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What Does 'Natural Capital' Do? The Role of Metaphor in Economic Understanding of the Environment

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ABSTRACT

At the time of its introduction in the end of the 1980s, the concept of natural capital represented new, more ecologically aware thinking in economics. As a symbol of novel thinking, the metaphor of natural capital stimulated a debate between different disciplinary traditions on the definitions of the concept and research priorities and methods. The concept became a means to control the discourse of sustainable development. In this paper, I focus on the power/knowledge implications of the use of the concept, and I follow the career of the concept of natural capital in ecological economic publications between the years 1988 and 2000. The main interests are (1) in the use of the concept to affect the rules according to which claims concerning sustainable development can be made and (2) in the constitution of objects of environmental knowledge.

KEYWORDS

Natural capital, ecological economics, power/knowledge, calculative practice

1. INTRODUCTION

The environmental awakening of the 1960s also affected economic thinking. In the beginning of the 1960s environmental issues were largely neglected in economic research. Economics of natural resources dealt with the optimal use of particular renewable and non-renewable resources while a small fraction of welfare economics, nowadays called environmental economics, focused on the welfare effects of environmental externalities. Environmental problems were considered separate, local failures in the use of natural resources. Due to rising environmental concern the economic research on environmental policy issues

grew significantly in the 1960s and 1970s. As a consequence, the two previously distinct fields of research were perceived to focus on the same issue area, the economy–nature relationship. The environmental awakening thus created a new discursive field within economic thinking. This discursive field was a new space to be filled with different objects: scientific concepts, methods and theoretical constructions, which defined the focus, boundaries and research orientation of environmental economics. In this article, I trace the career of one particular concept that came to fill this discursive field, namely natural capital.

Although classical economists had already drawn an analogy between nature and capital in the nineteenth century, the concept of natural capital itself was a novel opening in the discourse of environmental economics of the 1980s. When David Pearce introduced the concept in 1988 he did not refer to classical economists but to ‘modern sustainable development literature’ (Pearce 1988 599). The concept was thus a translation of the idea of ecological capital which was transferred to environmental economics from broader political discourse of sustainable use of natural resources. Consequently, the metaphor of natural capital potentially brought a new perspective on the economic analysis of the environment, which stimulated a debate between different disciplinary traditions on the definitions of the concept and research priorities and methods. The debate between different traditions of environmental economics can be thought of as a power struggle between different *truth discourses* (Foucault 1984) – established ways to produce, express and value truth claims. This power struggle affected the constitution of nature and humans as objects of knowledge which made it an essentially power-laden issue.

Sabine Maasen and Peter Weingaart characterise widely adopted metaphoric concepts as viruses, which infect different discursive contexts and spread meanings (Maasen 1994, Maasen and Weingaart 1995, 1997). They have sociologised the linguistic concept of metaphor and suggest that the use of metaphor can be defined as one of the social processes by which the production of discourse is controlled. Consequently, following a metaphor is a way to investigate the interplay of power and knowledge (Maasen and Weingaart 1995: 17–18). In the following I will draw on Maasen and Weingaart’s idea and focus on the interaction between the metaphor of natural capital and the discursive field of environmental economics. First, I will follow how the metaphor of natural capital has been adopted and integrated into the discourse of environmental economics. Next, section 3 traces divergences in the intellectual uses of the concept and section 4 illustrates the ways in which implications of the metaphor have been negotiated in various policy contexts. The paper is based on an analysis of the use of the concept of natural capital in publications of ecological economics between the years 1988 and 2000. The aim is to find out, first, in which ways the concept of natural capital has modified the economic understanding of environmental problems and, second, whether the concept has inspired any novel economic practices in dealing with environmental issues.

