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Ecological economics and organic farming

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Summary

Ecological economics (EE) is proposed as an approach to decision making and planning in organic farming. It is argued that EE is better suited for this task than the conventional neoclassical economy approach. The contribution that EE can make to the organic farming movement is apparent on the ontological level, through its focus on socio-economic systems as nested subsystems of the ecosystem. In addition, EE's stance on the issues of allocation, distribution and scale seems to constitute a more appropriate conceptualization about the interaction between socio-economic systems and the environment, which is more closely aligned to the principal aims of the organic farming movement. The concepts of time and scale are used as examples of how EE, with input from political economy, can help highlight problematic issues regarding the interaction between farming systems and their biophysical environment, which are not addressed in the neoclassical approach. Material Flow Accounting and Analysis (MFA) and Multicriteria Analysis (MCA) are discussed as practical

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examples of the framework that EE can provide for decision-making. It is concluded that, by reconceptualizing the way in which organic farming manages the complex interrelations between ecological and socio-economic systems, the EE paradigm and its frameworks for decision-making can be of considerable value to the organic farming movement.

Introduction

Traditional, neo-classical economic theory limits itself to monetary assessments of production efficiency and economic aspects of different production systems and their use of resources. This seems unsatisfactory when analysing the differences between organic and conventional farming, because the rationale behind organic farming includes non-economic aspects such as minimizing the use of non-renewable resources and pollution and improving animal welfare. Ecological economics (EE) has been proposed as a trans-disciplinary framework, which moves beyond the approaches employed in traditional economics in that it considers the natural environment as an integrated part of sustainable development (Costanza *et al.*, 1997). What does EE, as an analytical tool and decision-making framework, have to offer the organic farming movement, and where does EE differ from more traditional economic approaches? In this chapter we will first present how the economic system works from a political economy approach, and show how the functioning of a capitalist market economy has an inherently contradictory approach towards the larger natural ecosystems of which it is part. Secondly, we will present new theoretical insights on how organic farming, with its rules and regulations, can be regarded as a response trying to overcome the environmental consequences of these contradictions in agriculture. Thirdly, we will give some examples of how EE, as a trans-disciplinary approach, can be of theoretical and methodological support to the organic farming movement.

Ecological economics as a trans-disciplinary approach

Interactions between ecological, economic and social systems

Ecological economics primarily differs from traditional neoclassical economics by being a trans-disciplinary field of study, which examines the interactions between economic and ecological systems from a number of related viewpoints. Ecological economics focuses on the human economy both as a social system, and as one constrained by the biophysical world. Therefore EE often focuses on areas where economic activity comes into conflict with the well being of the ecological and the social systems. The first of these systems ultimately supports all activities, while the second is the system to which the benefits of economic activity should ultimately be directed (Edwards-Jones *et al.*, 2000).

EE is therefore automatically concerned with three analytic focus points:

- the ecological system;
- the economic system;
- the social system.

where the last two are considered open subsystems of the ecological system: a system that is finite, not growing and materially closed (though open to solar energy) (Figure 4.1).

EE emphasizes the relationships between these systems at a number of levels and scales, from the local to the global. It treats human beings as integral components of, and active participants in, the ecological systems that support them, rather than as external to these systems. It searches for ways in which analyses of these different systems can complement and support each other.

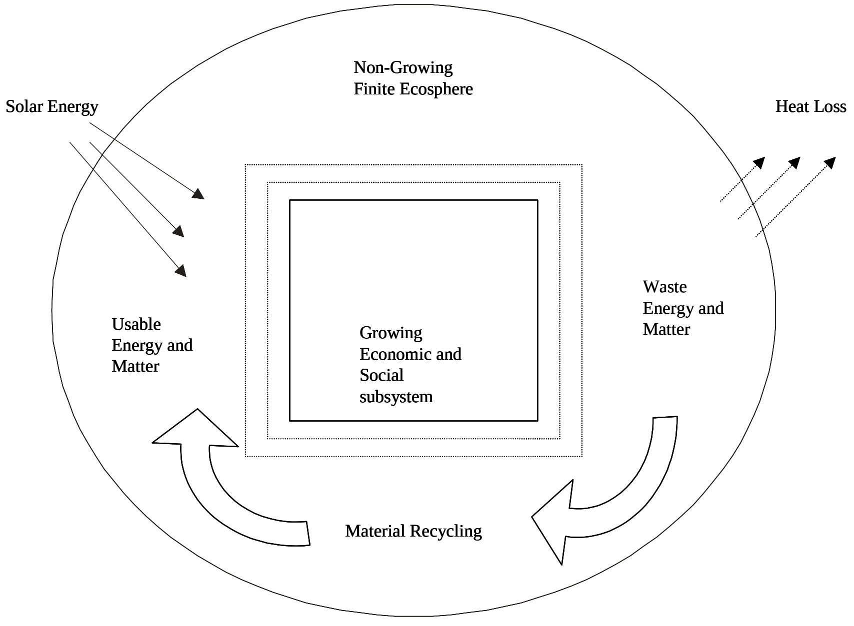

Figure 4.1. Ecological economics sees the economy as an open, growing, wholly dependent subsystem of a materially closed, non-growing, finite ecosphere (Rees, 2003).

The overall scale of the economic system, relative to the wider environment, is a key issue in EE (Daly, 1973). Daly argues for a ‘steady-state economy’ where the throughput flow of the economic system should be lowered to a minimum, because the throughput is the inevitable cost of maintaining the stocks of people and their wealth (Daly, 1991).

