Conceptions of Ecological Economics: its Relationship with Mainstream and Environmental Economics

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Introduction

The purpose of this paper is to offer some considerations for a reflection about nature-society relationships, with a view to increasing the array of available theories for socio-environmental discussions in Brazil, and the world as well. In this sense, it is as much a quick review as a critical evaluation of traditional economic thinking in the face of the environmental dimension of the economic process (the task of the second and third sections of the paper, respectively). The endeavor of incorporating the environment as an appendix to the dominant economic model is the object of the fourth section, while the fifth deals with the environmental conditioning of the economic activity, introducing the perspective of so-called ecological economics, with its transdisciplinary approach, as the object of the sixth section. The seventh section explores some implications of the integrated vision of ecological economics. The paper closes with an appreciation of the tendencies of ecologism and economic-ecological thinking. Important names connected to the subjects treated are offered in order to illustrate the various tendencies, with an emphasis on the contribution of Nicholas Georgescu-Roegen (1906-1994).

Economic Vision of the Economy

The celebrated Austrian economist Frederick von Hayek, 1974 Nobel Prize in Economics, argued at the beginning of the 1940s in the journal of the London School of Economics, *Economica*, that neither merchandise nor money, nor even food could be defined by their physical qualities, but only in terms of the opinions that economic agents have concerning them (Martínez Alier & Schlüpmann, 1991, p.182). Far from constituting an isolated perspective, this is the dominant vision among conventional economists. The traditional science of economics, in effect, does not consider any connections that can exist between

the ecological system and the activities of production and consumption that represent the kernel of any economic system. The typical economic model does not contemplate the framework of environmental restrictions. It cares to focus only on flows and variables in the economic domain, as indicated in Figure 1, found in any introductory textbook on economics (see, for example, Samuelson, 1967). In the model (Figure 1), money circulates in a closed loop between families (consumers) and firms (producers), allowing only the movement of exchange value. Nothing more than this. Money comes and goes between producers and consumers. Nature, there, is what has become known as an "externality".

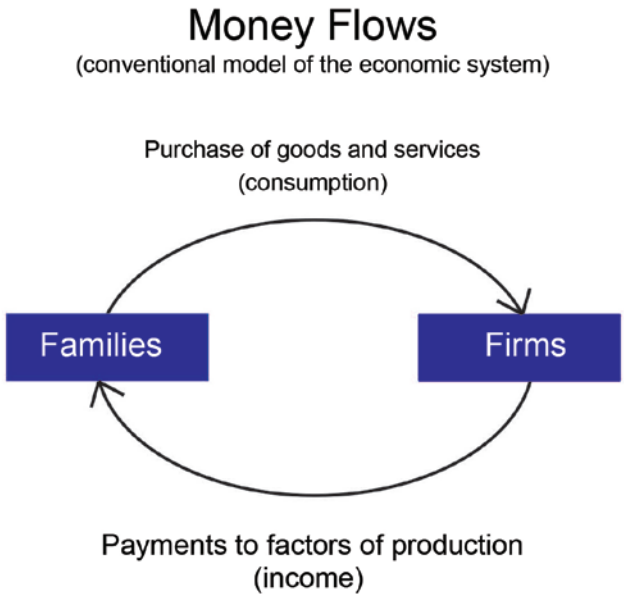

Figure 1 –The economy as an isolated system (*economic vision of the economy*).

In this perspective (that I call the *economic vision of the economy*), the economic system finds no limits. It can do everything. It is self-containing. Its expansion involves no opportunity costs. In other words, there are no exchanges nor any degradation derived from more economy that needs to destroy resources, whether for extraction, or for dumping the waste to which the economic process inevitably leads. If perchance, orthodox economics deals with environmental impact, it is to treat it as a phenomenon external to the economic system, as a market failure. For it external factors can, with adequate methods, be internalized within the price system: a means, supposedly, for correcting market failure.

