Chapter 2
The Challenges of Measuring Sustainability Performance

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When dealing with systems where sustainability is an issue, you are dealing with systems where life, i.e. bios, matters. Without life no subject would be present caring about whether something is sustainable or not.

For systems where life is a defining characteristic the following typically occur

- Thresholds
- Irreversibilities
- Mutual dependencies between
  - Systems such as ecological, economic and social ones, and
  - System levels from subcellular physiological processes, such as photosynthesis and the physiological processes of cows and the rumen microbes in interaction to sustainable global food and bioenergy supply
- The phenomenon called resilience.

Altogether, this contributes to the complexity of systems where life, bios, is a defining system characteristic.

Figure 2.1 illustrates this.

The level of system complexity is further enhanced when including humans, due to the values, preferences and opinions of over 7 billion individuals in a spectrum of networks and organisations.

From a system ecological perspective, the human economy is a subsystem within ecological systems. Ecological systems deliver ecological goods and services, such as energy resources, material resources as well as the capacity of ecosystems to take care of wastes and in solar driven processes upgrade them to new resources.

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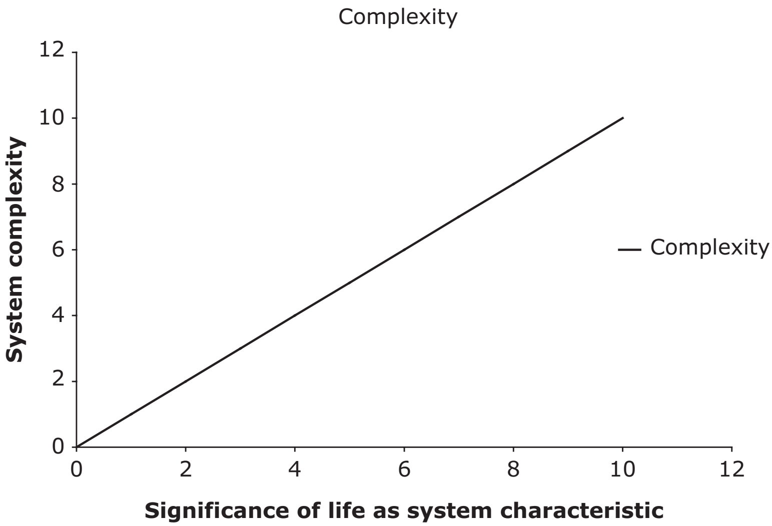

Fig. 2.1 Principle relation between the complexity of systems and the significance of life as system characteristic

Figure 2.2 presents this system using symbols and expressions common in systems ecology.

There are three independent energy sources to the global economy; solar energy, tides and energy from nuclear processes within the earth. Solar energy works through solar radiation, wind and rains. Hydro-power is a transformation of solar energy. Fossil fuels are the products of photosynthesis a long time ago. Bioenergy represents products of photosynthesis in near-time.

Figure 2.2 presents a strongly simplified version of reality. Real world systems are characterised by high level of feed-back mechanisms from the physiological processes within an organism to global carbon cycles. There are also feed-back loops between subcellular physiological processes and the global carbon cycle.

Within the human economy there are related biophysical and monetary fluxes. Labour, capital and natural resources go in one direction, their payments in the opposite one.

There is a pedagogic problem with Fig. 2.2. It presents a scientific language used to describe integrated ecological-economic systems that is unfamiliar to most people.

Figure 2.3 shows the same system using the language of economics.

The model contains three compartments. Ecosystems including natural resources (NR) constitute *Compartment I*. Sun, tide and processes providing heat in the depths of the Earth are independent power sources driving processes in economic and ecological systems. According to the first thermodynamic law the amount of energy