2. NATURAL CAPITAL AND THE IDENTITY OF ECOLOGICAL ECONOMICS

The emerging discourse of environmental economics consisted originally of several competing discursive fields with different theoretical and methodological backgrounds. Environmental and natural resource economics, institutionalised with the formation of the Association of Environmental and Resource Economists in 1975, applied the theoretical tools offered by neoclassical theory, such as the theory of externalities and economics of renewable and exhaustible resources which originate from the beginning of the twentieth century (see e.g. Kula 1998). The focus of research was the development of monetary valuation of environmental services, cost-benefit analysis and economic analysis of environmental policy instruments. At the same time, there was a growing criticism against the basic economic world view within environmental economics (e.g. Spash 1999). This criticism was, however, not unified. Already from the nineteenth century, the tradition of energetics and biophysical economics had claimed that economic theory neglects the connections between economy and material resource base in a broad sense (see e.g. Martinez-Alier 1987). During the period of environmental awakening several economists claimed that this neglect made it impossible for mainstream economics to deal with structural environmental problems. For example Herman Daly, Kenneth Boulding and Nicolas Georgescu-Roegen suggested that economics should focus more on the material and energy flows and search theoretical tools from mechanistic and evolutionary systems theory (e.g. Boulding 1966, Daly 1968, Georgescu-Roegen 1971). This led to the development of a field of research which focused on ecological-economic joint modelling in the 1970s (see also Costanza, Perrings and Cleveland 1997).

Another line of criticism arose from the traditions of institutional economics and political economy (e.g. Kapp 1950), which pointed out the inability of economics to see the connections between economy and other social institutions. The research which drew from these traditions was very close to research in political ecology (e.g. Peet and Watts 1996) which also developed in the 1970s. Institutional environmental economics and political economy focused for example on the evolution of resource management practices, multiplicity of environmental values, interaction between different social institutions and distribution of income and power. The different disciplinary traditions thus saw the dynamics behind environmental problems in different ways and therefore focused on different problems and applied different methods and research tools. Consequently, the interchange between the disciplinary boundaries was fairly weak although they all claimed to deal with environmental policy issues.

The idea of sustainable development, which rose on the agenda of politics in the 1980s, was a new stimulus for environmental economics. It challenged economists to find novel ways to deal with the use of natural resources and

environmental degradation and to overcome the old contradiction between economic and environmental goal setting. David Pearce responded to this challenge by introducing the concept of natural capital in 1988. He suggested that the policy goals of sustainable development can be operationalised if natural environments are thought of as a stock of natural assets serving economic functions.

Sustainable development is categorised by economic change subject to 'constancy of natural capital stock' – the stock of environmental assets are held constant while the economy is allowed whatever social goals are deemed appropriate. (Pearce 1988: 598)

David Pearce argued that the rule to keep natural capital constant was an elaboration of Robert Solow's work on intergenerational distribution of income given the use of exhaustible resources (Solow 1986). Therefore, its roots were in the economic theory itself, which already had the tools to analyse the problem of sustainability. In addition, he suggested that the preservation of natural capital would also solve other policy goals of sustainable development beyond the maintaining of the resource base. These goals included, for example, interspecies rights and the equity of intragenerational distribution of income (Pearce 1988).

Simultaneously with the rise of sustainability discourse a new school of thought, ecological economics, was founded in 1988. Earlier, in the 1970s, ecological economics had referred to biophysical economics, which mostly meant ecological–economic joint modelling. The new school of thought aimed, however, to serve as a broader forum of discussion. In the first issue of the journal *Ecological Economics*, Robert Costanza declared that the aim of ecological economics is to construct an interdisciplinary bridge between economics and ecology. He legitimised the new school of thought by the need to find solutions for global environmental problems, which were neglected by existing disciplines. Costanza furthermore emphasised that the aim of ecological economics is to gather together previously separate critical discussions and create a fruitful interaction between them and mainstream economics (e.g. Costanza 1989, Costanza et al. 1991). Therefore there was a need for common conceptual and analytical tools. New conceptual and analytical openings were also needed to clarify the distinction between old, mainstream environmental economics and new, ecological economics. The foundation of ecological economics can thus be seen as an attempt to take over the 'economics of sustainability'.