On what reality can the scheme of Figure 1 be based? It is worth recalling here what the mathematician and philosopher Alfred North Whitehead said, in his 1944 book *The Function of Reason* (1985, in Portuguese, p. 5). In his words: "The higher forms of life are actively engaged in modifying their

environment. In the case of mankind this active attack on theenvironment is the most prominent fact in its existence." Such an attack unfolds in three stages: (i) *living* (guaranteeing our survival – an "obligation" of every living organism); (ii) *living well* (deploying the best environment possible; no one survives in his own litter); and (iii) *living better (*conquering new levels of quality of life, a cultural phenomenon; improving; progressing, prospering). Here then is Whitehead's thrust: "The primary function of reason is to direct the attack on the environment" (ibid), with the corollary that "The function of reason is the promotion of the art of life." (ibid, p.3). That is to say: attacking the environment is something inevitable. There is no living without making a bid for it. The question is how to do it in an intelligent manner, using reason and the goal of living better. There is no way to admit to wanting to deal with physical things, artifacts that combine matter and energy, without considering the implications derived from them in terms of the environment.

Critical Perception of the Conventional Economic Model

There is a long tradition of scientific thinking attempting to find arguments to confront the reductionism of science by economists. Martínez Alier (Martínez Alier & Schlüpmann, 1991, p.9) organized a sufficiently diverse list of scientists in this tradition, from different fields of knowledge, which includes Fred Cottrel (1877-1948, physicist-chemist and inventor), the couple Anne (demographer-ecologist) and Paul Ehrlich (entomologist) – professors at Stanford University –, Herman Daly (ecological economist and professor at the University of Maryland), Barry Commoner (biologist and professor at the University of Washington), the Odum brothers (both ecologists), Howard (1924-2002, notable for his pioneering studies about energy flows in ecosystems) and Eugene (1913-2002, zoologist), Gerald Leach (1934-2005, science journalist), David Pimentel (entomologist and professor at Cornell University), Ivan Illich (1926-2002, priest, philosopher, and social critic), Kenneth Watt (ecologist and professor at the University of California-Davis), René Passet (economist and professor at the Sorbonne), Roy Rappaport (1926-1997, environmental anthropologist and professor at the University of Michigan), Wolfgang Harich (1923-1995, philosopher-writer and professor at Humboldt University), Kenneth Boulding (1910-1993, critical economist and professor at the University of Colorado-Boulder), Charles Perrings (environmental economist, ex-president of the International Society for Ecological Economics (ISEE) and professor at Arizona State University), Nicholas Georgescu-Roegen (mathematician and heterodox economist, bioeconomist).

To this list I would add the names of Frederick Soddy (1877-1956, chemist, Nobel Prize in Chemistry, 1921), E. F. Schumacher (1911-1977, statistician and economist) and Samuel Murgel Branco (1930-2003,biologist and professor at USP, who I didn't know personally, in contrast to the various names

on the Martínez Alier list, including this last). Branco (1999) is author of a book, which at the same time is simple, unassuming, and penetrating about nature-society connections. Martínez Alier (2007, p.47) also makes reference to three thinkers about ecological-economic problems: Ignacy Sachs (heterodox economist and professor at the Sorbonne), Roefie Hueting (environmental economist and pianist, proponent of the notion of national sustainable income) and José-Manuel Naredo (ecological economist and statistician).

What is transparent in the critical vision about the orthodox thinking in economics in the names cited, is that there should be no question that considering the economic process within the mark of the environment constitutes an imperious necessity, perhaps even a banal accomplishment. As recalled by Hueting (1980), for example, national (ecologically) sustainable income constitutes an indicator of the level of production that represents no threat to the conditions of life of future generations. Why does conventional economics not work with a variable of this significance? For the reason, according to ecological economists, that a mechanistic view prevails in dominant economics. As Georgescu-Roegen (1971, p.1) explains, the founders of economics had the only aspiration of framing it within the parameters of mechanics. In physics, mechanics knows only locomotion and this, aside from being reversible, does not contemplate quality change, the contrary of what occurs in nature, in which irreversible phenomena prevail. To admit that the circular flow of income (Figure 1) is the only aspect that interests economic life is equivalent to admitting that, in the economy, what is important is the fact that money continually passes from hand to hand and undergoes no qualitative change (other than the wearing away of the bills that represent it).