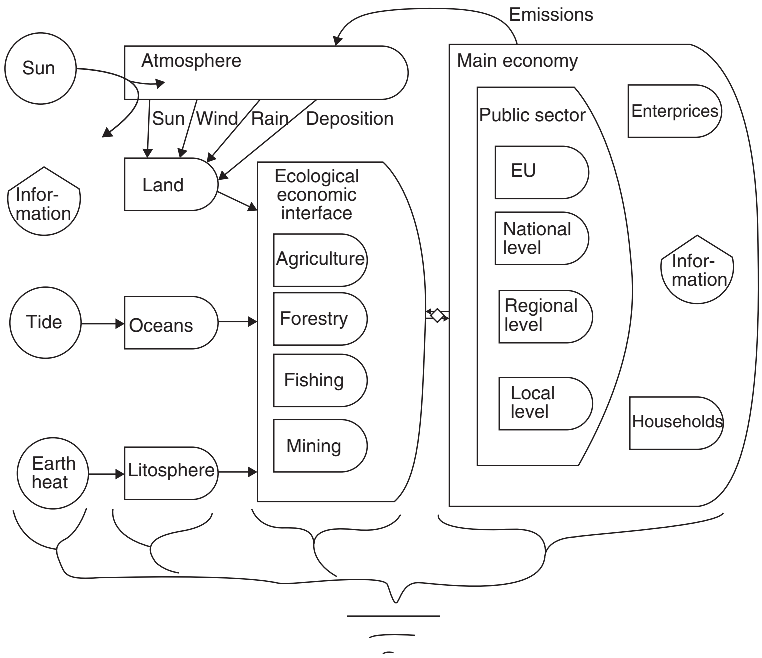

Fig. 2.2 A model of the global ecological economic system from the perspective of systems ecology based on the contributions by Odum (1988, 1996)

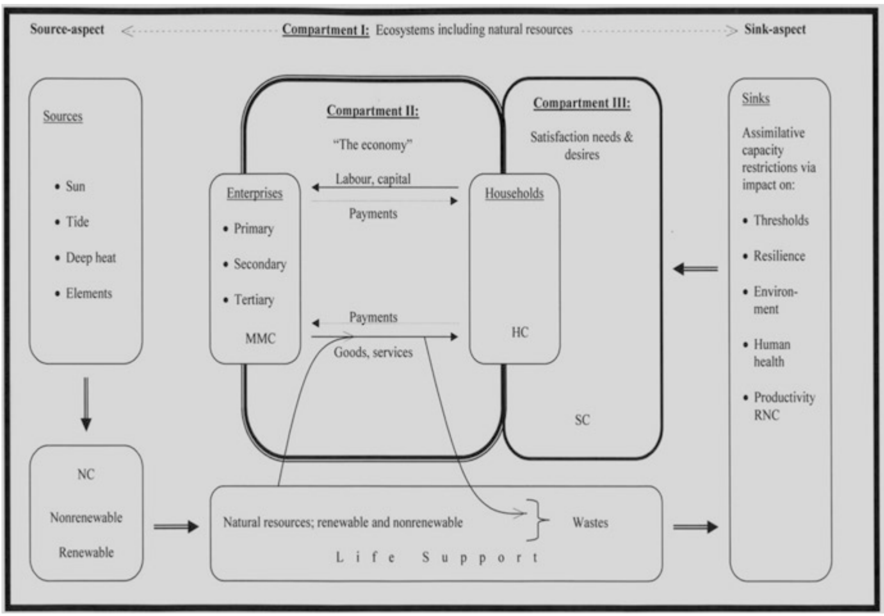

Fig. 2.3 A conceptual model of the economy in its ecological and social context (From Hellstrand et al. 2009). Abbreviations used in Figure. *HC* human capital, *MMC* man-made capital, *NC* natural capital, *NNR* non-renewable natural resources, *NR* natural resources, *RNC* renewable natural capital, *RNR* renewable natural resources, *SC* social capital

is constant while according to the second the quality of energy is degraded in real world processes (Pimentel and Pimentel 2008). The amounts of elements are assumed to be constant. Although this is not correct with regard to nuclear processes, it is an appropriate assumption for the purpose of this paper. In geobiophysical processes driven by independent power sources, elements are rearranged into stores of natural capital (NC). NC provides life-support, that is, the physiological necessities for life (Odum 1989). The economy consumes renewable and non-renewable natural resources (RNR and NNR, respectively), appropriated from the stock of NC. The availability of natural resources (NR) provides source restrictions to the economy. This is the source-aspect of ecological sustainability.

Ecological sustainability also includes a sink-aspect. The sink-aspect refers to the capacity of ecosystems to assimilate wastes from the economy without such negative environmental impact that the life-support capacity is threatened. Land-use may also affect the life-support capacity, and thus may be constrained by ecological sink-restrictions. The impact of the economy on thresholds, resilience, environment, human health and the productivity of renewable natural capital (RNC) is crucial in the understanding of how Nature through ecological sink-restrictions through the pressure Man puts on Nature, affects future human wellbeing.

In *Compartment II*, energy and other resources are transformed to goods and services measured in terms of GDP in processes steered by man-made and human capital (MMC and HC, respectively). HC refers to the capacity of the individual to contribute to production in Compartment II. It is a measure of the productivity of the individual. The primary sectors[a] act as a bridge between the first and second compartments, making NR available to the rest of the economy.