Herman Daly and Robert Costanza named the concept of natural capital relatively soon as one of the basic concepts of ecological economics (Daly 1991, Costanza et al. 1991, Costanza and Daly 1992). According to Costanza et al. (1991), natural capital refers to

The soil and atmospheric structure, plant and animal biomass etc. that, taken together, forms the basis of all ecosystems. This natural capital stock uses primary

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inputs (sunlight) to produce the range of ecosystem services and physical natural resource flow. (Costanza et al. 1991: 8)

While David Pearce had underlined the accountant's view of nature and put emphasis on environmental assets, the latter definition leans on the ecosystem modeller's view of nature. In this sense, the use of the concept differed significantly from Pearce's initial idea. Instead of economic theories, the focus is on ecosystem processes and ecological knowledge.

The use of the concept of natural capital spread in ecological economics in the 1990s. The *Econlit* index gives 1–3 references a year for the concept between the years 1988–93. In 1992 the biennial conference of International Society for Ecological Economics held in Stockholm was entitled 'Investing in Natural Capital'. After the conference, the number of references rose to 30 in 1994. Thereafter the concept has been constantly used as a label for ecological economics. Costanza and Daly, for example, used the concept of natural capital when to make the ideas of ecological economics persuasive for natural scientists in *Conservation Biology* (Costanza and Daly 1992). In addition, a book which presented the basic principles of ecological economics in a popularised form was titled *Natural Capital and Human Economic Survival* (Prugh 1995).

In the mainstream of economics of natural resources and the environment, the concept of natural capital has not been adopted. David Pearce, who uses the concept within the theoretical frame of neoclassical economics, is an exception albeit a very influential one. He has also used the concept to persuade a larger audience of the ability of economics to offer tools for sustainable development, for example by introducing the idea of natural capital in a series of 'Blueprints' for Sustainable Development (Pearce et al. 1989, Pearce et al. 1991, Pearce et al. 1994, etc.) which were targeted for both economic and policy discussions. The attempt to conceptualise nature in terms of capital was thus a way to make a difference between the old economics and the new economic thinking which is more aware of ecological processes. The concept of natural capital became a distinctive mark in the vocabulary of ecological economics. This adoption has, of course, a normative edge: the most adequate way to integrate 'nature' into economic thinking is to view it as a special kind of capital.

3. WHAT WAS THE CONCEPT OF NATURAL CAPITAL USED FOR?

Although the use of the concept of natural capital spread widely in the 1990s, the concept was not undisputed. Several critics within ecological economics have drawn a distinction between its metaphoric and analytical dimensions: analytically weak, metaphorically strong (e.g. Victor 1991, England 1998). They suggest that the analytical tools should be based on biophysical valuation instead of capital theory and monetary valuation. However, despite the criticism, the

concept of natural capital was still seen as heuristically powerful and its rhetoric use was not questioned. England expresses this clearly:

In sum: let us continue to speak about the need to preserve natural capital but simultaneously develop a rigorous measure of sustainable economic welfare. (England 1998: 265)

Another line of criticism focuses on political economy. Juan Martinez-Alier and Martin O'Connor have claimed that the use of the concept of natural capital supports capitalisation of nature (O'Connor and Martinez-Alier 1998: 37). Despite this criticism O'Connor applies 'the ecosystem view of natural capital' (e.g. Noël and O'Connor 1998: 77, O'Connor 2000) while arguing for the need of new environmental accounting and valuation tools. It seems that the concept of natural capital has somehow become an inevitable evil, a necessary reference also for many of those ecological economists who do not for some reason or other welcome its use in the first place. Why?