Thermodynamics in ecological economy

Due to the EE view of the economy as an integrated part of the biosphere – as an open subsystem of the environment it is essential to focus on the flows of matter and energy through the system, and the thermodynamic laws governing these processes. The concept of entropy and the laws of thermodynamics highlight how resource and energy scarcity, as well as the irreversibility of transformation processes, can constrain economic action (Georgescu-Roegen, 1971; Baumgärtner *et al.*, 1996).

The First Law of Thermodynamics says that in a closed system the amount of energy and matter is constant. This is the law that Boulding (1966) refers to when he describes the economic subsystem as a ‘spaceman-economy’. There is a finite amount of energy and matter onboard Spaceship-Earth, and there is a limit, in time and scale, on how we can use it. The other thermodynamic law is the law of entropy. This describes how energy or matter is structured within a system. The higher the structure and organization is, the lower the level of entropy. The less structure and organization, the higher the entropy level.

Entropy can be interpreted as an indicator of the system’s capacity to perform useful work. The higher the entropy value, the more energy already irreversibly transformed into heat, the lower the amount of free energy within the system and the lower the system’s capacity to perform work. Most goods that we find useful have relatively low specific entropy per unit of mass (i.e. they ‘wear-out’ with use, becoming more and more ‘mixed-up’ with the environment (Bisson and Proops, 2002)). On the other hand a large part of our production is derived from raw materials that have rather high specific entropy (e.g. iron ore), but are extracted with the help of low specific entropy fuels. However, the production of a low specific entropy object, such as iron, generates other high entropy ‘products’, like solid slag, carbon dioxide and waste heat, thus ‘all production is joint production’ (Faber *et al.*, 1998). This is due to the Second Law of Thermodynamics which tells us that entropy increases throughout any production process.

So, every process of change moving us away from thermodynamic equilibrium requires low entropy energy. This is the case for natural ecosystems (e.g. a leaf growing on a tree) as well as for the human economy (e.g. the production of metal from metal ore) (Baumgärtner, 2002). However, there are at least two characteristic differences between natural and industrial metabolism (the material and energetic dimension of the economic process) (Ayres, 2001):

- The low entropy energy employed in modern industrial economies is typically not sunlight, as it is in ecosystems, but energy stored in materials, such as fossil or nuclear fuels.
- Material flows in our economic system are not bound into closed cycles, as they are in ecosystems but, to a large extent, are one-way throughputs. Materials are taken from reservoirs outside the economy and are ultimately disposed of in other reservoirs outside the economy. As a consequence, economies not only emit waste heat, as ecosystems do, but also generate vast quantities of material waste.

So, from a thermodynamic viewpoint, waste is an unavoidable and necessary joint product in the production of material goods. It is important to consider the (in)efficiency of the processes as well as the properties of the waste, and thus distinguish between high entropy waste, in the form of heat, and low entropy waste, in the form of waste materials. The former may be considered a minor problem since it can, in principle, be radiated into space, but can also cause harm when directly released into ecosystems or the ability to radiate heat may be impaired by the greenhouse effect (Baumgärtner, 2002). It is the latter, which accumulates in the biosphere, that causes major environmental problems. This is due to the available energy still contained in waste materials, i.e. the potential to initiate chemical reactions and perform work (Ayres, 1998).

Thermodynamic analysis can then be used to identify sustainable social modes of metabolism which, according to Baumgärtner (2002), conform with the following principles:

1. To not use material fuels as a source of available energy, but only sunlight.
2. To keep matter in closed cycles, i.e. let heat be the only true waste.
3. To carry out all transformations in a thermodynamically efficient way.

Thermodynamics is thereby a tool to identify feasible solutions and their physical efficiencies. However, before a choice can be made we need to know which criteria must be included in a valuation and how these criteria are going to be judged. This implies to include how the society perceives and values the different joint products, the processing of them and the waste or pollution they generate. This means that we need to link the material and energetic aspects of production with human perception and valuation of commodity products and waste joint products (Baumgärtner, 2002). See the example shown in Chapter 7 about different perceptions of waste.

Ecological economics and strong sustainability

The view of the economy as an open subsystem of a wider finite ecological system is in sharp contrast to that of neoclassical economics, where the economic system is viewed as an open system *independent* of the boundaries from the ecological system. The dependencies only become relevant for the economic system, when the ecological system constrains further growth, through natural resource scarcity or vulnerability to pollution. Environmental problems are seen as *externalities* that appear because of market failures, and should be solved through the market. This can either be achieved through higher market prices for scarce resources (reflecting laws of supply and demand) or through internalizing the costs of pollution.

Neoclassical economic theory assumes that, over time, the market can and will solve the constraints set by the ecological system in its interactions with the economic system, by generating new technologies, new ways of organizing production, or new substitutes for the depleted resources.

A common theme for both neoclassical and EE in relation to environmental concerns is the question of maintaining economic activity into the future, whether at the local or the global scale. These concerns have led to the ubiquitous concept of 'sustainable development', described as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (WCED, 1987). In economic discourse, two competing positions, those of weak and strong sustainability, prevail today over the question of how to avoid compromising future generations' ability to meet their needs (Neumayer, 2003).

Weak sustainability argues for the need to maintain the *total capital stock* between generations. Total capital stock would be *natural capital*, like trees, fish, minerals, oil + *man-made capital*, such as machinery, houses, roads. In the weak sustainability approach it is acceptable to deplete certain natural capitals like oil resources if this leads to investment in man-made capital, such as universities generating new wealth, thereby securing the total stock of capital for the next generation.

