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Abstract
This paper discusses the development of environmental economics from the Industrial Revolution in Europe to today. Specifically, it comments on the general similarities and differences between the representatives of the schools of economic thought concerning the environment. Among others, the issues of scarcity of natural resources, of population growth as well as the limits to growth are discussed and the various views are presented. The paper also comments on the trends of environmental, evolutionary and ecological economics.

Keywords: Natural resource scarcity, limits to growth, environmental economics.

JEL Classifications: N53; N54; O13; B12; B13; B14.

1. Introduction

Throughout the history of mankind, civilizations have continually been built in fertile land areas where the growth of societies was supported by the availability of sufficient resources. As economies enlarged, a point was reached where resources were used faster than they could be refilled. If the society kept growing producing populations overrun one or even more vital resources could potentially disappear and this could lead to economic but also social collapse.

The main interests in environmental history have been, at least at the beginning, the scarcity and exhaustion of natural resources. During the 1960s environmental pollution became more widespread and led economists to look at resource scarcity in relation to possible users. From 1870 to 1970 most economists with some remarkable exceptions believed that economic growth was sustainable indefinitely.

Economic history has a wider spotlight than strict economic theory and has reflected the development in Economics. But after 1970 the majority of economists believed that growth remained feasible with no need to exhaust natural resources. At the same time this growth may be desirable in the sense that we don't have to reduce the total quality of life. The necessary element was an efficiently functioning price system capable of accommodating higher levels of economic activity with an acceptable level of environmental quality.

Although environmental economics is a recent concern we may say that it has been a concern from the writings of the classical economists. Referring to the classical economists we identify a number of economists writing in the 18^{th} and 19^{th} centuries where the Industrial Revolution was taking place together with the increase in agricultural productivity.

The classical economists paid attention to the supply analysis assuming that the amounts of supplied commodities were determined by the labour costs of production. Neoclassical economists also considered the demand side in the price determination and used as the norm full employment taking the overall level of economic activity as given. This full employment norm was not consistent in the post-First World War experience of most western economies, where we have persistent unemployment for more than a decade.

At this time most economists explained the problem with the reasoning that wages didn't fall in the existence of unemployment. They believed that the way out of the problem was to reduce wages. John Maynard Keynes (1883-1946) totally disagreed with this policy. He argued that the proper solution was for the government to intervene in the economy in order to maintain the demand for goods at a level capable of creating full employment. Keynes developed his theory of income and output determination. Keynesian macroeconomics was opposed to the microeconomics of neoclassical economics, and inspired a recovery of interest in growth theory in the middle of the 20th century and the development of the neoclassical theory of economic growth.

In this paper we will discuss the development of environmental economics from the Industrial Revolution in Europe to our times. Our major task is to discuss the general similarities and differences between and within economic schools of thought concerning the environment. An effort is also made to distinguish the terms environmental, ecological, resource and agricultural economics.

The structure of the paper is the following. Section 1 introduces the paper. Section 2 discusses the issues of natural resource scarcity as well as the limits to growth according to the classical economists and the Marxists. Section 3 presents the

main views of the neoclassical economists to humanists and institutional Economics. Section 4 examines the evolution of economic thoughts and the emergence of ecological economics. Section 5 discusses and comments the present trends of the environmental, evolutionary and ecological economics. The final section concludes the paper.

2. From classical economists to Marxists: Scarcity of natural resources and limits to growth

The classical economists were concerned with limits to growth but from a different angle to the modern theories that call for sustainability. A common component for the classical economists was the growth of population. Population growth was the main determinant of returns redistribution. This together with the dependence of production on labour and on the scarcity of land implied that economic growth may be inactive as capital profits would be reduced relative to wages. For this theory the absolute resource constraints were abundant.

The systematic allocation of resources and the importance of markets were emphasized by Adam Smith (1723-1790) who gave attention on the dynamic effects of markets. Smith in 1776 published the book *The Wealth of Nations*, where he uses economic analysis in order to suggest economic policy. He emphasized the distinction between the true value of a product or service and its market price. The latter is determined by the relative scarcity of commodities in little supply while the former by the amount of labour in the market. In this way, price may act as an indicator of relative scarcity of commodities in short supply.