The success of the concept of natural capital was partly, no doubt, due to its properties as a metaphor. When it was introduced in the 1980s it invited the audience to approach the relationship between nature and economy in a new way with familiar economic terms. As a contrast to commonly used economic metaphors of nature as a stock of raw materials and environmental services, which draw a passive image of nature, all the users of the metaphor of natural capital emphasised an active view of nature. The metaphor suggested that nature is a source of welfare and economic growth, which 'naturally' generates richness if wisely used. With an analogue between an asset and nature, the metaphor evoked for example a comparison between conservation of nature and investment saving. In addition, the metaphor of natural capital gave a possibility to conceptualise complex mechanisms of nature-human relationship in terms of something manageable, productive machinery or financial assets. This, in turn promised that a solution to environmental problems is achievable. The exact meaning of the metaphor was, however, not dependent on the linguistic construct as such. The meaning of the concept was defined as a result of the interaction process between the polysemic metaphor and particular, historically developed contexts of use (Maasen and Weingaart 1995). This enabled its flexible use for different purposes in the diverse field of environmental economics.

David Pearce saw the concept as a means to stimulate ecologically more sensitive approaches within existing environmental economics. This is clearly expressed in Pearce and Atkinson's response to Victor's attack against the monetarisation of natural capital. They used the strong expression of 'forcing existing paradigms to account for environmental problems' (Pearce and Atkinson 1993: 103). They claimed that the concept of natural capital was doing that very successfully. Despite the translation of the metaphor of natural capital to the terms of capital theory, David Pearce thus aimed, on one hand, to use it to challenge the growth-oriented mainstream economics to reconsider the value

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and substitutability of environmental resources. On the other hand, he used the concept to show that economic theory is in principle able to integrate environment into its core.

There is a problem, however, with the connections to capital theory. Although David Pearce emphasises the need to preserve the stocks of natural capital, by relating the concept of natural capital to Solow's theory he finally focuses on the constancy of benefit streams provided by natural resources. He introduced the theory of 'weak sustainability', which is based on the idea of guaranteeing a non-declining stream of benefits over time. Weak sustainability requires the maintenance of the aggregate stock of capital. The criterion allows the depletion of natural capital if it is compensated with rising stocks of man-made or human capital (e.g. Pearce and Turner 1990, El Serafy 1997). The key concern turns to the commensurability of natural capital with other types of capital. As a consequence, focus on monetary valuation of environmental goods fades out the physical ecosystem processes and emphasises market values and economic knowledge production. This gave rise to claims that the use of the concept of natural capital in the sense of weak sustainability did not make any significant difference compared to established approaches of environmental economics. Wilfred Beckerman argued that existing environmental economics has all the tools needed to adequately evaluate the use of natural resources (e.g. Beckerman 1995) whereas Sylvie Faucheux and Martin O'Connor claimed that the use of the concept of natural capital in terms of weak sustainability is only a means to expand a narrow economic view on nature (Faucheux and O'Connor 1998).

If the aim of David Pearce was to develop existing economic theories, the advocates of ecological economics used the concept of natural capital as a weapon against mainstream economic thinking. They used the concept to integrate ecosystem thinking into the core of economic theory. The aim was to change the basis of economic thinking. For them, the word capital referred to the physical factor of production, ecosystem machinery. Herman Daly explicitly denied the possibility of measuring sustainability by estimating future benefit streams.

... the welfare of future generations is beyond our control and fundamentally none of our business. As any parent knows, you cannot bequeath welfare. You can only pass on physical requirements for welfare. Nowadays natural capital is the critical requirement. (Daly 1995: 50)

Daly associated ecological economics with the requirements of 'strong sustainability'. He claimed that natural capital cannot be substituted with other types of capital. According to him, strong sustainability is based on the complementarity of man-made and natural capital in economic production. Therefore, the need to keep natural capital intact is a scientifically proven technical necessity, not a policy goal open to ethical consideration (Daly 1995).