The strong sustainability position focuses on natural capital, and argues for the need to maintain or increase the stock of this between generations. The wealth from using oil should therefore be directed to energy efficiency or renewable energy resources. The strong sustainability position therefore imposes some restrictions on the use of resources that imply stronger public interference in the market economy. The issues at stake here are those of *complementarity* and *substitutability* between natural resources turned into man-made resources. Ethical and philosophical values about nature influence the contrasting viewpoints about what should be handed on to future generations.

In general, neoclassical economists – including the larger part of environmental economists (e.g. Pearce and Turner, 1990) – favour the weak sustainability position, whereas ecological economists support the strong sustainability position. Table 4.1 compares the differing economic perspectives of EE and neoclassical economics.

Table 4.1. The differing economic perspectives of EE and neoclassical economics (Rees, 2003).

Neoclassical economics	Ecological economics
• Economic system is static, linear, deterministic • Economy separate from the environment • Models based on analytic mechanics· • Substitutions are possible so there are: • No limits to GDP growth • Analysis preoccupied with growth • Efficiency oriented • Emphasis on production/consumption • Short-term frame • Favours monetary assessments	• Complex systems are dynamic, non-linear, self-producing • Economy as a subsystem of ecosphere • Models recognize thermodynamics • Complementarity dominates so there are: • Constraints on growth • Analysis focused on development • Equity oriented (intra- and intergenerational) • Emphasis on well-being (social capital) • Long-term horizon • Favours biophysical assessments

These contrasting perspectives between EE and neoclassical economics generate different precepts and implications on values, justice and policy prescriptions. According to Vatn (forthcoming) the systems perspective on nature demands a view of societal processes while the individualistic perspective of neoclassical economics adapts a more ‘itemized’ perspective of nature. In the institutional perspective for environmental management, the focus is first on the rights structures involved – i.e. who gets access to which resource, how different uses are allowed to affect other uses, and how the institutions involved treat such conflicts. A secondary question is that of how different regimes motivate actions and influence values (Vatn, forthcoming). This discussion parallels that about ecological justice (se Chapter 3).

In what ways are these different perspectives and values about the interrelations between economic activities and the environment of interest to the organic farm movement?

Political economics and the conception of time and scale

‘Time is money’ as the old saying goes, but it carries a central truth when it comes to understanding the depletion of many ecological systems caused by the workings of the economic system.

From a political economics point of view money (M) (or capital) is the starting point to understand the workings of a capitalist market economy. As illustrated in Figure 4.2 money (M) is used for buying commodities (C) such as natural resources, labour and technology. Through production these commodities are organized as efficiently as possible to produce a new commodity (C) sold at a market. The intention is that the money received is higher than that invested (M becomes M1), and production can be maintained by M1 being reinvested.

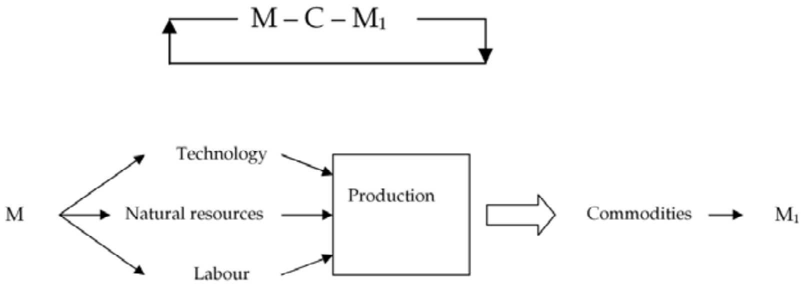

Figure 4.2. Resource flow from the political economic perspective.

In the political economy model money has a cycle (Marx, 1970, [1867]).

The circuit of money introduces time into the model, and 'time becomes money', influencing how commodities are produced and distributed to the market, in order to accelerate (i.e. shorten the return time) the return of M.

Secondly, the organization of a market economy, protected by institutions securing private property and a competitive market environment, enforces individual producers to be constantly alert for new technologies, new ways of organizing production or utilizing new resources to reduce costs, if they want to stay in business. This forced creativity, driven by the market's competitive downward pressure on prices, generally leads to producers following one, or more, of three logical paths:

1. Expanding production by using economies of scale and/or of scope.
2. Extracting or exploiting the input factors more efficiently.
3. Shortening production time by reorganizing labour, take advantages of the division of labour, apply new technologies, make better use of resources etc. Shortening production time reduces the time needed to reproduce capital, hence the cost of M invested becomes less.

This insight from political economy, on the pressures within the economic system to constantly grow in scale, and shorten production and distribution times, takes us to the heart of understanding some of the major contradictions inherent in the capitalist market economy and its relations with the ecosystem.

As we recall, from the perspective of EE, the economic system is viewed as a subsystem of the ecological system. This connectedness becomes clearly evident when we focus on time and scale.

Behind every effort in the economic system to reduce time and expand scale and the resources used, there exists another time and finite level of scale in the ecological system. There is the bio-spherical time, which created the mineral resources long before man was born. There is the time needed for nature to break down waste and to reproduce renewable resources. There is time needed for humans to reproduce themselves (physically and socially), as well as the workings of the more general time of various natural, social and cultural processes taking place in the world around us.

In a world made up by natural systems (living systems, ecosystems, climatic systems, socio-cultural systems, farm systems etc.) the ongoing pressure within the economic system for shortening production time and growing in scale, inherently potentially collides with the various times and scales required by the larger ecosystem to produce, or reproduce, itself.