In *Compartment III* ecological goods and services produced in Compartment I as well as goods and services produced in Compartment II are consumed, satisfying human needs and desires. Social capital (SC) is related to the degree of social sustainability and is connected to aspects such as democracy, legitimacy of authorities and distribution of resources. At the interface between Compartments II and III, consumer prices and production values are established. Compartment II, including the interfaces to Compartments I and III respectively, is the primary focus in economics. It can be called the GDP economy. Prices are important information carriers and the basis for production and consumption decisions by market actors. Consumer surpluses describe the social value of the goods and services consumed and invested. GDP is an estimate of production, not welfare.

Compartment I defines ecological restrictions to society, Compartment II provides the means, while Compartment III contains the objective; human wellbeing.

The sustainability map in Fig. 2.3 is inspired by the way the ecological economic system was presented in ecological economics in the early 1990s. Important contributions were made by Herman Daly (Daly 1990; Daly and Cobb 1989) and Robert Costanza around 1990 (Costanza 1994; Costanza and Perrings 1990), as well as Hall et al. (1986). From this perspective, the path towards sustainability is described as

- A substitution of non-renewable natural resources with renewable ones
- Efficiency in the use of non-renewable natural resources as well as renewable natural resources

- A restriction of emissions and discharges from the economy to be within their assimilative capacity
- A restriction on land-use changes so that the life-support capacity of the landscape is not harmed too much.

OECD (2001) follows close to the perspective of the economic system as a part of the ecological system laid out by these authors. The challenges to handle are presented in the beginning of this chapter.

The brothers Eugene and Howard Odum are pioneers within systems ecology. Figure 2.2 represents their perspective of the economic system in its biogeochemical context. Within ecological economics, their description was translated into the language of economics. However, Figs. 2.2 and 2.3 basically describe the same system with the same basic subsystems and relations.

The model in Fig. 2.3 is a basis for later approaches from an economic perspective to understand what a sustainable economy is, such as

- OECD (2001) and their report *Policies to enhance sustainable development*
- Beyond GDP[1]
- The Economics of Ecosystems and Biodiversity (TEEB 2010).[2]

The perspective in Fig. 2.2 formed the basis for the thorough exploration of the state of the ecosystems of the earth and their delivery of ecosystems services supporting human wellbeing, initiated by the Secretary General of the UN at that time Kofi Annan, under the name Millennium Ecosystem Assessment (MEA[3]). E.P. Odum describes the life-support capacity of ecosystems as their basic capacity to provide the physiological necessities for life on earth. This includes clean air, clean water, food, forestry resources and natural resources in general. MEA follows this structure. Ecosystems, according to this perspective, support human wellbeing in three paths.

1. Natural resources can be upgraded to economic goods and services
2. The capacity to take care of emissions from society and often in solar energy driven processes, such as photosynthesis, upgrade them to new resources which can be utilised in a new circular loop in the ecological–economic production system
3. A landscape which is the product of ecosystems interacting with their geological contexts over millions of years, in which humans feel good.

If 2 represents a regeneration of wastes from society to resources, 3 refers to the regeneration of human minds and souls.

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[1] See http://ec.europa.eu/environment/beyond_gdp/index_en.html, accessed 2016-08-07.

[2] TEEB 2010. Mainstreaming the Economics of Nature: A Synthesis of the Approach, Conclusions and Recommendations of TEEB, http://doc.teebweb.org/wp-content/uploads/Study%20and%20Reports/Reports/Synthesis%20report/TEEB%20Synthesis%20Report%202010.pdf, accessed 2016-08-07.

[3] http://www.millenniumassessment.org/en/About.html, accessed 2016-08-07.

Regarding "circular loops" in ecological–economic systems this is a half truth. Elements and material can be recycled (almost) in infinity. Energy resources cannot. While the amount of energy is constant, the quality of energy in all processes we know of relevance for the human economy and society is decreased. Thus, the circular loop of material in the economy, in ecological systems and in integrated ecological–economic systems is driven by a linear flow of energy with quality that is degraded. This is important to know, as this puts limits on the physical volume of the human economy that can be sustained.

Taking the life-support systems of ecosystems into account as well as the economic and social parts of the human economy, we arrive at ecological, economic and social restrictions to the volume and character of what can be called a sustainable economy. This is narrower than the physically restricted maximal volume of the human economy.

The ecosystem-perspective of the economy in its ecological context, with the life-supporting systems in a central position, is quite similar to how these systems were described in classic economic theory during the eighteenth and nineteenth century, in which three production factors were identified; land, labour and capital. Labour refers to human capital in Fig. 2.3; capital to man-made capital; and land to natural capital. This way of presenting the economy, as a part of the natural system, was common in agricultural economics during the first half of the twentieth century. For centuries and millennia, society has constantly faced the challenge of managing agricultural and forestry systems in such a way that the harvest in the short term was high enough, while maintaining and enhancing the long-term productivity. During this course, analytical and management tools evolved with the basic capacity to handle the system characteristics presented in the beginning of this chapter.