The main criterion for sustainability is to keep the natural capital stock either intact or above a critical limit, i.e. to keep the critical natural capital intact – the key concern being to maintain the stability of ecosystem processes. While speaking of natural capital Herman Daly emphasised the existence of nature as a physical entity which constraints human activities. Consequently, one of the basic research aims of ecological economics was to define the optimal scale for human presence in the global ecosystem (e.g. Folke et al. 1994, Daly 1991, Daly 1996). Biophysical valuation of natural capital was a tool to show that this limit is an objective fact. In particular, carrying capacity models were frequently used as natural scientific evidence of the limits to economic growth (e.g. Ehrlich 1994). These claims were connected with the moral rejection of the view that humans can overcome nature's limits with their ingenuity (Costanza 1989, Cleveland 1987). The core of the argument was a distinction between humanity and nature and the use of the latter as an argument for policy aims. In his criticism of the concept of sustainability Beckerman claimed that this kind of argumentation was 'morally repugnant' and made open moral and ethical debate impossible (Beckerman 1995). This tendency also stimulated criticism among ecologists. Harte (1995) disapproved the use of the concept of natural capital to gain natural scientific legitimacy for the normative claims of economists to keep natural capital intact. He pointed out that nature does not exist as capital without humans. Despite the criticism, the use of the concept of natural capital as a tool to question economic 'facts' with natural scientific 'facts' continued.

The polysemy of the metaphor of natural capital made it possible to underline different connotations and attributes of words 'natural' and 'capital' on different occasions. Following on from that, the metaphor offered the possibility of strengthening different theoretical positions in the discourse of economic sustainability. In addition to a debate between weak and strong sustainability (see also Berkes and Folke 1992, Daly 1995, Jacobs 1995, Faucheux et al. 1998, Noël and O'Connor 1998, etc.), the concept of natural capital was also useful for critical scholars of political economy. The concept was a concrete object against which criticism of the expansion of monetary valuation and repressive capitalist power structures could be directed. The metaphor of natural capital thus became a mediator in the new, problem-oriented field of economic discourse which focused on sustainable development. Although the different definitions of natural capital were mutually exclusive and led to diverse theoretical elaborations, the use of the same concept acted as a manifestation of the existence of new economic thinking that was aware of ecological problems.

In addition to mediating between different theoretical discourses, the concept of natural capital has been used to manifest that its users belong to a broader group of people – scientists, policy makers and environmentalists – who take the challenge of sustainable development seriously. The concept of ecological capital had been used in the WCED report *Our Common Future* (WCED 1987), where sustainable development was defined to include the maintenance of

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economic, ecological and social capital. After the Rio World Summit in 1992 several countries produced national strategies of sustainable development which increased the use of the metaphors of social capital and ecological or natural capital in administrative and political language. In addition, the World Bank used the concept when referring to new environmental national accounting systems and furthermore, environmental NGOs adopted the metaphor of natural capital in their campaigns (see e.g. Carley and Spaapens 1998).

The spread of the concept of natural capital to the field of politics was important for ecological economics. When the concept was used, a reference was often made to ecological economics, which emphasised the value of research in ecological economics. The concept of natural capital was thus a linguistic device, a fluid object, which offered a common ground of communication for actors coming from different social worlds, acting in different contexts, involved in heterogenous practices and having different goals. Susan Leigh Star and James Griesemer use the concept of boundary object to describe ideas, material objects or linguistic devices which are both plastic enough to adapt to local needs and constraints of several parties employing them, yet robust enough to maintain common identity across sites (Star and Griesemer 1989: 393). They claim that boundary objects are crucial in enabling different social worlds to communicate and co-operate in such a way that they can maintain their own autonomy. To become a politically important field of research ecological economics needed allies among policy makers and funding organisations in addition to ecologists, economists and other social scientists. Therefore, devices which facilitate co-operation between very heterogenous actors were essential. As a metaphor, the concept of natural capital could become a boundary object.

Choosing to use the concept of capital in the metaphorisation of nature can thus be seen as a wise strategic move for ecological economics. With the legitimacy gained from established theoretical traditions, the needs of political discourse and resource management practices, the concept of natural capital could become a hegemonic concept in the discourse of economic sustainability. The problem of rhetorics, however, is that a strategic choice is always a constitutive choice also.