How, where and when such collisions will occur is a complicated dialectic process that depends on the type of resource extraction, technology used, cultural knowledge and social morality of man, as well as the scale of intervention by the economic system into the ecosystem. This is one of the main reasons why advocates of EE emphasize a trans-disciplinary approach to better understand the changes in the environmental system in relation to the impacts of growth in the economic (market) system.

Farming, production time, nature's time and scale

In agriculture the borderline and contradictions between the economic system and the environmental system become evident, when we examine the production time of agricultural commodities and the scale of output.

In contrast to industrial production, using non-living raw materials, commodities in agriculture are living species that tend to slow down the reproduction (turnover) of capital. Since firms extract profits from each cycle of capital, they can only use these profits to replenish and expand their production when the production cycle is over and the product sold.

Figure 4.3 illustrates how production time consists of both labour time and nature's time. Production time can be prolonged due to drought, diseases or other more uncontrollable natural causes, *so unsteady nature time* has been added to the total production time. The arrows show the deliberate attempts (mainly by research and other efforts) to reduce production time either by shortening labour time or the time it takes for nature to produce a certain agro-commodity. Such attempts will include innovations from farmers, agro-corporations and researchers as well as governmental schemes all designed to help agro-capital achieve a better, and less risky, profit. These attempts can also be driven by *indirect* pressure via retailers and food processors squeezing farmers on price margins or imposing specific requirements on production size and time of delivery (Kledal, 2003: 19).

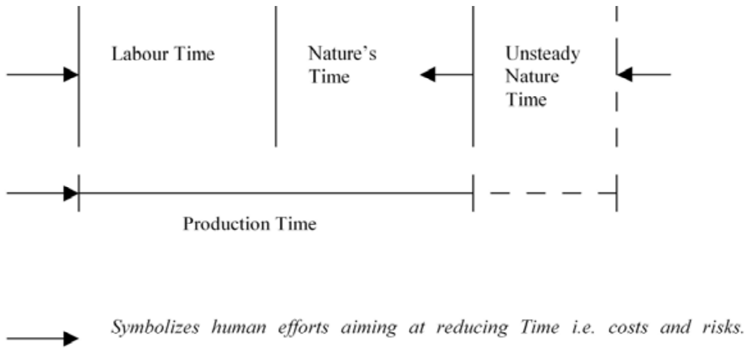

Figure 4.3. Production time in agriculture.

As organic farming relies on the utilization of natural resources, and focuses on sustainability, through (among other things) recycling resources and reducing pollution, it is an endeavour that shares many of the values and perspectives of ecological economics. However, the ecological economics literature has paid little attention to exploring how the principles of organic farming combine economic with ecological benefits for society as a whole.

Attempts at reducing labour time could typically include specialization, division and enlargement of agro-production so the farmer, or farm workers, only have one or few work processes, so as to better utilize economies of scale. For example, one farm takes care of only farrowing, another produces only hogs, but they can both produce more per labour unit.

Examples of attempts to shortening nature's time could be new genetics, or better management and feed systems that speed up growth. Reducing unsteady nature time could involve the implementation of technologies like pesticides, GMO, precision farming (GPS: Global Positioning System) etc.

As well as the noted differences that exist between agriculture and industry in relation to the cycle of capital and the relation to turnover time, there are considerable differences between different agro-commodities in regard to both production and labour time.

Figure 4.4 shows the production time of fattening hogs and wheat. The turnover frequency of hogs can be almost four times per year, whereas for wheat it is only one (in the northern hemisphere at least).

These two examples, one a plant the other an animal, show that, in general it has been easier for humans to shorten production time for animals, whereas for plants the push from capital has been to raise output (through higher yields). In the southern hemisphere, though, it has been possible to expand the cycles of plants, such as maize and rice, and thereby shortening the return time on capital invested in plant production.

In Table 4.2 a few examples are used to illustrate increases in farm productivity through shortening production time for animals (speeding up the production cycle) and raising yields in plants in conventional farming in Denmark.

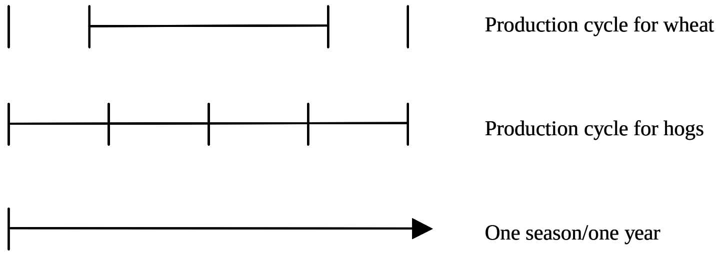

Figure 4.4. The number and length of production cycles for wheat and hogs during a one-year season.

Table 4.2. Rise in productivity of different agro commodities in Denmark between 1980 and 2004 (Pedersen *et al.*, 2001; Landskontoret for Svin, 1980-81; Jultved, 2004; Danish Agricultural Advisory Service, 2004 (www.lr.dk/budgetkalkuler2004)).

	1980	**2004**
Broilers	33 g/day	50 g/day
Fatteners	600 g/day	833 g/day
Winter wheat	6700 kg/ha	8300 kg/ha

The ability to raise productivity in animals and plants has given rise to various environmental and animal welfare problems. For example, the increased growth rate in broilers has led to serious leg problems because of weak bones, and the higher yields in cereals have led to increased leaching of nitrogen and problems of pesticides in ground and drinking water. The development of organic farming is closely related to these environmental and animal welfare problems, and the principles and standards of organic farming implicitly place constraints on the returns to capital investments in agriculture.

