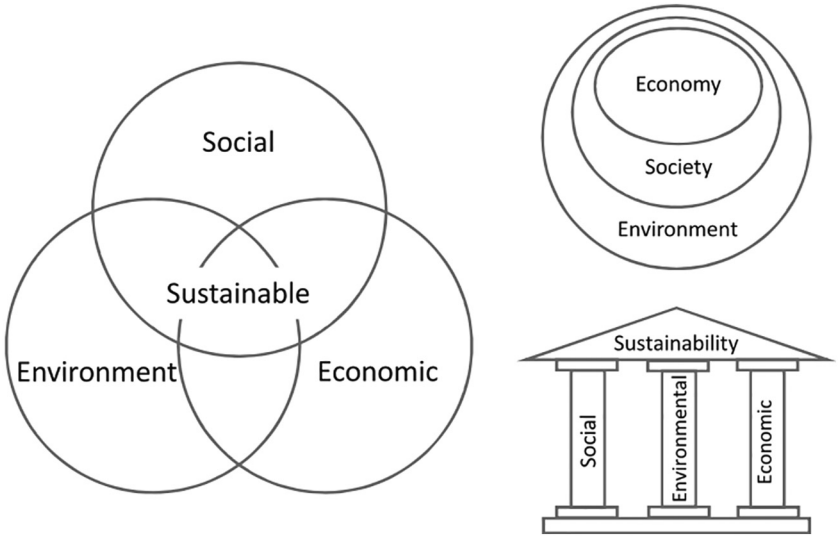

Fig. 1. Variants of the classical triple-bottom-line model (Purvis et al., 2019, p. 682).

3). The latter paradigm, while anticipated by von Bertalanffy himself, mainly originates from the work of natural scientists Maturana and Varela, 1992 who were searching for an encompassing biological definition of life. Maturana and Varela (ibid) came to understand the essence of life in terms of the interrelated phenomena of autopoiesis and operational closure, both of which have been later appropriated by Luhmann. As autopoietic systems, living organisms "produce not only their structures, but also the elements of which they consist, within the network of these very elements" (Luhmann, 2012, p. 76f). As a result, autopoietic systems can be said to operate "only in the context of [their] own operations" (Luhmann, 2018, p. 33).

If life is understood in terms of its autopoietic organization, it would follow that "(t)he structure of living systems and their actual (material) components are complementary yet distinct aspects of any biological explanation: they complement each other reciprocally but cannot be reduced to one another" (Varela and Maturana, 1972, p. 382).

We may read these lines as a reminder not to confuse our object of research with its footprint. Life is not what it takes to live. As organisms, we are neither what we eat nor the air we breathe, and we are not our excrements and other ecological footprint either. And it is precisely this condition that explains why we do, and indeed can, crave for nutrition, water, oxygen, and all other environmental factors that we critically depend on.

Just as Varela and Maturana insisted on the dividing line between matter and life, Niklas Luhmann (1995, 2013) drew and defended the distinction between the behaviour of autopoietic biological systems and the communicative autopoiesis of social systems, the latter of which he said to be reliant, yet not reducible to the level of individual behaviour. It is ironic that Luhmann established this borderline between biological and social systems by drawing on a concept that was originally invented by biologists, and that this move exposed him to criticism from both natural and social scientists alike (see Cadenas and Arnold, 2015; King, 2001; Mingers, 2002), including Humberto Maturana:

> "I have had relatively long discussions with Maturana on this point. He always told me that1 if one speaks of the autopoiesis of communication/ one has to show it. That is to *say,* one has to show that the concept really works in the domain of communication so that it is possible to state that an individual communicative act can come about only in the network of communication. It cannot be conceived as a one-time event. And it also cannot be conceived as produced externally, in a communication-free context, as it were—say, as a chemical artifact that then has a communicative effect. On the contrary, it must always be produced by and through communication. I believe that this claim does not create much difficulty. It is relatively easy to see—especially if one considers the linguistic tradition of Saussure, for instance and all that came of it—that communication occurs via its own differences and has nothing to do with chemical or physical phenomena." (Luhmann, 2013, p. 79).

