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Ecological Economics

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Abstract

Ecological economics is a relatively new interdisciplinary field concerned with the relationship between economic systems and the biological and physical world. This article covers the following topics: A discussion of views on whether ecological economics is just a field or approach within economics or a new “transdisciplinary” field in its own right; Origin of the name of the field; Core common principles of ecological economics; Comparison with environmental economics; Applications; History and institutions of ecological economics. The core principles are that the economy is embedded and dependent upon the ecosphere and that, therefore, models of the economy have to comply with biophysical principles. Ecological economists believe that there are limits to our ability to substitute human-made inputs and knowledge for natural resources and the environment in both production and consumption. They also argue that economic policy must consider jointly the objectives of economic efficiency, equity, and sustainability.

Keywords: Economics, social science, interdisciplinarity, policy, sustainability

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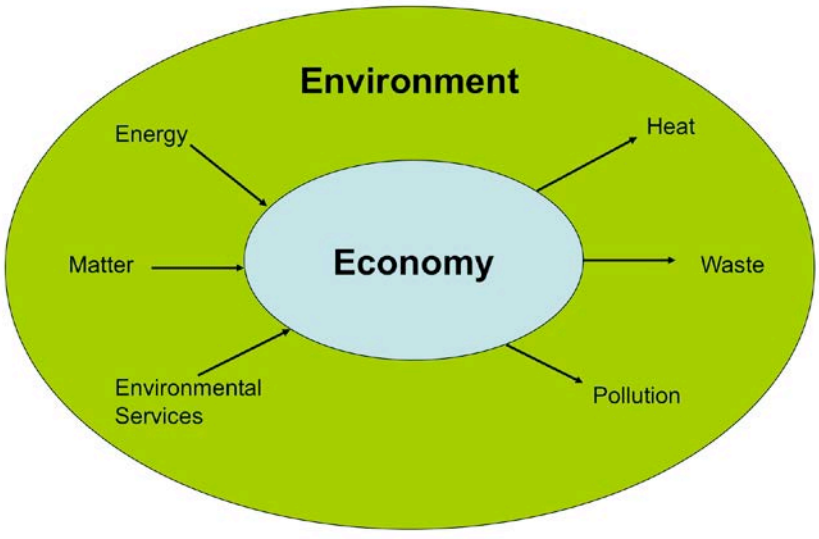
What is Ecological Economics?

Ecological economics is a relatively new interdisciplinary field concerned with the relationship between economic systems and the biological and physical world. Opinions differ on whether ecological economics is an interdisciplinary or transdisciplinary field comparable to, for example, international relations, a new disciplinary paradigm in economics, a new field within mainstream economics, or even a subarea within the conventional economics field of environmental economics [1].

The International Society for Ecological Economics (ISEE) and the journal *Ecological Economics* take the position that ecological economics is a "transdisciplinary" field. It recognizes that practical solutions to pressing social and environmental problems require new interdisciplinary approaches that focus on the links between economic, social, and ecological systems. Neither the traditional practice of economics nor the natural sciences alone are held to be sufficient for addressing these issues. Neither can each alone explain the past history of the human-environment system.

Figure 1: Economy and Environment



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In this view, the starting point and central organizing principle of ecological economics is that the economy is embedded and dependent upon the ecosphere – it is part of a larger system. Energy, material inputs, and environmental services are extracted from the natural environment and eventually return to the environment as waste heat, pollution, or waste (Figure 1). Study of this joint environment-economy system must take into account natural science principles from thermodynamics, ecology etc. as well as principles from psychology and other social sciences. So ecological economics integrates economics and various social and natural sciences (not just ecology). “Ecological economics” is the name given to the field because:

1. Many ecologists were involved early on in the history of ecological economics [2].

2. The main antecedent to ecological economics was a biophysical economics that focused on energy flows in the human ecosystem [3].