Smith did not take into consideration that the natural resource scarcity problem would create an obstacle to economic growth. On the contrary, he believed

that nature was generous and agriculture was capable of offering outputs far in excess of inputs (Barber, 1967). Smith emphasized the contribution of accumulation of capital in the increase of labour productivity in agriculture. According to Smith's writings, destroying economic dependency on agriculture would at the end increase demand for agricultural output in excess of supply. This will lead to distributional impacts in private property institutions, exchange relationships and the income distribution (Barber, 1967).

Smith through the principle of the invisible hand argued that self-interested rational individual behaviour may satisfy needs and wants but at the same time may serve the interests of the society as a whole. The important issue for economic and social prosperity was that economic transactions would be free on the basis of freely competitive markets.

Like Smith, Thomas Malthus (1766-1834) and David Ricardo (1722-1823) were pessimistic about long run economic growth. Specifically, for the classical economists the origin of this pessimism was the law of diminishing returns in agricultural production. Malthus and Ricardo expressed their thoughts for environmental limits in terms of the limits on the supply of good quality of agricultural land and thus diminishing returns in agricultural production.

The starting point in Malthus' Essay on *The Principle of Population* is the Malthusian law that states that population increase and the growth in food production follow mathematical paths which may reasonably result in food shortages and probably in poverty and deprivation. According to Malthus this is justified through natural laws which specify that population growth is quicker compared to the increase in the level of agricultural production (Malthus, 1798; 1820).

The Malthusian view was that the stock of agricultural land was completely limited and when this limit was reached, the population growth to continue would require increasing level of cultivation and thus would create diminishing returns per capita. On the other hand, the Ricardian view considered diminishing returns as a current issue which was representing the lowering in the quality of land as more and more correspondences were produced within the margin of profitable cultivation (Ricardo, 1973).

Barnett and Morse (1963) were the first who distinguished Malthusian and Ricardian economic approaches in natural resource scarcity. Malthusian scarcity treats natural resources as homogeneous in quality while Ricardian considers them as varying in quality. In both cases economic activity is constrained if technological change is present. In the Malthusian scarcity diminishing returns appear only in the absolute limits of natural resources available stock. In the Ricardian case, diminishing returns do not require any assumption of the absolute limit in terms of natural availability as well as no need for time horizon identification.

In the Ricardian scarcity, the reduced productive (fertile) land requires more effort leading to an increase in average cost. On the contrary, in the Malthusian scarcity there is no difference in quality terms of the resource stock and thus costs do not increase until the absolute limits of the natural resources are reached.

The classical economists tried also to analyze the distribution of income and wealth within a society. For the former they believed that prices were determined by the production costs and tracked all production costs back to labour costs in the labour theory of value.

John Stuart Mill (1806-1873) thought of economic progress as a battle between diminishing returns in agriculture and technical change. Mill (1857, 1909)

accepted the potential of renewable resources to act as one of the constraints on economic growth regardless of population pressures. He claimed that technology may postpone constraints imposed by resource scarcity which should increase relative prices. This will not necessarily produce a rapid disaster.

We can say that compared to the other classical economists Mill was more optimistic due to the fact that knowledge and technical progress would have provided most of human individualistic material needs and in this way society can pursue other social goals like education.

This influenced Marxist economists. Karl Marx (1818-1883) agreed with the labour theory of value from the classical economists. He supported the thesis that as capitalism is developed exploitation increases to a point where a worker's revolution will take place. In this way socialism would replace capitalism. For Marx workers were the only source of net economic product. He was as pessimistic as the classical economists concerning the future living standards for the working class (the majority of people) in the capitalist society.

Marx (1960) considered the political state as an alternative to the nature. The latter was available to be exploited with the help of science in such a way that inherent value became use value. We may argue that Marx adopted what we call today a materials balance approach to the production process over time. Capitalist systems are not sustainable and environmental damage may be considered as a source of non-sustainability. Workers are exposed to more than the fair amount of pollution. In this way the maintenance of labour productivity requires more and better medical care. If unions demand better health care compensations their real wage will be increased at the expense of profits and capital accumulation.

3. From neoclassical economists to humanism and institutionalism

In the 1870s, a number of works started the replacement of classical economics with neoclassical economics. Classical economists (and Marx) considered value to originate from the labour power personified in the output of the production process. Neoclassical economists considered that value is determined by production costs and preferences. Absolute scarcity was replaced by relative scarcity.