With this what we have is a process that has only a circulatory system and no digestive tract. The adherence of economists to the mechanistic dogma constitutes a mystery. It is curious to notice that a revolution occurred in physics at the moment in which the basis for the foundation of the economic science was being laid. The revolution consisted in the recognition that heat moves in only one direction, from the hotter body to the colder, which exemplifies a condition of irreversibility. It is in this framework that "the fundamentally nonmechanistic nature of the economic process fully reveals itself" (ibid, p.3). For economic activity consists of producing and consuming; in other words, transforming raw resources into artifacts and, later, into trash, in an irreversible manner. This process requires energy – and energy cannot be recycled – a topic pertaining to the sphere of thermodynamics, and not of mechanics.

Economic Vision of the Environment

In conventional economics, the environment never appears – as an exam of normally used textbooks suggests (case of Mankiw, 2004, the currently most listed of them in the entire world). There are moments, however, in which speaking of the environment is important in the model. An adjustment is then

made considering the environment as an appendix of economic activity, which continues to be seen as the dominant whole; in this case, the ecosystem ends up with the essence of a storehouse or dispensary (see Figure 2), and can even been thought of as a bauble. This is the field of study known as environmental economics; in my view it could be termed *the economic vision of the environment.* Environmental economics is normally considered as a branch of microeconomics. Its focus is to find correct prices for the optimum allocation of resources (situations of maximum benefit, minimum cost). It is thus that it is taught and practiced where the need is manifest. With a central motivation: to internalize environmental costs so that prices reflect more fully opportunity costs.

Figure 2 - The environment as an appendix to economic activity (*economic vision of the environment).*

It can be said that economic theory does not have an environmental macroeconomics chapter (in opposition to what happens with microeconomics, the true sense of environmental economics). The predominant vision of the economic system as the big whole portrayed by the circular flow of wealth (Figure 1) imagines the economy as an isolated system. Thence the preoccupation with the environment, its natural resources, pollution and depletion, is nonexistent. An isolated system has no environment; it has no connections with anything that might constrain it. To admit that the economy does not possess the nature of an isolated system, without connections with the outside, is bound to bring a change in perspective putting the macroeconomy as an open subsystem within the naturally finite ecosystem (the environment). This means abandoning the isolated circular flow of abstract exchange value, unrestricted by the balance of mass, entropy and finitude. As Daly emphasizes (1991, p.35), "The physical exchanges crossing the boundary between the total ecological system and the economic subsystem constitute the subject matter of environmental macroeconomics." Including these physical exchanges in the economic model means that it becomes decisive to determine what is the volume of exchange that can fit within the context of the nature-economy relations.

How much can be extracted and how much can be returned to the environment by means of the economic process? In other words, what is the scale of the economy compatible with its ecological base? It is worth using here the image of a boat, whose load – being optimally distributed within it (solution of the microeconomic problem) – should respect the water (Plimsoll) line. When the water level reaches this line, the boat is full; it has reached its safe

capacity load (optimal scale). Environmental economists, working with markets, don't elaborate the problem of the optimal load; what interests them is the adequate accommodation of the boat's cargo. Ecological economists – invoking the principles of physics and ecology – consider that the size of the cargo is fundamental. In the conception of a possible macroeconomics of the environment, the carrying capacity therefore assumes a key role. It is it that is going to limit the scope of sustainable development. It is it, too, that is going to lead us to consider as unrealizable the proposal of perpetual growth, also called – in a totally inappropriate way – "sustainable growth." A growth without end, of this nature, perfectly possible in the conventional economic vision and in the economic vision of the environment, characterizes the priority of the Brazilian government in 2010, consolidated in the Growth Acceleration Program (PAC) of the government of President Lula da Silva. And this is likewise the paradigm of world economic evolution, from China to the United States, from Angola to India.