4. CALCULATIVE PRACTICES AND ENVIRONMENTAL GOVERNANCE

At first it seems, that the metaphor of natural capital evoked two very different images of nature: first, financial asset and second, ecosystem. These images lead to different strategies of knowledge production and environmental management. The rationale for the monetarisation of nature with different monetary valuation practices such as contingent valuation surveys, hedonic pricing etc. was to reveal individual preferences and to help take them into account in policy decisions.

Green national accounting systems are a clear example of an attempt to internalise natural capital into one of the most followed economic indicators, the GDP (e.g. El Serafy 1991, 1997). This was seen to be necessary, because money is the only language that economic agents take into account (Pearce and Atkinson 1993). Therefore, when nature was named as capital, it not only meant the representation of nature as a monetary asset. It furthermore defined humans, the subjects and objects of environmental policy as rational, calculative economic actors – consumers and investors.

Ecological economics, on the other hand, applied the practices of ecosystem modelling and biophysical valuation to estimate the value of natural capital in terms of an ecosystem. The main focus was to develop management strategies which guarantee that human actions do not cause irreversible changes in the state of ecosystems. Wackernagel and Rees (1997) introduced the concept of ecological footprint and Hinterberger et al. (1997) the concept of MIPS (material input per unit of service) as material indicators of human–nature interaction. These measurement tools focused on the physical stress that human activities caused on environment. Different energy and materials throughput models were presented as tools for a better ‘stewardship’ of the object of governance, the planet Earth as a global ecosystem. This placed the emphasis of environmental policy on one hand on the idea of scientific ecosystem management and on the other hand on the ecologically aware consumer who can reduce his material impact on nature if adequate information about different choices is available. The functioning of biophysical management tools is thus also based on the existence of a rational consumer, although this time he was a green consumer.

The metaphor of natural capital thus suggested diverse views on the relationship between humans and nature. Figure 1 shows the multiplicity of attributes that were connected with the words nature and capital in different contexts of environmental economic discourse. It also shows how the perspective of capital, as it was interpreted in ecological economics, emphasised the attributes of nature that were linked to its productive and measurable functions (bold) and suppressed some other attributes (italics). It was thus a means to impose the economic view on natural processes. The arrow from the word ecosystem back to capital on the other hand illustrates the attempt of ecological economics to use the metaphor of natural capital to integrate ecosystems, and following from that a new approach to uncertainty, into the core of economic theory, i.e., an attempt to provoke a major theoretical shift in economics.

Despite the different views offered by the metaphor, the context of economic discourse on sustainable development nevertheless led to a narrowing of the metaphor. In the course of time, the metaphor was reduced to refer to nature as productive machinery. Therefore the metaphor downplays meanings of nature and natural other than those that are related to production. Sabine Maasen and Peter Weingaart claim that the socio-historical privilege attached to some metaphors is not only the result of some intellectual game, but a competition of

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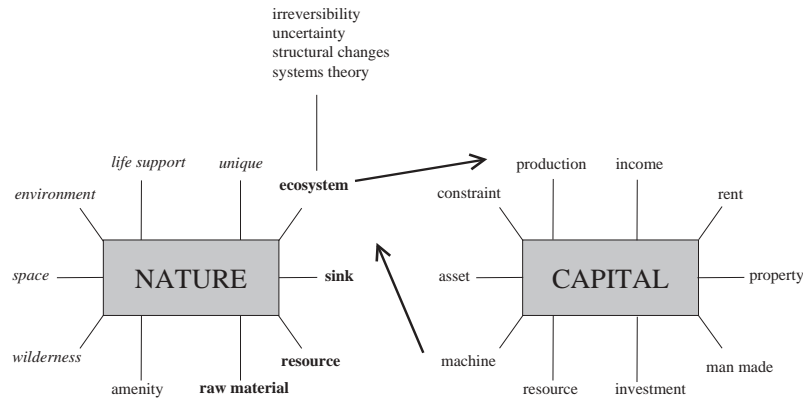