In terms of methodological issues, the marginal analysis (relations between small or unitary changes) was approved giving a formal notion to diminishing marginal productivity in the case of an explicit production function. Stanley Jevons (1835-1882) and Carl Menger (1840-1921) proposed the theory of consumer preferences in terms of utility and demand theory. Jevons (1865) was more pessimistic on the limits to growth in Britain due to coal exhaustion. Technological advance together with the oil substitution led to a failure of his predicted catastrophe and enabled the formation of what remains in mainstream economics as an argument against considering depletion as awkward.

It is worth mentioning that in the early neoclassical models there is an absence in the production functions used in such models of any natural resources. The introduction of natural resources into neoclassical models of economic growth took place in the 1970s with the systematic investigation of optimal resource depletion.

Leon Walras (1834-1910) developed neoclassical General Equilibrium Theory embodying the concepts of efficiency and optimality. Alfred Marshall (1842-1924) elaborated the partial equilibrium supply and demand analysis of price determination. Marshall (1890) in his *Principles of Economics* summarized the main arguments such as the use of marginal analysis and the potential of mathematical modelling.

The neoclassical theory of the market was assumed neutral and value free considering tastes as exogenous. Persons searched for the satisfaction of substitutable needs in a rational way improving society's welfare. Thus the heart of the neoclassical synthesis was a specific model of human nature the "rational and egotistic individual" (Pearce and Turner, 1990). The determination of the economic value of goods and services traded in the market, unpriced environmental commodities or worries for future generations was a function of the individual utility created. The choices that people make expose their preferences and rationality was displaced in the consistency and efficiency of these choices.

The followers of the minority of humanistic theory didn't accept the rational economic individual. On the contrary, they agreed to a behavioural psychology approach that gave emphasis to a hierarchy of needs rather than wants. Humanists' preferences are dynamic, interdependent and determined by genetics. They claim that an extended rationality concept is needed within a single person – on one side self-interest and on the other group-interest. Eventually, a final ranking of the alternative motivations will take place judging group-interest as better to self-interest one. That is notions like altruism, entropy and connections to bioeconomics appeared for the first time (Pearce and Turner, 1990).

Similarly, the followers of the minority of institutionalism appeared in the beginning of the last century and considered the economy as dynamic process. They connected economics and ecology and paid attention to technical progress. They also explained socio-economic change on the basis of cultural determinism, giving importance to scientific and technological change. These changes are the factors that give the structural and functional dynamic change of the economic system. What is still unclear is the degree of intervention necessary to attain a social harmony. Some

neo-Malthusians believed that a strict system would be able to achieve and impose the appropriate changes in order to protect the environment although some others believed that decentralized socialist systems may play this role.

4. The evolution of economic thought and the emergence of Ecological Economics

After the Victorian economists and in the first part of the last century economists showed little or no concern for resource exhaustion or environmental issues (Dasgupta and Heal, 1974). The only exception may be assigned to Hotelling (1931) and his theory of the mine that describes optimal non-renewable resource exhaustion[1]. Thus the literature in the first part of the last century is considered as dealing with the optimal use (not preservation) of the economics of conservation related mainly to agriculture and forestry as well as the establishment of a theoretical approach to non-renewable resource exhaustion.

A number of modern theories of natural resources scarcity in the 1960s and 1970s were proposed by Hotteling (1931) and Ramsey (1928). There is no big difference between Marshall's and Hotteling's views on exhaustible resource depletion but we may say that Hotteling's theory is more completely developed.

The resource economists of the 1950s relied on the conservation work mentioned before. They considered the environment as a source of materials that required specialized management due to characteristics which separated them from the traded goods. These economists can be viewed as within the neoclassical school of thought and we may say they have a strong relation with agricultural economics. Nowadays, resource economics is based on the study of conceptual mathematical models that illustrate the optimal and efficient use of minerals, forests and fisheries.

[1] Other literature on the economics and management of mineral resources can be found in Spash (2005) who cites among others Gray (1914) and Ciriacy-Wantrup (1968).

Ciriacy-Wantrup (1968) may be considered as inspiring the development of environmental economics. His work in 1950s motivated a number of researchers who verified environmental economics as a different sub-discipline in the 1960s and 1970s (Krutilla, 1967).