The same intrinsic logic that draws the dividing line between biological and social systems as different forms of systems then also applies to the differentiation between different forms of social systems. Thus, as much as biological and social systems constitute environments for each other, and as much as there is hence no overlap but only mutual influences or "irritation" between these two forms of systems, so too is there no overlap between different subsystems of the comprehensive social system we commonly refer to as society.

If we now insist "that the economy is embedded within society" (Costanza, 2020, p. 2), then this claim is perfectly compatible with Luhmannian social systems theory, in which the economy is a subsystem of society and thus a social system itself. A social systems-theoretical perspective also allows for the observation that the economic system is now confronted with two different forms of environment, namely one intra-societal and one extra-societal environment. There are, however, two major differences. First, a social systems-theoretical variant of the triple-bottom-line model depicted in Fig. 1, there would be no need for a border around the extra-social environment unless we intend to observe it as a(n eco)system and thus distinguish it from yet another environment (see Fig. 2).

The second big difference between an ecological economics and social systems-theoretical perspective is that the latter does not content itself with an ultimately cancelled negative definition of society as the complement of its economic subsystem.

If we challenge the idea that society is properly defined as "economy and the rest of society", then we shift our focus from the economy to its intra-societal environment. In looking at this social ecology of the economy, however, we quickly realise that the economy is certainly not the only subsystem of society as politics, science, religion, art, or law clearly are social subsystems, too. As there is no system without environment, this discovery implies that all other systems are not only located in the intra-societal environment of the economy, but also locate the economy as much as all other in their respective intra-societal environments. In other words, the social ecology of the economy is made of numerous social systems, each of which has a different environment and thus a different view of the overall ecology of social systems. As each of these systems has a different view of the social

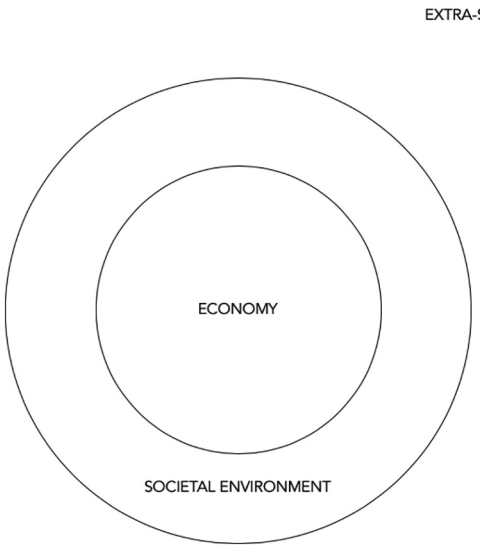

Fig. 2. A systems-theoretical version of a sustainability model of embedded systems.

ecology, they necessarily have a different view of the extra-societal environment, too. True, natural science defines this environment as nature; yet, from a religious point of view, this environment may be populated by spirits or Gods, and most commonly referred to as one of these God's Creation. For yet other subsystems, this environment might appear as an indefinite learning space or an equally gigantic though potentially shrinking stock of non-social resources.

A truly *social* science that accounts for this multienvironmental condition would therefore need to refrain from over-identifying the extra-social environment with the environmental concepts and terminologies of the natural sciences. This is true because, first, it is hard to impossible to prove scientifically that one of the above-mentioned subsystems is essentially more important than the other(s). Second, even if a scientific bias to science seems logical or at least comprehensible, it would still remain unclear why social sciences should favour an environmental concept of the natural sciences over a social-scientific one.

In the subsequent section of this article, we shall therefore outline a social-scientific concept of environment, in the context of with the natural-scientific concept of nature is positioned as one environmental concept among others.