3. Both economics and ecology share the Greek root “oikos” meaning "house" or "place to live". Ecology is the study of how organisms interact with their environment, support themselves, and interact with each other. Economics is the same applied to people [4].

In practice, more economists than non-economists have been attracted to the emerging field and so it is natural for some of these economists to see ecological economics as a new paradigm in economics alongside existing paradigms such as the mainstream neoclassical economics and the alternative Post-Keynesian, Institutional, Marxist paradigms. They argue that ecological economists need to reject the neoclassical approach to economics [5], though there is no agreement on what to replace it with. But there are also natural scientists that believe that ecological economics can overturn and replace mainstream economics [6]. Both these groups reject the core model of neoclassical economics – that economic theory should be primarily based on modeling the decision-making processes of individual consumers and firms with the default assumption that these agents maximize utility or profits. There have been ongoing tensions between mainstream and heterodox economists in ISEE [1] as well as tension between those who see ecological economics as an academic field and those who see it as a social movement or form of activism.

By contrast, many mainstream environmental economists think of ecological economics as either a new field within mainstream economics that deals with the management of complex

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ecological systems or as a subfield within the field of environmental and resource economics [1]. This is reflected in the code given to ecological economics by the *Journal of Economic Literature* as part of its classification system of the economic literature: Q57 – a subfield within environmental economics.

Core Principles of Ecological Economics

Ecological economists who see the field as something larger than a specialty within environmental economics share a common set of assumptions and approaches [1]. Namely that:

1. The economy is just a sub-system of the larger human-environment system.
2. Models of the economy have to comply with biophysical principles while mainstream economics underemphasizes the role of natural science.
3. That there are limits to our ability to substitute human made inputs and knowledge for natural resources and the environment in both production and consumption [7]. These limits are due to several considerations:
    a. Thermodynamics: There are minimum amounts of energy required to transform and move matter, which is the foundation of economic activity.
    b. Basic human needs for human needs for food, shelter etc. that require some material and energy inputs and perhaps higher psychological needs for contact with nature [8].
    c. Essential “natural capital” required for planetary life support.
4. Economic policy must consider jointly the objectives of economic efficiency, equity, and sustainability, instead of the primary emphasis on efficiency in mainstream economics. Ecological economics has been characterized as “the science and management of sustainability” [9].

The first three principles imply that there are limits to the possible physical scale of the economy. Unlimited growth of the use of resources is not possible. Considering the third and fourth principles jointly leads many ecological economics to argue that sustainability requires minimum levels of natural capital or natural resources to be maintained as human made

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inputs have limited ability to substitute for them in the provision of human welfare. This idea is termed “strong sustainability”. By contrast, many mainstream environmental economists assume that human made inputs can substitute extensively for natural inputs. They argue that sustainability could be achieved as long as sufficient investment is made in human produced capital. This is referred to as “weak sustainability” [10].

Comparison with Environmental Economics

One way of distinguishing between environmental and ecological economics is that environmental economics has a focus on price while ecological economics has a focus on quantity. Environmental economics focuses on market failures as the main determinant of environmental problems. Seen in terms of external costs, the problem is incorrect prices and the solution is implementing the right prices. In many cases, these prices must be determined through research, hence the huge emphasis on valuation in environmental economics. Ecological economics sees environmental problems as being primarily problems of scale – that the scale of exploitation of natural resources and the production of wastes are both too large relative to the Earth’s carrying capacity. Therefore, ecological economists are more likely to analyze economic-ecologic systems in terms of quantities of flows of materials and energy. Tools of analysis include energy return on investment and the ecological footprint – both quantity rather than price indicators. Ecological economics focuses primarily on sustainability – equitable distribution of resources over time, while environmental economics focuses on efficiency – ensuring that marginal costs and benefits of activities are equal.