Although not in the mainstream, Kapp's (1950) work may be considered as an important contribution. His analysis was based on institutional economics and criticized a number of important points in environmental economics. For instance, he claimed that social costs and benefits are not quantitatively comparable in a cost benefit analysis (CBA). His reasoning was that environmental protection provides social benefits throughout the society and in this way environmental policy formation was a matter of political economy and not a technical issue to be decided by a CBA (Spash, 2005).

Additionally, Kapp (1970) was against monetary valuation as power structures in real markets distort prices which then fail to reflect resource scarcity. This was justified as markets are expected to be oligopolistic and not perfectly competitive. But the interactions between environment and economy within economies looked like moving in the reverse track to Kapp.

A tradition of thought classified as ecological economics may be traced back almost to the middle of the previous century (Martinez-Alier, 1987). However, the current progress relies on the concerns of the 1960s and 1970s for limits to grow (Boulding, 1966; Meadows et al., 1972) on the study of Georgescu-Roegen (1976) on the flow of energy and materials in the economy and the management of environmental externalities as persistent social costs and the restrictions in the application of CBA in Kapp (1950).

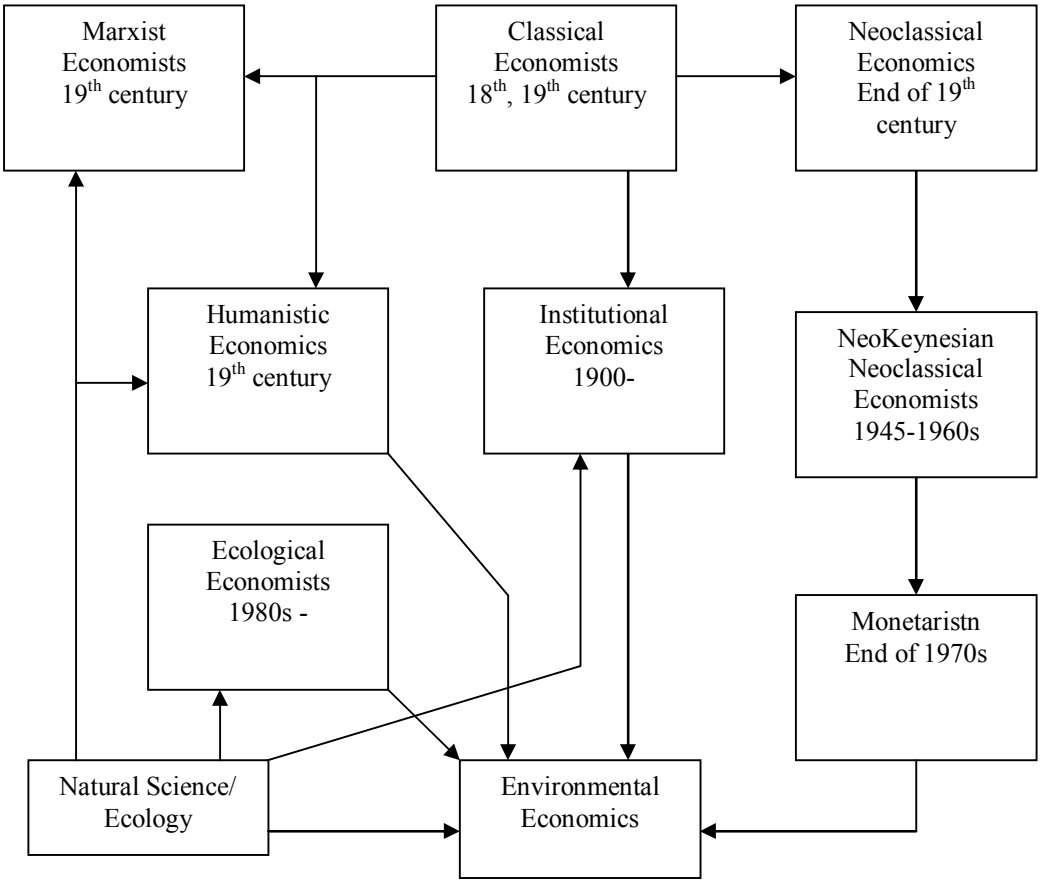
Ecological Economics emerged in the last two centuries and treats the economic system as part of the larger system that is planet earth. It recognizes first that economic and environmental systems are independent and then it studies the joint economy-environment system with the help of developments in the natural sciences (thermodynamics) and ecology in the last two centuries.