Taking the analytical and management tools developed during centuries of experiences and scientific evolvement in agriculture and forestry together with the recent contributions in systems ecology briefly presented, results in a complementary description of what a sustainable society and economy is.

In a sustainable society and economy the long-term production of ecological goods and services, i.e. sometimes called ecosystem services, is greater than the consumption from the economy and society. The sustainable supply is greater than the demand. This focuses on the ecological part of sustainability. It is then the task of the economy and society to make use of the sustainable level of ecosystem services delivered, in a way that supports a good economic and social development within the ecosystems carrying capacity limits. This is not in conflict with common principles of sustainable development discussed above in relation to Fig. 2.3. It is another way to describe the same thing.

In Chap. 4, the supply and demand perspective of ecosystem services is applied on the issue of biological resources available for the economy from agriculture and forestry.

OECD (2001) identified an implementation gap and a knowledge gap as major obstacles for a sustainable development. From their perspective, the knowledge about what a sustainable development is and how to achieve it is quite good. However, the implementation of policies for sustainable development is poor and uneven.

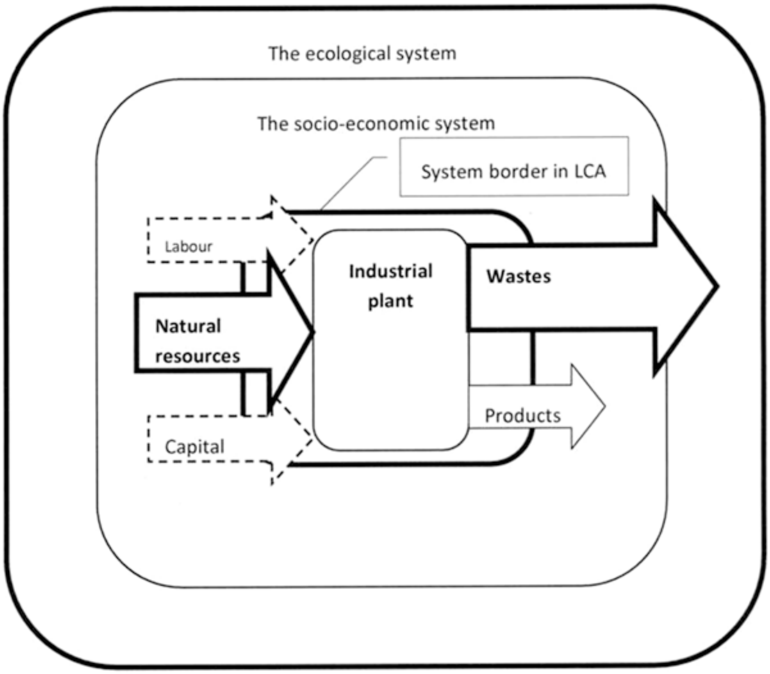

Fig. 2.4 LCA and the sustainability context

Hellstrand (2015) found that this situation could be specified. On a general level with a macroeconomic and what you can call a macro-ecological perspective, the challenge is quite easily expressed:

- Get the prices right so that they reflect positive and negative environmental and human health effects,
- Remove subsidies that support unsustainable choices,
- Apply policies that are neutral between sectors.

The problems occur when it comes to the everyday choices that all together determine whether the path towards the future is sustainable or not: On the operative level, choices aimed at sustainable development often miss the target as they rely on the rationality of models, approaches and methods that do not represent the knowledge frontier in those disciplines that represent the competence of excellence regarding the systems and issues that are at the focal point when sustainability is an issue.

Figure 2.4 illustrates the situation. It shows the gap between the characteristics of real systems according to the best available knowledge and the characteristics of the models of real systems used in different analyses aimed at supporting a sustainable development. Commonly, they are based on the logics of Life-Cycle Assessment (LCA) as defined within SÍSO 14040 and ISO 14044.

LCA is a methodology that was developed in the engineering sciences; thus, its scope is limited and excludes vital features of systems where life is a key system characteristic, as shown in Fig. 2.4.

The engineering-based conceptual model of the production system is the industrial plant. The importance of labour and capital (using their traditional meanings) is ignored. Furthermore, the model suggests that there are no natural resource costs behind humans, labour and capital. The focus is on influxes of natural resources, and effluxes in the form of wastes. Products and product quality in relation to their usefulness in the socio-economic system are typically treated with substantially less accuracy.