How much overlap is there between ecological economics as actually practiced and the mainstream economic field of environmental and resource economics? An analysis of the content and citation patterns of the leading journals in each field – *Ecological Economics* and the *Journal of Environmental Economics and Management* (*JEEM*) found that there is a significant overlap between the two fields at the journal level — the two journals cite similar journals [11]. The main differences are that ecological economics tends to cite (but not be cited by) general natural science journals more often than environmental economics does, environmental economics cites more heavily from journals rather than other publications, and citations in environmental economics are more concentrated on particular journals and individual publications. However, there is much less similarity at the level of individual articles. Nonmarket valuation articles dominate the articles cited in papers published in *JEEM* while green accounting, sustainability, and the environmental Kuznets curve are all

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prominent topics in *Ecological Economics*.

Over time, however, there has been a convergence between mainstream environmental and resource economics and ecological economics. This can be seen in the trends over time in topics covered in journal articles with a greater number of mainstream valuation articles published in *Ecological Economics* [12] and mainstream papers increasingly include more realistic biophysical features.

Applications

Ecological economics is an increasingly applied field [12] with a wide array of applications. Discussion of a couple of these can highlight the contribution of ecological economic thinking to practical problems.

Producing biofuels to replace the use of petroleum in transport is a strategy for addressing climate change and energy security that has been aggressively promoted by governments in both Europe and North America and encouraged by some academic research [13]. However, taking a system-wide approach shows that little or no net energy is produced when ethanol is produced from corn [14]. This is because industrialized farming, refining, and distribution use large amounts of energy directly in the form of fuels and electricity and indirectly in the form of fertilizers and the energy required to build and maintain machinery and infrastructure. Furthermore, sunlight is a diffuse resource and plants, especially in cold climates such as the American Corn Belt, are very thermodynamically inefficient converters of sunlight to the sugar used to produce alcohol. As a result, the energy required to produce the ethanol is similar to the energy it contains and ethanol from corn cannot meaningfully contribute to reducing climate change or improving energy security.

According to the *Scopus* citation index, several of the most cited papers published in the last five years in Ecological Economics are on the topic of ecosystem services and payments for ecosystem services (PES). Ecosystem services are benefits provided to people by natural systems. This concept has changed views of how nature matters to human societies from viewing the preservation of nature as something for which we have to sacrifice our well-being, to viewing the environment as one of society's important assets, natural capital [15]. PES are voluntary transactions to ensure the provision of eco-system services [16]. Costa Rica has pioneered the used of PES in developing countries and the program has been partly credited in achieving negative net deforestation [17]. In developing countries, those receiving

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payments are often poor and so PES can also achieve sustainable development goals. Two programs to reduce greenhouse gas emissions in developing countries – the Clean Development Mechanism and the UN-REDD program - can be considered forms of PES.

Institutions and History of Ecological Economics

Though modern ecological economics dates to the late 1980s, as a school of thought ecological economics has deep roots in thinkers who developed various forms of "biophysical economics" such as Herman Daly, Howard Odum, and Nicholas Georgescu-Roegen [2, 3]. ISEE was founded in 1988 following discussions and meetings between ecologists and economists from the US and Europe, particularly Sweden. The first president of the society was Robert Costanza, followed by Dick Norgaard, John Proops, Charles Perrings, Joan Martinez-Alier, Peter May, and Bina Agawam. There have been booms and busts in membership of ISEE over time. At the time of writing in 2011, ISEE has 3049 members worldwide. There are now local "chapters" of the international society in most regions of the world: Africa, Argentina and Uruguay, Australia-New Zealand, Brazil, Canada, Europe, India, Meso-America, Russia, and the United States. The European Society for Ecological Economics (ESEE) is the largest chapter in terms of members, followed by the US and India. Their main role of the chapters is to hold regional conferences in the odd calendar years. The international society holds meetings every even year. These have been held in: Washington DC (1990), Stockholm (1992), San Jose, Costa Rica (1994), Boston MA (1996), Santiago de Chile (1998), Canberra (2000), Sousse, Tunisia (2002), Montreal (2004), New Delhi (2006), Nairobi (2008), and Bremen-Oldenburg (2010).