Organic farming: a response to ecological damage caused by growth in scale and shortening of production time

Agriculture is unique in the sense that economies of scale and production time in the economic system are very closely connected to the various time requirements and scales of the ecological system that it relies upon. Therefore, conflicts and constraints between agriculture, as an economic subsystem that works with nature and living species, and the ecological system of which it forms part, are more evident than they are in industrial production.

Capital's ongoing push for maximizing profits (or minimizing costs) will, at certain points, encounter different types of constraints. This is shown in Figure 4.5, where constraints are encountered when trying to raise labour productivity, shorten the biological time on animal reproduction. Ecosystem constraints, such as polluting the environment, can be encountered, from trying to raise output. The black arrows in Figure 4.5 illustrate this. The more the market economy pushes for shortened production times and increased output, the more constraints it will encounter. These constraints can, at some point, lead to various types of societal conflicts (or externalities): alienation from how food is produced, environmental degradation, inadequate food safety and animal welfare, as well as concerns about the marginalization of farmers and rural areas.

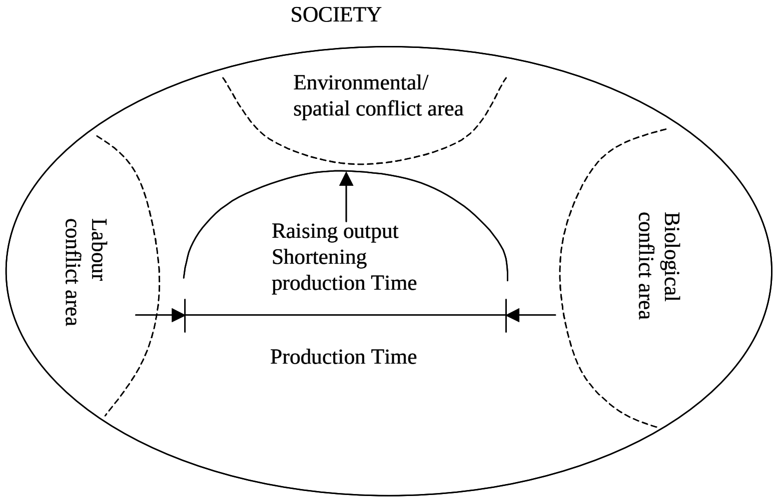

Figure 4.5. The connection between farming and areas of potential environmental and societal conflicts.

Organic farming can be viewed as a response to these conflicts. The rules and regulations set up by the organic farmers and consumers are, in many respects, counter rules that either *extend* nature’s time, labour time and thereby total production time, or constrain scale and resource use, by limiting certain technologies or inputs. These include rules about animal welfare with regard to space and access to the open air, bans on the use of pesticides, limits to fertilizer use and basing nutrient supply on improved soil fertility, principles of self-sufficiency etc. (Kledal, 2003: 23).

Table 4.3 shows differences in productivity between conventional and organic farming for certain agro-commodities, illustrating how the rules and regulations of organic farming impose lower productivity and higher feed consumption (in the case of fatteners) as a trade off in addressing certain environmental and animal welfare problems. At first glance it might seem odd that it takes more feed to produce organically. It should be kept in mind though, that the overall fossil energy input of organic farming often is lower than that of conventional farming. However, the overall economic performance of organic farms is not necessarily lower than in conventional farming (FØI, 2004). This shows that the apparent trade-off between productivity and solving environmental and animal welfare related issues is not as clear-cut as it might seem.

It is these self-imposed constraints on input use and cost–minimizing efforts that reduce productivity and make organic products more expensive within today’s institutional market regime. This is because organic farmers and consumers have voluntarily internalized the value of the ecological system as a reservoir of wealth creation for future generations. The challenge is how to translate these so called *private cost*s internalized by organic farmers and consumers into *social benefits* for the whole of society.

Table 4.3. Productivity differences between Danish organic and conventional production, year 2004. (Pedersen *et al.*, 2001; Landskontoret for Svin, 1980-81; Jultved, 2004; Danish Agricultural Advisory Service, 2004 (www.lr.dk/budgetkalkuler 2004); Ørum and Christensen, 2001).

	Organic	**Conventional**
Broilers	24 g/day	50 g/day
Fatteners (Energy consumption)	3.16 FE/kg	2.86 FE/kg
Winter wheat (output)	5500 kg/ha	8300 kg/ha
Winter carrots (output)	35 t/ha	50 t/ha

In this regard the framework of EE can provide a structure for addressing some very important research questions within and about organic farming. One of these is assessing the sustainability position brought about by organic farmers' self-imposed lower productivity at the farm level (higher energy consumption in feed, lower yields, more land needed for the same amount of food production etc.), and the societal 'trade off' generated by maintaining a steadier state economy, with lower waste from using less energy, no fertilizers or pesticides and a minimal use of veterinary medicine. Another is to address the sustainability position of organic farming in a global perspective, in relation to world food consumption (see Chapter 11), increasing global food trade as well as the need for a more just distribution of resources and access to them.

The ecological economic perspective and organic farming

EE is mainly about scale, distribution and efficiency and addresses these questions from the perspective of its vision how the economic system is nested within the social system, which in turn is nested within the ecosystem (Vatn forthcoming).

The issue of 'scale', which refers to the physical size of the economy relative to the containing ecosystem (see Figure 4.1), is not recognized in standard economics. EE claims that *sustainable scale* and *fair distribution* are both problems that logically demand solution prior to *determining efficient allocation*. Scale determines which natural resources are scarce from an ecosphere point of view (Figure 4.1) and what is free or unlimited. Distribution determines who owns scarce goods or services. Only after these issues have been determined is the market able to effect exchanges, determine prices and allocate resources efficiently (Daly, 2003).