FIGURE 1. Meaning of natural capital.

existing and institutionally established discourses that select for or against the import of particular foreign constructs (Maasen and Weingaart 1995: 17). It seems that the strong quantitative connotation of the metaphor of natural capital stresses the measurement of nature's services. This made it a useful tool for ecological economists to claim expertise in analysing sustainability, due to their long history of ecological-economic joint modelling. The use of the metaphor coincided with a measurement debate, which culminated in a struggle over who has the appropriate theoretical and methodological resources to interpret the relationship between natural and human processes: should the information be based on ecological or economic knowledge production?

The need to withdraw from market analysis and the paradigm of substitutability was a central issue in biophysical economics and a rationale for the claim of strong sustainability. The use of the concept of natural capital however opened the previously biophysically oriented ecological economics to market valuation. Although the concept was defined in terms of ecosystem functions, the emphasis on capital underlined the definition of ecosystems' market values. In fact, this is not a surprising phenomenon, because the concept of capital is already used in a commercial sense in everyday language. A good example of the alliance between monetary and biophysical valuation methods is a paper published in *Nature* in 1997 (Costanza, d'Arge and de Groot 1997). The study takes monetary valuation even further than mainstream environmental economics would do and estimates the total value of the world's ecosystem services and natural capital.

The writers emphasised the severe methodological problems of their approach but argued for the necessity of such valuation studies. The claims were based on the idea that environmental policy choices are necessarily based on rational calculations. A decision-maker values how much ecosystem services she can afford to lose compared to the increase in benefit streams somewhere else. The more informed the decision maker is the better will the decision be (see, for example, Costanza, Perrings and Cleveland 1997: 7). In addition to an attempt to make the value of ecosystem services visible, the study can be seen as a way to claim that ecological economics is able to develop tools which can grasp both the monetary and the biophysical aspects of natural environments.

The study triggered considerable criticism within ecological economics and a special issue of *Ecological Economics* focusing on the study was published in 1998. A characteristic aspect of the criticism is that although implicitly present in some comments (e.g. Norgaard et al. 1998), there was very little explicit criticism of the idea of environmental policy as rational decision making. It seems, therefore, that the focusing of research practices on the estimation and use of natural capital at the aggregate level marginalises the point that environmental policy also deals with conflicts concerning distribution of environmental goods and bads. The solution for these problems is not usually found in efficient resource management. It needs better conflict resolution practices, which in turn require better understanding of diverse local historically-developed resource management institutions and power structures.

The competition between different calculations of natural capital spread also outside scientific discourse. As mentioned earlier, the World Bank started to develop tools for green accounting, and several countries developed their own green national accounting systems. As an alternative to official natural capital estimations, in 1992 Friends of the Earth Europe established a 'Sustainable Europe' campaign. During the campaign, local action-research teams estimated the environmental space of 38 countries. The concept of environmental space was offered as a biophysical measurement of natural capital. The campaign received scientific and methodological support from the Wuppertal Institute for Climate, Environment and Energy in Germany and the Commission of the European Union sponsored the campaign. The overview of the results of the campaign and an action plan were published in English in 1999 (Carley and Spaapens 1999). In the report, the estimations of environmental space are used to illustrate the unequal global distribution of environmental goods as well as the need to radically change production structures in the industrialised north. Despite the methodological differences and even differences in political goal setting, all the different calculations put the emphasis of environmental policy on the efficiency of the use of natural resources.

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5. AGAINST NATURALISATION OF NATURAL CAPITAL

The development of environmental policy required the constitution of the environment as a meaningful whole, a domain of social concern and a target of governing and policing (Darier 1999, Rutherford 1999). Constitution of the new object of governance was essentially connected with a development of different knowledge production systems which both defined the nature of the problem of environmental policy and offered tools for its solution. Economics and ecology were both important in this process. Ecology offered the image of ecosystem processes and economics defined their social meaningfulness. Ecological economics aimed to integrate these two and to offer a holistic view of the economy–nature relationship for policy purposes. The metaphor of natural capital was a symbol of this integration.