4. The Triple Bottom Line Coming Full Circle

Regardless of whether we define ecological economics as a natural or a social science, it remains true that the economy is neither a natural nor a social science. As economy and science are two distinct though certainly interacting subsystems of society, the current situation, in which a transdisciplinary field attempts at almost coercing one social subsystem to adopt the environmental perspective of one branch of another subsystem, seems far from being natural. In looking at Fig. 3, the reductionist nature of this enterprise is even more evident:

Fig. 3 depicts a challenge and extension of the classical "3-D sustainability" (Mauerhofer, 2008) models such as the triple-bottom-line and cognate frameworks. The basic feature of these models is that they locate the economy (the right-hand triangle) within society (the social environment of the economy triangle). Society is then again embedded within an extra-social environment, which is commonly referred to as nature, ecosystem, or ecological environment. In order to observe ecosystems or nature, however, we need science in general and natural sciences in particular (Luzzati et al., 2014, p. 100). Science, however, does not appear in its own models, which is as ironic as consequential

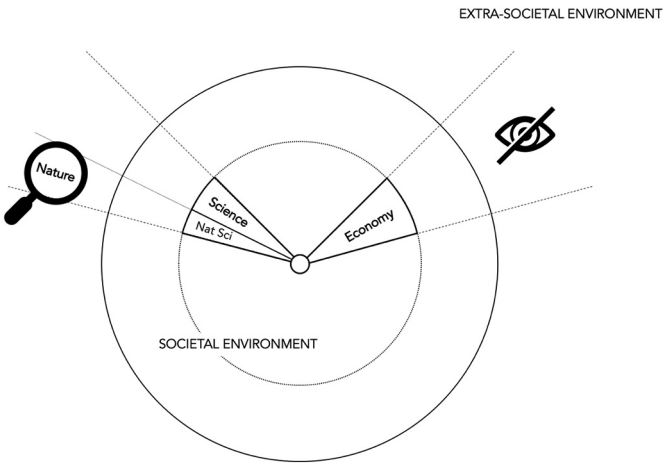

Fig. 3. The classical triple-bottom-line model in an emerging multi-environmental context.

as these models are used to argue that a sustainable economy must confuse its environment with the environment of the natural sciences. In Fig. 3, this condition is depicted as a prohibition to use an economic radar and obligation to use a natural scientific radar for environmental screening. As indicated earlier, in its more radical forms, this concurrent prohibition and obligation explicitly includes or is extended to the social environment, e.g., when Ruth (2006, p. 339) suggests to establishing "the economic, legal, institutional and ethical basis" of sustainable human behaviour "on fundamental insights from the natural sciences".

In revisiting Fig. 3, however, it becomes obvious that even this already enhanced version of the triple-bottom-line remains incomplete as economy and science are certainly not the only subsystems of society. Moreover, it is just as sensible that these subsystems constantly influence each other. For instance, "(t)he political system depends upon informational and conceptual inputs and contributions from the other societal systems in the governance process—for example, the social and the natural sciences" (Luks and Siebenhüner, 2007, p. 418), and the same is true vice versa. Last not least, it is critical to realise that function systems constitute parts of the social environment for each other and that they are only one type of social systems that constitute the overall social environment, with other types being, for example, families or organizations. In Figs. 3 and 4, the label "societal environment" is therefore written across the border between the "inner circle"

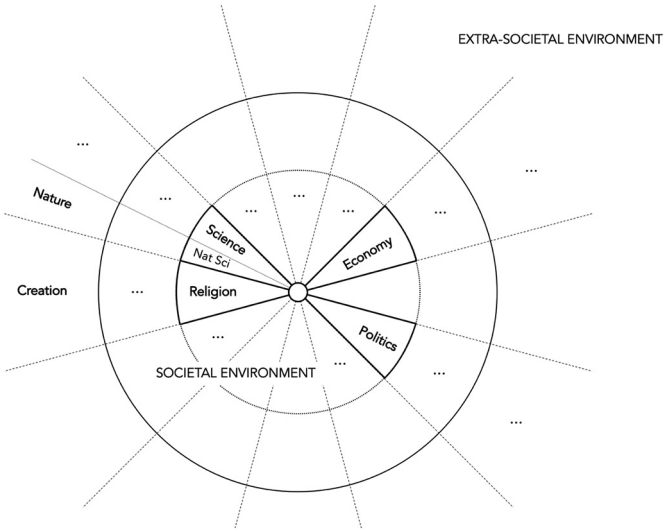

Fig. 4. From triple-bottom-line to multienvironmental scanning.

of function systems and the overall societal environment.