With its background in engineering sciences, LCA has its strengths in analysis of the technical aspects of industrial production processes (see Baumann and Tillman 2004). Inputs of natural resources into the production system and emissions out of the production system, where the industrial plant is the mental model used, are handled easily. Problems arise because engineering sciences do not provide expert knowledge regarding the ecological, economic and social process restrictions that define the level of sustainability in specific production situations. To overcome this limitation in the understanding of the total sustainability, different assumptions are made, providing analytical shortcuts. For example, it is commonly assumed that there are no time and space dependent variations whatsoever in conditions in ecological systems. Furthermore, ecological carrying capacity limits are not considered. With these assumptions, the concept of ecological sustainability becomes irrelevant as there is no longer any ecological process restriction that can be affected, and thus no ecological carrying capacity limit that can be trespassed. Such assumptions devalue the results obtained, given the sustainability context. This illustrates the scientific problems of extrapolation, here on the methodological level. Methods that have proved useful within the boundaries of engineering sciences are applied outside these boundaries, generating results that carry a high risk of being inaccurate.

There are similar problems within

- The EU-directive concerning Integrated Pollution Prevention and Control and its Best Available Technology-principle,
- The Integrated Product Policy of the EU,
- The Swedish system of Environmental Accounts,

to mention three examples. The basic problems are that the environment, the ecological system, is not located within the system borders, and that the modus operandi is the scientific language of physical sciences, while it is the understanding of the features of life, of bios, that is crucial.

Hellstrand (2015) presents a tool-box for sustainable development that substantially diminishes the implementation gap. The individual tools are derived from the fields of systems ecology, economic theory, theories of complex systems and agricultural sciences.

The individual tools are

1. A conceptual model of the economic system in its ecological and social contexts, in which natural capital, man-made capital, human capital and social capital are considered, see Paper I and II, and Fig. 1.
2. Biophysically Anchored Production Functions (BAPF), where production value in the economic production process are expressed as a function of inputs of natural capital, man-made capital, human capital and the environmental impact of the production process through impact on the life-support capacity. Goods and services measured in the adjusted GDP-terms suggested are means to support the maintenance of social capital, see Paper II.
3. A contribution within participatory multi-criteria, multi-level analysis for evaluation of how a specified subsystem contributes to a hierarchy of sustainability objectives in the ecological, economic and social dimensions from low to high system levels considering typical features of complex systems such as thresholds, resilience, irreversibilities, mutual dependencies between systems and system levels (Paper III).
4. System of ecological economic accounts (EEA) obtained when specifying BAPF in time and space, where capital stocks and their changes can be focused, or the flux of economic and ecological goods and services. EEA can be used to measure the performance of any system in ecological, economic and social terms and in relation to affected systems sustainability limits, if sufficient knowledge about them is available. Tables 3 and 4 present results from evaluation by means of EEA, where it is shown how the EEA measure contributions to a majority of the 16 national environmental quality objectives in Sweden decided by the Parliament, as well as to Millennium Development Objectives from the UN. Table 7 gives outcomes on a local community, regional and national level. Hellstrand (2003a, b, 2007) used EEA to measure sustainability performance on a regional level. Hellstrand and Yan (2010) present an evaluation of whether China is an option when Sweden and the EU reduce their contribution to climate change.
5. A simulation model of animal production systems with supporting crop production where EEA for specified agricultural production subsystems are developed with included biological-economic production functions based on Hellstrand (1988, 1989). The simulation model is a development of common tools within agricultural sciences used to optimise the use of available resources of land, labour and capital. The simulation model can be used to generate data for further analysis of sustainability performance of animal production systems based on a genuine professional understanding of animal production systems, and of how balanced agricultural production systems shall be constructed where in- and effluxes in biophysical and monetary terms between systems are constant. It is also an example of and suggestion for how on a societal level to find solutions supporting a sustainable development through the combination of different stocks of capital mentioned in 1. Hellstrand (2009) elaborates on this possibility in connection with a job concerning physical planning for sustainable attractiveness in Gothenburg on behalf of Göteborg Stad. The task was to develop new methods to measure values from agriculture in a landscape dominated by urban

and industrial elements utilising the concept of ecosystem services, and then apply them. In this context EEA was used as a means for urban planning for sustainability.

By the tools 1-5 a map of the sustainability landscape in a given situation and within a given context can be generated that reasonably guides a tour towards sustainable development, considering the complexity in systems where life is a defining system characteristic, see Fig. 2.1.