As a symbol of novel thinking, the concept of natural capital became a target of struggles about definition. The proponents of weak and strong sustainability selected different aspects of the metaphor and defined the concept in such a way that they could strengthen the position of particular theoretical traditions, namely neoclassical economics and ecosystem thinking, in the economic discourse on sustainable development. The aim was to affect the rules according to which claims concerning sustainable development could be made. David Pearce introduced the concept of natural capital to stimulate research on sustainability within the framework of neoclassical economics. Once the concept was introduced it was at the disposal of anyone. Costanza and Daly redefined the concept and used the ecosystem view on natural capital to impose ecosystem thinking into economic analysis and to argue for major theoretical change. They thus used the concept as a means to gain access and legitimacy for ecological economics in the economic discourse of sustainability. Therefore, although the concept of natural capital was imported both to the context of neoclassical and biophysical economics, its use did not break the disciplinary boundaries between different discourses. The use of the same concept did, however, create a common ground for interdisciplinary communication.

Despite the differences between definitions of natural capital, the conceptualisation of nature in terms of capital emphasised in both the discourses of weak and strong sustainability the relationship between natural capital and other types of capital and their substitutability. This led to a similar formulation of the core question of environmental policy: How much can we afford to lose our life support system with regards to gained benefit streams? As a consequence, the power struggle finally culminated into a development of competitive types of calculative practices, the biophysical and the monetary. The metaphor of natural capital became a centre of a new discursive field which focused on environmental economic calculation practices.

There are thus two basic problems with the spread of the concept of natural capital. First, it diffuses calculative practices and produces calculative agency in areas which have earlier been outside the realm of economics. The attempts to monetarise the intrinsic value of other species are a clear symptom of this process. Second, it marginalises other ways of expressing the relationship between humans and nature. This has important power/knowledge implications. The valuation of natural capital is a complex issue and involves diverse links between heterogeneous elements. It can not be calculated without adequate tools. Following from that, calculative agency does not emerge without those tools. Therefore, the ability to calculate is located in particular sites where inscriptions of the state of the world are collected and combined. Bruno Latour calls these sites centres of calculation (e.g. Latour 1987, 1999). By becoming a boundary object, the concept of natural capital acted as a point of translation which strengthened the role of certain centres of calculation. In addition, as the tools for economic calculations are not evenly distributed, imposing certain rules to calculate decisions can be a starting point for relationships of domination (see Callon 1998). This has forced, for example, grass roots organisations to develop their own calculation tools. Monetary valuations of the world's ecosystem services, governments' official environmental accounting systems and Friends of the Earth's environmental space estimations were all attempts to develop and strengthen a centre of calculation in which guidelines for environmental policy choices could be outlined.

Another problem arises from the tendency to create a clear distinction between nature and the human world in the estimations of natural capital. Both the ecosystem view and the monetary view of natural capital are based on the assumption of clear boundaries between nature and humans. This leads to difficulties in recognising the intertwining of human and natural worlds which becomes clear, for example, in the problems of dealing with so-called *cultivated natural capital* – agricultural land, cultivated forests etc. – which is neither a product solely of nature nor of humans. This is connected with neglect of the historicity of human nature relationship and other dimensions of that relationship than that of user and resource (see also Holland 1997, 1999). The tendency to downplay the value of lived nature in natural capital calculations, although necessary to enable calculations, causes a problem which is not only theoretical, that of the ability of the concept to grasp different aspects of human–nature relationship. Insofar as the calculation tools are used as a central tool to create knowledge, these practices force people to express their relation to the environment in specific, universal monetary or biophysical terms in order to be heard. Therefore, instead of stimulating approaches which would give a new insight into the evolving everyday practices through which humans are connected with their natural environment, the concept of natural capital seemed to marginalise these discourses and strengthen the ahistorical and non-contextual view of environmental problems.

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