From a social-scientific perspective, we therefore observe an entire ecology of interacting social subsystems and their corresponding environments. In the Luhmannian terminology, what we observe is polycontexturality: a multitude of interdependent, yet mutually incommensurable and operationally closed systems bringing forth their unique definitions of both the societal and extra-societal environment.

As important as the actually quite provincial natural environmental perspective might seem today against the backdrop of the urgent threats to its environment, so too is the perceived urgency no scientific argument to ignore, devalue, or even prohibit the environmental perspective of other subsystems of society in general and other subsystems of science in particular.

However, from a social-scientific perspective, there is no need to ignore, devalue, or even prohibit the environmental perspective of the natural sciences either. Rather, what is needed is a multifunctional perspective similar to the one depicted in Fig. 4.

Fig. 4 presents a social-scientific perspective on society and its internal and external environments. This perspective does not ignore, devalue, or even prohibit; to the contrary, it encourages the natural sciences to make universal claims about the nature of both the societal and the extra-societal environment of the economy or any other social system. Yet, Fig. 4 is also a reminder that universality must not be confused with exclusivity (Luhmann, 1995, p. xlviii). This means that each type of environment can harbour unique sustainability risks, many of which would remain unnoticed even by the modern sustainability concepts such as the triple bottom line concept.

5. Outlook

The relationship between the Luhmannian systems theory and ecological economics is marked by a deep ambivalence, which, is not unique to the present paper. Take the case of Kenneth Boulding, who was not only the author of the seminal “Spaceship Earth” metaphor but also an engaged systems theorist. Whereas the spaceship metaphor evidently rested on Boulding's firm belief in the certainty of the exhaustible and destructible nature of the environment of the economy, his systems-theoretical views were more open-ended. In his systems-theoretical treatise *Ecodynamics* (Boulding, 1978), he titles one of the sections “The Myth of the Environment”. In the section, he explains that “There is no such thing as an ‘environment’, if by this we mean a surrounding system that is independent of what goes on inside it. (…) It makes sense to divide the totality of the universe into parts that have some degree of independent dynamic pattern, but none of these parts is really independent of others: all interact. (…) Everything is the environment of everything else” (ibid, p. 31).

The Luhmannian systems-theoretical perspective affirms the view that “there is no such thing as the environment”, but for somewhat different reasons. If we agree that there is 1) no system without environment, 2) no ecology without a plurality of systems, and thus 3) no ecosystem without a plurality of environments, then we cannot assume *the environment* as a singular entity to be given with ontological certainty. It is rather the case that different social subsystems have different views of their environment, and that nature—the environment of the natural sciences—is nothing more or less than the environment of a subsystem of the scientific subsystem of society.

Does that mean that the Luhmannian perspective relativizes the fundamental sustainability concerns of ecological economics? A sympathetic look at Fig. 4 would suggest that these concerns are generalized and radicalized rather than relativized. While sustainability risks addressed by ecological economists are serious, they are observationally contingent. Employing other observational perspectives may lead to the discovery of new dimensions of risks which are no less serious. On a more positive note, these risks may likewise engender entrepreneurial opportunities. Just as the triple bottom line concept has provided inspiration for the development of sustainable business models (cf. Joyce and Paquin, 2016), the polycontextural environment indicated in Fig. 4 invites the use of strategic management tools for the purposes of the multienvironmental screening and accounting of the diverse logics and observational perspectives (Roth et al., 2018). These tools would open radically new possibilities for navigating multidimensional sustainability risks, particularly for those types of social systems (such as corporations) that are known to systematically blind out specific segments of environmental complexity or stakeholder interests (Will et al., 2018; Valentinov et al., 2019a, 2019b). Take classical environmental scanning tools such as PEST or its derivates PESTLE, STEEPLE, STEEPLED (see Roth et al., 2017, p. 200f), many of which give additional weight to ethics and the natural environment. While the individual letters P (politics), E (economy), S (society) and T (technology) have been continually supplemented or reshuffled, it is clear that critical aspects of the societal environment have escaped the attention of these and many other environmental scanning tools. Health is one such factor, as the system does not seem to deserve a dedicated letter or specific attention and is typically lumped together with often both “political” and “social” issues. Yet, the coronavirus crisis has shown in the most dramatic ways that such neglect may come at a cost.