The role of entropy and the finite nature of the ecological system should also lead us to reconsider our conceptions of evolution, progress and the production of material things. Thermodynamics and biology will force us, over time, towards a state of minimum production of entropy and conservation of resources. To maintain the energy flow at a low level, slowing down the entropic process, we must look towards a more decentralized, small-scale organization that uses renewable resources (Tiezzi, 2002).

The principles of organic farming share very similar lines of thought. By setting up its own democratic counter rules, regulations and values on farm production methods and distribution, organic consumers and farmers have created a social setting trying to implement:

- sustainable limits on output (e.g. max 1.4 LU per ha);
- letting the resource flow on the farm depend as much as possible on the farm systems' own reproductive abilities;

- connecting social justice and farm production with environmental issues. Examples of the latter could be Community Supported Agriculture (CSA), Ecological Villages, or various types of closer links between producers and consumers sharing economic and environmental responsibilities, both locally and globally.

These policies and actions within the organic movement, designed to address natural resource and environmental constraints, constitute a complex system with many components and where many actors are interacting to produce self-organized systems, which can only be adequately evaluated by analysing and examining the ecological and the economic systems simultaneously. An analytic framework encompassing both properties is therefore an obvious choice of tool (Costanza *et al.*, 1991).

Frameworks for decision-making

Economists have attempted to help decision-makers by finding ways to measure the wide range of effects of environmental changes on a single monetary scale. The derivation of a monetary value for goods that do not have a market value – which is basically the case for many environmental goods and services – is an attempt to extend the utilitarian and democratic principle of the free market into environmental decision-making (Edwards-Jones *et al.*, 2000). Thus traditional environmental economics has constructed a set of techniques in order to apply this utilitarian approach and thereby derive a market value for certain environmental goods or services. Three types of technique for such valuation can be discerned:

- conventional market approaches;
- implicit market;
- constructed market.

These techniques use various methods to try to measure either actual behaviour that occurs in the market or *potential* behaviour.

As described in the introduction, scholars within EE have raised many philosophical and ethical objections to the underlying assumptions behind this utilitarian, individual, free-market approach that underlies neo-classical economics and the shortcomings of such approaches which seek to value environmental goods and services in strictly monetary terms.

In this section we present some methods from EE which we argue are more appropriate for evaluating organic farming systems and informing decision making for these systems. We focus on three analytical tools from EE, Material Flow Analysis, multi criteria analysis and deliberative institutions, which can be used for valuing environmental "goods' and informing decision making. They do however, have different characteristics, as they belong to different value articulating institutions (Jacobs, 1997). As Vatn (2004: 9) writes:

> A value articulating institution is a constructed set of rules or typifications. It defines **who** shall participate and on the basis of which capacity – i.e. in which **role**… A value articulating institution also defines **what** is considered relevant data and **how** data is to be handled.

Thus different value articulating institutions tend to generate different outcomes. This implies that, if for example animal welfare issues and pollution issues are seen to be important for evaluation of a farming system, it may be proper to use value articulating institutions that consider such. These issues are about ethical values and not so much about individual values (Holland, 1995), i.e. they may better be handled through dialogue than through monetary assessment. Therefore multicriteria analysis may be a more appropriate value articulating institution than a contingent valuation study, because the first allows for discussion and incommensurable values while the last one is based on commensurability and financial capability.

The principal concept in EE of the economy as a subsystem of the environment dependent on a constant throughput of materials and energy underlies the *Material Flow Accounting and Analysis (MFA)*. MFA is a dynamic systems perspective and theory that draws on the central concepts of stocks, flows, feedbacks and delays. These concepts are well known to, and applied in, many disciplines within the social and natural sciences. In MFA, raw materials, such as water and air, are extracted from the natural system as inputs, transformed into products and finally transferred back to the natural system as outputs (waste and emissions). MFA offers the foundation for setting up a 'theory of waste' connected to the economic and social activities of society.

The main purpose of an economy-wide MFA is to provide aggregate background information on the composition and the changes of the physical structure of socio-economic systems. MFA represents a very useful methodological framework for analysing economy–environment relationships and deriving environmental and integrated environmental/socio-economic indicators. Material flow-based indicators can be aggregated from the micro to the macro level. They allow comparisons with aggregated economic or social indicators such as GDP and unemployment rates, thus providing policy–makers with information they are familiar with handling and helping to shift the policy focus from a purely monetary analysis to one which integrates biophysical aspects (Kleijn, 2001). MFA can also be used as a method to consider the scale and the environmental impact of the economy. But scale only determines what is scarce and what is free. Distribution is about ownership and equity.

Using scarce resources most efficiently is a major task in economics. Providing effective policy interventions concerning environmental protection are those that solve environmental problems at minimum cost while meeting social and cultural goals. Faced with limited budgets and with sets of conflicting uses for scarce natural resources, decision-makers seek guidance on how to trade-off between those possible uses so as to maximize welfare or utility overall. For an individual decision-maker this choice can be made with a direct knowledge of personal goals and preferences, whereas democratic governments must operate on behalf of all their citizens in determining how to achieve overall welfare.

To comply with a more democratic and ideological approach, methods like the *Multi Criteria Analysis (MCA)* have been applied in EE trying to encompass the benefits of environmental goods and services within the realm of a multidimensional social and economic sphere.