A relevant map of the sustainability landscape is essential, but not enough. A compass is needed as well to assure that the sum of actions of households, enterprises and government bodies result in an overall orientation of the societal development that is sustainable.

Ecosystems deliver ecosystem services. As around 75% of terrestrial land in Sweden is classed as agricultural land or forests, most of the total production of ecosystem services originates from agriculture and forestry. Globally, the corresponding value is 70%. A sustainable situation is at hand when the total consumption of ecosystems services is within the sustainable production level. One major incentive towards achieving this is to adjust the prices of goods and services so that they reflect the value of positive and negative ecosystems and human health impacts (OECD 2001). FAO (2006), Millennium Ecosystem Assessment (MEA 2005) and TEEB[4] make similar proposals.

FAO (2006) named their proposal Polluter Pays, Provider Gets, another common expression is systems for Payments of Environmental/Ecological Services, i.e. PES. Such systems are discussed in EU,[5] UNEP as a follow up of the work of Millennium Ecosystem Assessment,[6] IUCN[7] and TEEB.[8] It harmonises well with OECD (2001), and their stress on the importance of getting prices right, reflecting positive and negative ecosystems as well as human health impacts.

Hellstrand (1998) suggested a solution based on the Precautionary Polluter Pays Principle (the 3P principle) (Costanza and Perrings 1990; Costanza 1994). The 3P principle integrated the precautionary and the polluter pays principle into a market based insurance solution. The 3P principle made it rational for enterprises to reduce (the risk of) human and ecosystem health damages caused by production. It also provided incentives where enterprises benefitted from actions that reduced the uncertainty regarding possible negative external impacts of production. In the 3P principle, enterprises have the full responsibility for possible future costs of their activities.

[4] http://www.teebweb.org/wp-content/uploads/Study%20and%20Reports/Reports/Synthesis%20report/TEEB%20Synthesis%20Report%202010.pdf, accessed 2014-02-18.

[5] http://ec.europa.eu/environment/integration/research/newsalert/pdf/30si_en.pdf, accessed 2016-06-25.

[6] http://www.unep.org/pdf/PaymentsForEcosystemServices_en.pdf, accessed 2016-06-25.

[7] http://www.unep.org/pdf/PaymentsForEcosystemServices_en.pdf, accessed 2016-06-25.

[8] http://www.teebweb.org/wp-content/uploads/Study%20and%20Reports/Reports/Synthesis%20report/TEEB%20Synthesis%20Report%202010.pdf, accessed 2014-02-18.

With contrafactual reasoning, if the 3P principle had been in place, much of current agriculture would look different. For example, three of the most severe environmental and human health catastrophes we have experienced globally are related to the production of biocides, i.e. chemicals to control parasites, insects, weeds and fungi in modern agriculture;

- Seveso in northern Italy in 1976[9]
- The Bhopal disaster in India in 1984
- The Sandoz chemical spill in Switzerland in 1986.

If the 3P principle had been in place, the insurance costs for the companies assuring the capacity to fully cover the external costs that these events eventually caused, would have been so high, that they would not have been competitive.

In a broader perspective, this would have influenced the shape of modern agriculture, as practices causing poor human health and environmental costs would have to bear their full external costs.

However, one piece of the puzzle was still missing. The 3P principle did not link the consumption of environmental space to its production, i.e. it did not link consumption of ecosystem services to production. The 4P principle (the Precautionary Polluter Pays the Preventer/the Polluted Principle) however does this, within production levels set by affected ecosystems carrying capacity limits (Hellstrand 1998). The potential contribution of the 4P principle was discussed in relation to aspects such as: cadmium fluxes in the food system with its impacts on human health; the depression of photosynthesis, and thus production in forestry and agriculture as a result of ozone close to the ground due to emissions from society; carbon sinks in forestry as well as production permits to the forestry industry based on the so-called best available technology principle.

The 4P principle stresses the importance of not only utilising environmental fees and taxes but also reward systems when actors take measures to improve the environment and the production of ecosystem services.[10] In theory, with this kind of principle an insurance solution is enforced where environmental as well as human health risks of production systems are internalised in the price. Actors that harm the environment and/or human health are forced to pay those that bear the costs. Finally, in this system actors that produce ecosystem services that enhance the sustainability basis of society are paid for this production. In fact, the 4P principle provides a frame where for example, trading systems for emissions are anchored in the carrying capacity limits of affected ecosystems. By doing so, the market mechanism is used to enhance social and economic development in affected systems within ecological and human health limits. Solutions that provide low satisfaction of human needs per unit emissions will then be outcompeted while solutions that provide high

[9] Afterwards an EU-directive was named the Seveo-directive, with the aim to minimise risks for and effects of future accidents in chemical industries, see http://ec.europa.eu/environment/seveso/, accessed 2016-06-25.