The same events have furthermore demonstrated the inescapable incommensurability of the individual spheres (Kapp, 1977, p. 538; Luzzati, 2009, p. 315) or subsystems of society (Luhmann, 2002, p. 52; Roth, 2019, p. 508) as emerging dilemmas or trade-offs between health on the one side and money or liberty on the other side clearly indicate that we are confronted here with some of “those questions that are in principle undecidable” (von Foerster, 1992, p. 14).

In discussing the example of managerialized public health care, Roth et al. (2019, p.8) argue that the

> “proliferation of this type of health care can be observed from multiple and equally legitimate points of view associated with the function systems, each of which potentially generates a distinct moral evaluation of this trend. Business-like public health care may be politically endorsed (i.e. good) and economically efficient (i.e. good) while being inconsistent with medical professionalism and unchristian. It may at the same time present a setback for risk sport participants and probably even a scandal in the mass media system, while making no difference from an artistic or legal point of view. This diverse constellation of moral judgments shows the rise of business-like public health care to be simultaneously good, bad, and morally irrelevant. This example makes clear that functional differentiation precludes the automatic identification of economic, political, legal or scientific operations as inherently good or bad.”

In showing how quickly conventional judgments on the relative importance of the individual function systems may change, the 2020 coronavirus crisis, therefore, make a strong case that a better (mutual) understanding of how differently different function systems conceive of both their societal and extra-societal environment is essential. The basis of this understanding would be a strategic management tool that accounts for the, in principle, equal importance of all functions systems that could be acronymized “RHESAMPLES” (Roth et al., 2017, p. 201), a derivation from the initial letters of each of the 10 function systems: religion, health, economy, science, art, mass media, politics, law, education, and sport.

As another implication for further research, a multiplication of sustainability concerns achievable by the proposed multienvironmental scanning would be capable of yielding information on the possible environmental shocks that might be suffered by specific social systems. That way, the introduction of multienvironmental scanning holds the potential to improve the resilience of the systems in question, a property which is often understood as the systemic capacity “to absorb change and disturbance and still maintain the same relationships” (Holling, 1973, p. 14). In the last decades, the concept of resilience rose to prominence in the context of the literature on the socio-ecological systems (ibid) and was applied to numerous other contexts. It was

acknowledged that ensuring the resilience of the socio-ecological systems requires adaptive governance which must be conceptualized as multilevel and polycentric (Van Assche et al., 2019). It is evident that the proposed multienvironmental scanning radically expands the observational capacity required for anticipating the possible shocks. While this may be a valuable contribution to the literature on the socio-ecological systems, the understanding of these systems may itself be transformed by the multiplication of observational perspectives suggested by a consistent application of the Luhmannian insights.

Furthermore, the Luhmannian systems theory may itself benefit from appreciating the way in which the polycontextural diversity of the modern society converges on the twofold understanding of the boundary between the social and the natural. As van Assche et al. (2019), p. 313) explain, "the ecological is the environment of the social in a double sense: internally and externally". The same understanding of the boundary is evidently applicable to the distinction between human organisms and what Luhmann took to be psychic systems. There is room to argue that much of this complexity can be illuminated by the proposed multienvironmental scanning, especially given that the *co*-evolution of organisms and psychic systems may itself be a reflection of the much more encompassing process of co-evolution of systems and environments constituting the regime of polycontexturality.

Finally, the diverse observational perspectives generate further insights going beyond risks and entrepreneurial opportunities. Paradoxically as it sounds, these insights bring to the fore new solutions and new resources that have been invisible from the traditional or dominant perspectives. If contemporary societies are responsible for what we commonly refer to as ecological problems, then the solutions to these problems might require not ever-bigger natural-scientific efforts (Shah, 2020), but rather a shift of perspective to the environments of social sciences and a corresponding multienvironmental scanning that dislodges the problems while foregrounding the above opportunities that have not been clear before.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships

that could have appeared to influence the work reported in this paper.

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