The MCA is designed to deal with complex decision-making for problems characterized by having many, often conflicting, objectives for the assessment of a diversity of possible alternatives and often involvement of several decision makers. There are two fundamental conflicts involved (Vatn, forthcoming). First, those between different interests, individuals or groups and secondly, we have conflicts between value dimensions or perspectives. The latter can be as relevant within a person as between persons. MCA is formulated so that it can handle values or criteria that are not easily transformed into one dimension like a monetary measure. This is actually the core of MCA as the name also indicates: criteria are *multidimensional*, and the method allows for handling criteria that are *incommensurable* (Martinez-Alier *et al.*, 1998). It can also handle the fact that weights may be considered *coefficients of importance*, not signalling trade-off capabilities (Munda, 1996).

There are many different MCA methods. Common for most of them is that they have a number of criteria for evaluation of multiple alternatives. Most MCA methods include to define and structure the problem, to generate the alternatives, choose a set of evaluation criteria, identify a preference system of the decision-maker, choice of an aggregation procedure and calculation of efficient solution and best “compromises’ (Munda *et al.*, 1994; Lahdelma *et al.*, 2000).

MCA techniques have some clear advantages over more restricted decision-making techniques, such as cost-benefit analysis. Their popularity has increased very substantially with improvements in both methodologies and computer power. Furthermore, their suitability to environmental and natural resource planning is increasingly being recognized (Edwards-Jones *et al.*, 2000).

MCAs have also been designed and implemented to enhance public participation putting emphasis on the process – named participatory or deliberative processes (de Marchi and Ravetz, 2001). MCA offers a distinct response to the complex decision-making – for environmentally related challenges like organic farming – and often ill-defined problems. From this perspective MCA can be described as a structured search process where the analyst supports the decision-maker or the stakeholders in defining the problem, articulates their values and objectives, looking for alternatives, assessing their consequences, ranking the alternatives in relation to the objectives, maybe going back and formulating new alternatives etc. (Vatn, forthcoming). These processes generally aim to be exploratory or consultative with focus on participation in the decision-making. The currently most used and reported forms of participation include focus groups, in-depth groups, citizens' juries, consensus conferences and forums. In some way also multi-criteria methods are viewed as participatory approaches. The approaches are advocated on grounds of justice and democracy in procedure and an appreciation that complex, multi-attribute issues cannot be effectively evaluated by a one-dimensional numeraire based on simple consumer choices (de Marchi and Ravetz, 2001). During the 1990s the momentum for such processes has developed, and the initiatives under 'Local Agenda 21' are an example that encourages local participation in decision-making. For further examples see de Marchi and Ravetz (2001).

Multicriteria decision-making methods are designed to deal with complex problems such as how to deal with scarce resources, different notions of values concerning welfare and make use of opportunities now or for future generations etc. The challenge is to choose or to form a value articulating institution that fits the character of the problem or good at hand. Shortly we can say this is about how to solve questions related to who to be involved, how to involve them and what to be involved about (Refsgaard, forthcoming).

These non-monetary approaches have a better potential of valuating the societal benefits from organic farming systems. Organic farming systems need to be valued not only through their contribution with pure food products, but also by their contribution to the environment like for example reduced use of fossil fuel, contributions to biodiversity, nearness in the consumption–production cycle etc. On these matters use of a single monetary measure will be highly misleading, which, again, is where EE may contribute with a broader perspective. In addition, the multiplicity of users (and perspectives) also makes a unique ordering of values or prioritization difficult or impossible. In the valuation of organic farming systems we have both the different contributions, the different users of them and their different interests implying that a process for evaluation and articulation is needed.

Conclusions

This chapter shows how ecological economics explores the interrelations between the ecological, the economic and the social systems. The EE paradigm and its frameworks for decision-making could be an important tool for the organic farming movement, in conceptualizing the way in which it manages these interrelations and could constitute the intellectual underpinning on which to base the construction of future policy tools. The current worldwide growth of organic farming raises new challenges about how organic production relates with, and depends upon, our environment. Researchers and farmers involved in organic farming and food consumption need to be able to identify how new policies can be formulated, that help and promote organic farmers and consumers, and make these interrelations more harmonious and sustainable. So far very little has been done in this regard.

Ecological economics itself is a new and dynamic field as well as a pluralistic one. Its foundations, based on economy, ethics and ecology, offer a theoretically and methodologically wider perspective drawing on a more multidisciplinary approach which has the potential to generate a better understanding and evaluation of organic farming and its complex relations with the social, economic and biophysical spheres.

References

Ayres, R.U. (1998). Eco-thermodynamics: economics and the second law. Ecological Economics 26: 189-209.

Ayres, R.U. (2001). Industrial ecology: wealth, depreciation and waste. In: Folmer, H., Landis Gabel, H., Gerking, S. and Rose, A. (eds) Frontiers of environmental economics. Edward Elgar, Cheltenham, pp. 214-249.

Baumgärtner, S. (2002). Thermodynamics of Waste Generation. In: Bisson, K. and Proops, J. (eds) Waste in Ecological Economics, Edward Elgar, Cheltenham, UK, pp. 13-37.

Baumgärtner, S., Faber, M. and Proops, J. (1996). The use of the entropy concept in ecological econmics. In: Faber, M., Manstetten, R., and Proops, J. Ecological Economics: Concepts and Methods, Edward Elgar, Cheltenham, Chap. 7.

Bisson, K. and Proops, J. (2002). An Introduction to Waste. In: Bisson, K. and Proops, J. (eds) Waste in Ecological Economics, Edward Elgar, Cheltenham, UK, pp. 1-12.