[10] The issue of externalities and how to price them has been discussed for a long time within economics.

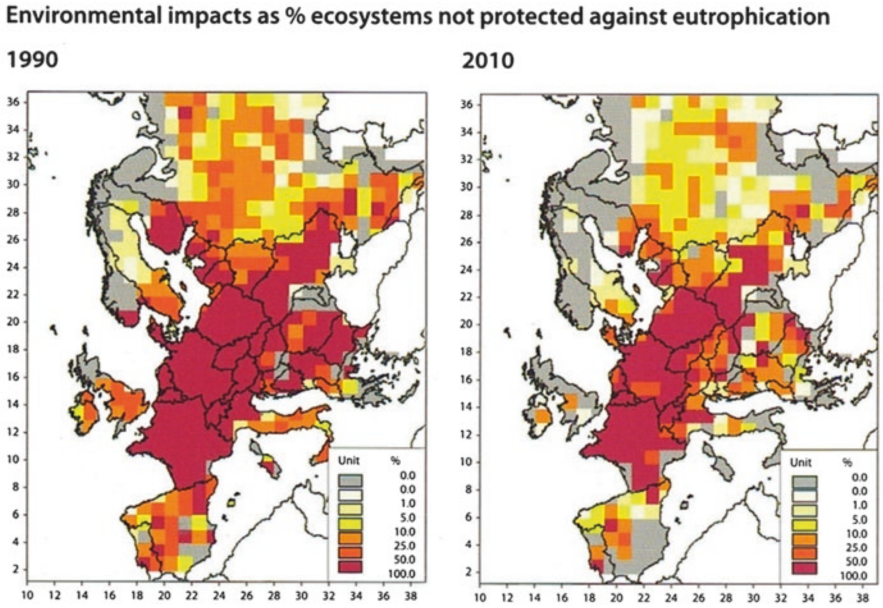

Fig. 2.5 The exceedance of critical loads for eutrophication around Europe for the base year 1990 and target year 2010 of the Gothenburg Protocol (From Pleijel 2007)

satisfaction of human needs per unit emission are favoured. At the same time, this system suggests how the total amount of emissions can be captured within the carrying capacity of affected ecosystems. It provides incentives where managers of ecosystems are encouraged to improve the production of ecosystem services; and it provides incentives favouring technological development and innovation favouring social and economic development within sustainability limits of affected ecosystems.[11]

The Swedish ecological-economic system combines industrial sectors with high resource and emission efficiency as well as ecosystems/recipients with higher remaining assimilative capacity compared to most other developed nations. The latter aspect is mainly a function of the low concentration of humans per ha of biologically productive ecosystem. The share of land area where deposition of nitrogen exceeds critical thresholds is substantially lower in Sweden compared to most EU countries (Fig. 2.5).

Figure 2.5 shows a huge variation in the degree to which critical loads, i.e. assimilative capacity limits, are trespassed in Europe. In the most densely populated

[11] This concept has been treated at a conference and a workshop at the Swedish Royal Academy of Forestry and Agriculture. The exercises are documented in separate reports, see *Jakten på den gröna marknadskraften*, in separate issues of KSLAs Journal. The first report is also available in English, *The Search for green market forces*. Links to these reports are http://www.ksla.se/publikationer/kslat/kslat-1-2006/; http://www.ksla.se/publikationer/kslat/kslat-6-2008/; http://www.ksla.se/publikationer/kslat/kslat-1-2006-eng/, all accessed 2013-01-03.

areas, which also have the highest economic activity per area unit, the critical load is trespassed for 100% of the area of ecosystems.

Emissions to air also have human health impacts. They were estimated to cause around 400,000 deaths in the year 2000 in the EU. The annual cost to society of this level of health impacts has been estimated at 270 to 880 billion € (EU-Commission 2005).