Nowadays, much of ecological economics relies on the role of nature described as Malthusian. Specifically, this is expressed through the importance of thermodynamic laws for the relationship of nature and the economy. The second theorem of thermodynamics is significant in ecological economics and the physical laws of nature impose significant restrictions of economic processes (Daly, 1980, 1996; Faber et al. 1995). These considerations are replicated in Malthus' view of nature in its ability to enduring certain laws which tackles humankind with a necessary condition and absolute external limit of his economic activity (Isenmann, 2003).

Thus Ecological Economics have exposed a necessary determination of the economy with the help of thermodynamic laws and their consideration as sufficient conditions for sustainability. But these thermodynamics laws cannot recognize all aspects of the relationships between the economy and the environment, like homo economicus selfishness and rationality of utility maximization (Manstettean, 2000; Soderbaum, 1999; Nyborg, 2000; Jager and Janssen, 2000; Gintis, 2000).

Figure 1 presents the schools of Economic thoughts and the environment, where the interactions between the various schools of economic thoughts can be seen.

Figure 1: Schools of Economic Thoughts and the Environment



5. Environmental, evolutionary and ecological economics

Environmental economics and evolutionary economics are two sub disciplines of economics which study the ecology. On the one hand, environmental economics deal with resource scarcity and ecosystem while on the other hand evolutionary economics is based on population theory (van den Bergh, 2007).

Environmental Economics treat environment as an element of the economic system and consider it as an asset or resource input (Thampapillai, 1991) and believe that the market will allocate the environmental inputs efficiently (Beder, 2011). According to environmental economics, environmental problems arise from the inability to properly price the environment (Beder, 2011). In order to correct the problem, environmental economics apply a number of tools to price environmental

goods. One of these tools is the enhanced Cost-Benefit Analysis (CBA), which includes environmental factors measured in monetary units. These environmental factors are measured by techniques such as hedonic pricing, travel cost method and contingent valuation. Contingent valuation can either be in the form of "willingness to pay" or "willingness to accept". Additionally, in order to monitor and assess environmental regulations, environmental economics have adopted and develop the environmental policy theory (van den Bergh, 2007). Other thematic fields that concern environmental economics are the depletion of the resources and the concept of continuous growth and weak sustainability (van den Bergh, 2007, Beder, 2011).

Another interesting aspect of environmental economics is the internalization of environmental costs and benefits. The idea is that a person who causes environmental degradation and pollution must pay for it and the money of this environmental tax should be used to improve the quality of the environment (Beder, 2011). Environmental economists believe that the problem of environmental degradation lies to the fact that the environment is a common good and not a private owned, thus the people tend to overuse and abuse it which is known as "the tragedy of the commons" (Hardin, 1968). Also, they argue that if it was privately owned the invisible hand would correct the anomalies (Nadeau, 2008).

Environmental economics have received a lot of critique and have been accused of being a mono-disciplinary approach which ignores the natural science and fails to promote the betterment of the environment through environmental regulations (Spash, 1999). On the contrary, evolutionary economics and ecological economics, a relative new sub-discipline, provide a platform for various research themes across a wide range of disciplines from ecological economics to evolutionary economics. While evolutionary economics may provide ecological economics with the necessary

theoretical background, it may also provide environmental economics with methodological answers to various problems.

In the past, the two schools of evolutionary economics fail to consider the long-term environmental issues as part of an economic system. Neo-Shumpeterian school investigates short-term technological innovations while evolutionary game theory employs simple analytical models (van den Bergh, 2007). Nowadays, the development of evolutionary economics has resulted in the incorporation of environmental issues at its framework.

Evolutionary dynamics is a very interesting aspect which implies that economic and ecological systems are dynamically connected and influence each other. According to van den Bergh (2007), evolutionary economics suggests a number of improvements in environmental issues such as the incorporation of biological evolution in the environmental analysis which is supposed to provide more robust results. Another interesting aspect is the evolutionary growth theory which studies the co-evolution of environmental regulations, resources and growth.

Moreover, the evolutionary theory rejects GDP as a proper measure for growth because it makes no distinction between basic and higher needs. Furthermore, the loss of diversity is considered as a matter of extreme importance and evolutionary models are able to deal with this problem and evaluate the long term benefits of diversity. Additionally, evolutionary economics investigates a unified framework were not only economic but also ethical and social aspects are taken into account.