Boulding, K.E. (1966). The economics of the coming spaceship Earth. In: Jarret, H. (ed.) Environmental Quality in a growing Economy. Resources for the future/Johns Hopkins University Press, Baltimore, pp. 3-14.

Costanza, R., Daly, H. and Bartholomew, J.A. (1991). Goals, Agenda and Policy recommmendations for Ecological Economics. In: Cosanza, R. (ed.) Ecological Economics. The Science and Management of Sustainability. Columbia University Press, NY.

Costanza, R., Cumberland, J., Daly, H., Goodland, R. and Norgaard, R. (1997). An introduction to ecological economics. Sct. Lucie Press, Boca Raton, Florida.

Daly, H.E. (1973). The Economics of the Steady State. In: Daly, H.E. (ed.) Toward a Steady State Economy. W.H. Freeman, San Francisco, CA.

Daly, H.E. (1991). Elements of environmental macroeconomics. In: Constanza, R. (ed.) Ecological Economics, the Science and Management of Sustainability. Columbia Press, NY.

Daly, H.E. (2003). Ecological economics: The concept of scale and its relation to allocation, distribution and uneconomic growth. Presentation at CANSEE, October 16–19 2003. Jasper, Alberta, Canada.

Danish Agricultural Advisory Service (2004). www.lr.dk/budgetkalkuler 2004 de Marchi, B. and Ravetz, J.R. (2001). Participatory approaches to environmental policy. Environmental Valuation in Europe. Policy Brief no. 10. C. L. Spash and C. Carter. Cambridge Research for the Environment, Cambridge.

Edwards-Jones, G., Davies, B. and Hussain, S. (2000). Ecological economics – an introduction. Blackwell Science.

Faber, M., Proops, J. and Baumgärtner, S. (1998). All production is joint production – a thermodynamic analysis. In: Faucheux, S., Gowdy, J. and Nicolaï, I. (eds). Sustainability and firms. Technological change and the changing regulatory environment. Edward Elgar, Cheltenham, pp. 131-158.

FØI (2004). Økonomien i landbrugets driftsgrene 2003. Serie B, nr. 88. København, Fødevareøkonomisk Institut.

Georgescu-Roegen, N. (1971). The entropy law and the economic process. Harvard University Press, Cambridge, MA.

Holland, A. (1995). The assumptions of cost-benefit analysis: a philosopher's views. In: Willis, K.G., Corkindale, J.T. (eds) Environmental Valuation. New Perspectives. CAB International, Wallingford, pp. 21-38.

Jacobs, M. (1997). Environmental valuation, deliberative democracy and public decision-making institutions. In: Foster, J. (ed.) Valuing Nature: Economics, Ethics and Environment. Routledge, London, pp. 211-231.

Jultved, C.R. (2004). Rapport over P-rapporternes resultater oktober 2003. Notat nr. 0405.

Kledal, P.R. (2003). Analysis of Organic Supply Chains – A theoretical framework. København, Fødevareøkonomisk Institut. Working paper 15/2003. http://www.foi.dk/Publikationer/wp/2003-wp/Wp15-03.pdf

Kleijn, R. (2001). Adding It All Up. The Sense and Non-Sense of Bulk-MFA. Journal of Industrial Ecology 4(2): 7-8.

Lahdelma, R., Hokkanen, J. and Salminen, P. (2000). Using multicriteria methods in environmental planning and management. Environmental Management 26(6): 595-605.

Landskontoret for Svin (1980-81). Håndbog for Driftsplanlægning, Landbrugets Informationskontor 1980-81.

Martinez-Alier, J., Munda, G. and O'Neill, J. (1998). Weak comparability of values as a foundation of ecological economics. Ecological Economics 26(3): 277-286.

Marx, K. (1970) [1867]. Kapitalen: Kritik af den politiske økonomi. 1. bog 1. Rhodos, København.

Munda, G. (1996). Cost-benefit analysis in integrated environmental assessment: some methodological issues. Ecological Economics 19(2): 157-168.

Munda, G., Nijkamp, P. and Rietveld, P. (1994). Qualitative multicriteria evaluation for environmental management. Ecological Economics 10: 97-112.

Neumayer, E. (2003). Weak Versus Strong Sustainability – Exploring the limits of Two Opposing Paradigms. Edgar Elgar publishing.

Ørum, J.E. and Christensen, J. (2001). Produktionsøkonomiske analyser af muligherderne for en reduceret pesticidanvendelse i dansk gartneri. Fødevareøkonomisk Institut, rapport nr. 128.

Pearce, W.D. and Turner, R.K. (1990). Economics of Natural Resources and the Environment. Harvester Wheatsheaf, NY.

Pedersen, N. m.fl. (2001). Slagtefjerkræ, Landbrugets Rådgivningscenter, Landskontoret for uddannelse, Landbrugsforlaget 2001.

Rees, W.E. (2003). Understanding Urban Ecosystems. An Ecological Economics Perspective. In: 'Understanding Urban Ecosystems – A new frontier for Science and Education'. Springer-Verlag.

Refsgaard, K. (forthcoming). Process-guided multicriteria analysis in wastewater planning. accepted for publication in Government and Planning C: Government and Policy.

Tiezzi, E. (2002). The Essence of Time. WIT. Ashurst, UK.

Vatn, A. (2004). Environmental valuation and rationality. Land Economics 80(1): 1-18.

Vatn, A. (forthcoming). Institutions and the Environment. Edward Elgar.

WCED (1987). World Commission on Environment and Development in: Our Common Future. Oxford University Press, Oxford.