The spatial variation in ecosystem impacts through eutrophication due to air emissions (Fig. 2.5) is similar to the spatial variation in the decrease of expected life span due to air emissions of particles (Fig. 2.6). Thus, in the most densely populated areas with the highest economic activity, the expected lifespan is expected to be

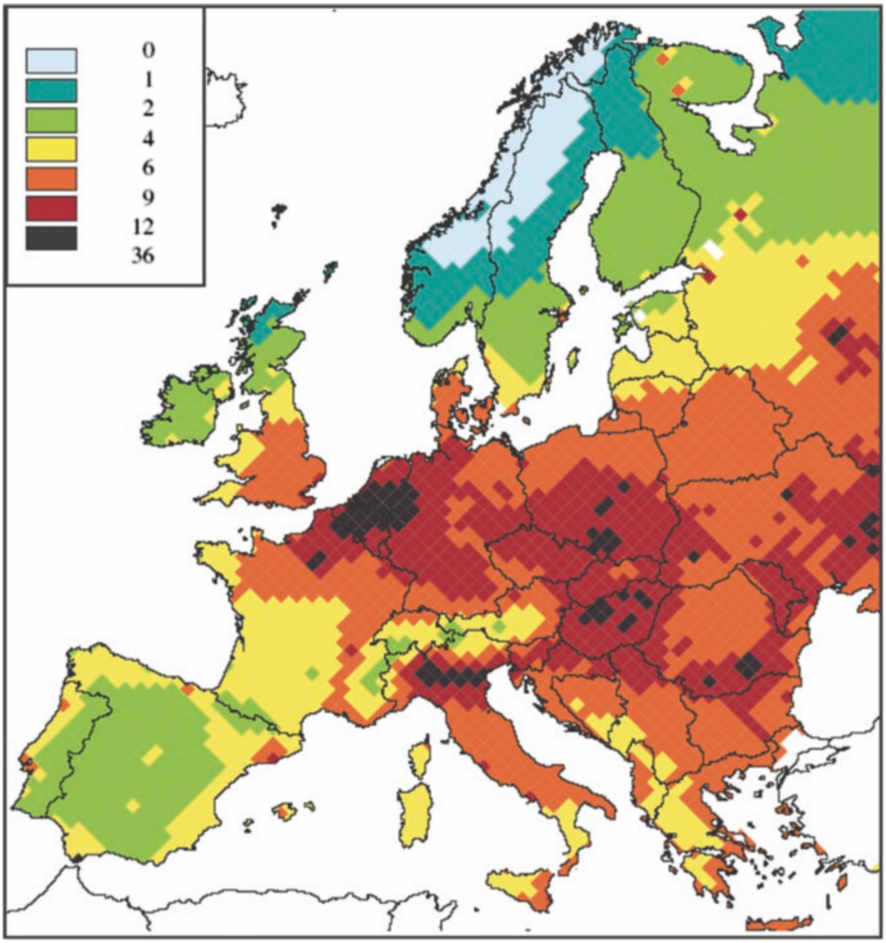

Fig. 2.6 Loss in statistical life expectancy in Europe in 2000 due to emissions of particles (PM2.5) (From the presentation "Kommissionens luftvårdsstrategi – CAFE: Fina partiklar men också de traditionella luftföroreningarna", Peringe Grennfelt IVL Svenska Miljöinstitutet Svensk Energi 27th of January 2005. Figure used with the author's permission.) in months

reduced by 1-3 years due to air emissions. In the three largest cities in Sweden the reduction is 6-9 months, while in the majority of Sweden it is 0-4 months (personal communication; Grennfelt 2009).

The concentration of ecosystem and human health impacts in areas with the highest level of economic activity per area unit in combination with the high economic costs in terms of human health impacts suggests that economically efficient policies for sustainable growth in Sweden and the EU would improve the competitive power in rural areas in Sweden in two ways:

1. Through payment for the production of ecosystems services such as the annual sink of around 170 million tonnes of carbon dioxide via photosynthesis in Swedish forests.
2. Through the competitive advantage of industries via the combination of resource and emission-efficient industrial plants located such that the negative pressure is zero or significantly lower compared with identical industrial plants located in areas with high economic activity per area unit with a corresponding high environmental and human health load (see Figs. 12 and 13; Hellstrand 1997 and 1998 treat this issue).

Incentives with the characteristics of the 4P principle would work via these two paths. At the same time, they would favour cost-efficient measures that help the adaptation of those urban/industrial regions to human health and ecosystems carrying capacity limits where they are now trespassed. This implies that the costs of such measures are allocated in those urban areas where the contribution to GDP will be somewhat lower when the ecosystem and human health impacts are internalised in the price mechanism, improving the environment and increasing expected average lifetime.

We suggest that the 4P principle works as a compass for societal processes resulting in sustainable development when complemented with sufficient maps of the sustainability landscape.

The five tools mentioned combined with the 4P principle express the system perspectives of Figs. 2.2 and 2.3, solve the major problems of Fig. 2.4 with regard to relevance for systems where life is a defining system characteristic, and thus have a high capacity to support increased sustainability performance of complex systems expressing the syndrome of complexity typical when life is a matter, i.e. sustainability (see Fig. 2.1).

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