The society's journal, *Ecological Economics*, published by Elsevier, was founded in 1989 and has had three editors in chief: Robert Costanza, Cutler Cleveland, and Richard Howarth. The journal now receives over a thousand submissions each year, while publishing 273 articles in 2009. It is also increasingly cited. By 2004, citations per year about matched the longer-established *JEEM* – though the latter publishes fewer papers [11]. In the first decade of the 21st Century, *Ecological Economics* was publishing far more of the most cited papers in the field of environmental, resource, and ecological economics than *JEEM* though a higher percentage of the articles published in *JEEM* were among the most cited [18]. Edward Elgar and Island Press are probably the two largest publishers of ecological economics books. The journal *Environmental Policy and Governance* is now associated with ESEE.

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References

[1] Røpke, I. (2005). Trends in the development of ecological economics from the late 1980s to the early 2000s, *Ecological Economics* **55**(2), 262-290.

[2] Røpke, I. (2004). The early history of modern ecological economics, *Ecological Economics* **50** (3-4), 293-314.

[3] Martinez-Alier, J. & Schlüpmann, K. (1987). *Ecological Economics: Energy, Environment, and Society*, Basil Blackwell, Oxford.

[4] Common, M.S. (1995). *Sustainability and Policy: Limits to Economics*, Cambridge University Press, Melbourne.

[5] Spash, C.L. (1999). The development of environmental thinking in economics, *Environmental Values* **8**, 413–435.

[6] Hall, C., Lindenberger, D., Kümmel, R., Kroeger, T., Eichhorn, W. (2001). The need to reintegrate the natural sciences and economics, *BioScience* **51**, 663-673.

[7] Stern, D.I. (1997). The capital theory approach to sustainability: a critical appraisal, *Journal of Economic Issues* **31**, 145-173.

[8] Pezzey, J. (1992). Sustainability: an interdisciplinary guide, *Environmental Values* 1, 321-362.

[9] Costanza, R. (1991). *Ecological Economics: The Science and Management of Sustainability*, Columbia University Press, New York.

[10] Neumayer, E. (2004) *Weak Versus Strong Sustainability: Exploring the Limits of Two Opposing Paradigms*, Edward Elgar, Cheltenham.

[11] Ma, C. & Stern, D.I. (2006). Environmental and ecological economics: a citation analysis, *Ecological Economics* **58**(3), 491-506.

[12] Castro e Silva, M. & Teixeira, A.A.C. (2011). A bibliometric account of the evolution of EE in the last two decades: Is ecological economics (becoming) a post-normal science? *Ecological Economics* **70**(5), 849-862.

Electronic copy available at: https://ssrn.com/abstract=2066195

[13] Farrell, A.E., Plevin, R.J., Turner, B.T., Jones, A.D., O'Hare, M., Kammen, D.M. (2006). Ethanol can contribute to energy and environmental goals, *Science* **311**, 506-508.

[14] Murphy, D.J. & Hall, C.A.S. (2010). Year in review – EROI or energy return on (energy) invested, *Annals of the New York Academy of Sciences* **1185**, 102-118.

[15] Liu, S., Costanza, R., Farber, S., Troy, A. (2010). Valuing ecosystem services: Theory, practice, and the need for a transdisciplinary synthesis, *Annals of the New York Academy of Sciences* 1185, 54-78.

[16] Engel, S., Pagiola, S., Wunder, S. (2008). Designing payments for environmental services in theory and practice: An overview of the issues, *Ecological Economics* **65**(4), 663-674.

[17] Pagiola, S. (2008) Payments for environmental services in Costa Rica, *Ecological Economics* **65**(4), 712-724.

[18] Hoepner, A. G. F., Kant, B. Scholtens, B., Yu, P.-S. (in press) Environmental and ecological economics in the 21st century: An age adjusted citation analysis of the influential articles, journals, authors and institutions, *Ecological Economics*.

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