Ecological economics is the result of an attempt to bring close economists and ecologists. It gives the opportunity to individuals to specialize in a particular field while they are aware of the evolutions in other fields. As already mentioned the major difference from environmental economics is that it provides an interdisciplinary

framework and examines the linkages between different academic fields. According to Spash (1999), there is an argument among ecological economists because there are two possible ways for ecological economics, either accept or not the neo-classical theory as a basis.

If we accept the neoclassical theory, the objective is the development of proper models to connect the neoclassical theory with ecology. If we do not accept the neoclassical theory, then based on past experience the objective is the creation of new paradigms. Such new paradigms may include environmental constraints like resource scarcity, moral values and ethical issues, respect to future generations and sustainable development and a fair and efficient treat of economic and ecological systems.

Another difference is that ecological economics consider economic system as a part of ecological system and not vice versa (Costanza et al., 2007). Environmental economics suggest that there is no limit to growth and through technological improvement the resource scarcity problem can be overcome. On the other hand, ecological economics accept that there are limits to growth and willing to measure them through ecological footprints (Ropke, 2005). Ecological footprint is a measure of human demand for natural capital. Another difference from environmental economics is that ecological economics consider ethical and social issues in the analysis (Spash, 1999). In addition, environmental economics are more anthropocentric while ecological economics are more flexible and include animal and plant rights (Proops, 1989).

Like environmental economists measure the environment through enhanced cost benefit analysis, ecological economists measure the environment mainly with Gross National Income and a number of variations which include environmental factors, which is a measure of weak sustainability (Beder, 2011). Sustainable

development refers to the preservation of capital for future generations and it includes human, human-made and natural capital. Weak sustainability allows an environmental good to be exchanged for another good, even if this environmental good is non-renewable. Strong sustainability eliminates the possibility that non-renewable natural capital will be substituted.

Since 1990's the exploration of the issue of economic growth and environmental damage in the form of pollution was extended by the consideration of the Environmental Kuznets Curve hypothesis where the empirical findings show a mixed picture (see among others Grossman and Krueger, 1995; de Bruyn and Opschoor, 1997; Halkos 2003, 2011).

6. Concluding remarks

In this paper we presented the evolution of environmental economics from the industrial revolution in Europe to our times. We examined the views of the classical, neoclassical and Marxists economists as well as these of the humanists and institutional economists.

Smith did not consider as an obstacle to growth the resources scarcity problem, but for him nature was generous and agriculture capable of offering outputs in excess of inputs. The approaches proposed and adopted by Malthus and Ricardo have more in common between them compared with the modern views of scarcity in natural resources. The main characteristic to Ricardo's and all classical theories is the main function of the Malthusian theory in terms of population increase and the associated assumption that economic development and growth especially in agriculture is a function of increasing labour inputs. Economic stagnation may result

from the interaction of these two factors with the relative scarcity of land and the implied distributional effects such as the fall in profits in terms of wages and rent.

On the contrary, Mill, Jevons and Marshall moved economic theory to a newer era and claim a significant evolution from the classical to modern analysis of natural resource scarcity. Exhaustible resources in an industrialized economic process played an important part together with the associated welfare consequences. Marshall and the new neoclassical economists adopted an optimistic view of natural resource scarcity which holds till 1960s. Also modern Marxism has seen natural resource scarcity as a possible constraint on growth but has not proposed an alternative view.

In the neoclassical economics relative scarcity replaced absolute with a clear absence in the production functions of any natural resources at least in the early neoclassical models. We meet an introduction of natural resources into growth models in the 1970s with examination of optimal resource depletion. The hardcore of the neoclassical synthesis was a model of human rational behaviour.

Humanists' claim that extended rationality was needed with individuals having to face self-interest and group-interest. Similarly, institutionalism considered the economy as a dynamic process connecting economics and ecology and giving attention to technical progress and changes which are the factors that create the structural and functional dynamic change of the economic system.

These interactions led to the emergence of Ecological Economics. For many people (mainly not economists) ecological economics cannot be differentiated from environmental economics or even agricultural and resource economics. However there are important differences as the recognition of the need to fundamentally change the current approach to economic analysis.

Conventional economists believe that environmental and natural systems are basics of human production and welfare. Ecological Economics has been considered as refreshing Environmental Economics but it is considered as either at its best a poor substitute for environmental economics or at worst bad economics by self-promoting natural scientists (Spash, 1999).

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