Ecological Vision of the Economy

Ecological economics has arisen because a hundred years of specialization of scientific research has left the world incapable of understanding or conducting interactions between human and environmental components of the planet. While no one questions the insights that scientific specialization has brought, many of us recognize that it has also turned into our Achilles heel. In an interconnected evolutionary world, reductionist science has stretched the array of knowledge in many and distinct directions, but deprived us of ideas about how to formulate and resolve problems that crop up in the interactions between the human species and the natural sphere. In what manner human behavior is articulated with changes in hydrologic, nutrient and carbon cycles? What are the feedbacks between the social and natural systems, and how can such feedbacks influence the services that we receive from ecosystems? Ecological economics (EE), as a field of study, attempts to respond to questions of such an order.

The growing perception that the life-support ecological system is increasingly threatened constitutes the starting point for the reflection that led to ecological economics. There has been a constant confrontation between nature and society, the environment and the economy, with uncertainties, drawbacks, urgencies and new frontiers. Conflicts appear that challenge the tendency to the purely monetary valuation (such as the "market's," for example) of situations essential for human life. For EE a central theme is exactly the incommensurability of values in face of the economic (Martínez Alier, 2007, p.23) .In effect, this was a consensus of the workshop conducted at the Aspen Institute (Wye

Island, Maryland, US), in May 24-26 1990 – in which I took part with 37 other persons and from which a collective book resulted (Costanza, 1991). This foundational book classifies EE as "the science and management of sustainability."

In the context of EE, it goes on to disagree as much with *conventional*

economics as with *conventional* ecology in terms of the range of problems that it should address. In the same way, it should delve into the basis of understanding of the environment-economy interactions. There can be no doubt, therefore, that EE sees the human economy as part – or subsystem – of the greater whole that is nature, and that it subordinates the economy in one way or another to nature. Such is its paradigm, which Figure 3 attempts to portray.

The issue that is brought about in Figure 3 is the conception of the economy as an open system within the ecosystem (the ecosystem is the whole; the economy, a part. Matter and energy enter into the economic system, go through a process – the *throughput* – and turn into waste or degraded matter and energy. The significance of the throughput is equivalent to the metabolic flow of a living organism. The organism assimilates external resources that come from the environment and returns the waste that results from the metabolism, after the useful part of the resources is made the most of it. Thus there is no wealth creation in the economic process. There is, indeed, transformation of matter and energy from low-entropy (resources) into high-entropy (waste) matter and energy – as established by the inescapable laws of thermodynamics. To the thermodynamic perspective of EE might be attributed the characteristic of an *ecological vision of the economy*. According to it, the economic system has a digestive tract, besides the circulatory system imagined by conventional economics. This is also Georgescu-Roegen's (1971) biophysical comprehension of the economic process.

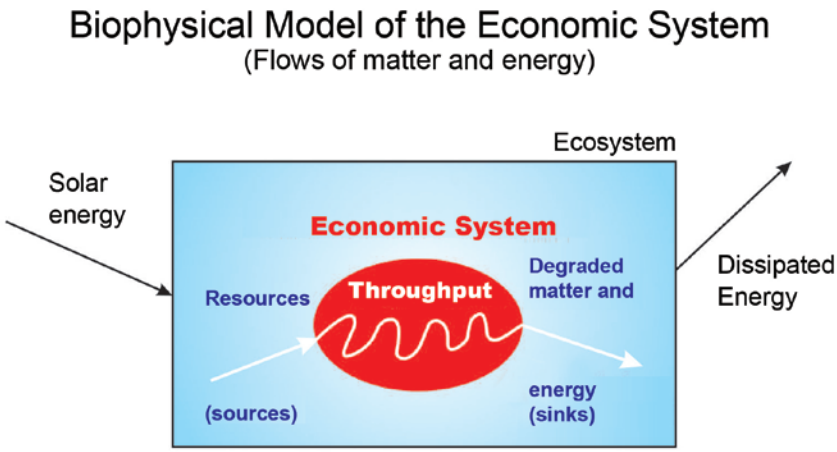

Figure 3 –The economy as an open system inside the ecosystem (*ecological vision of the economy*).

The above vision is thermodynamic because, since any activity means a transformation of energy – it is thus that human beings survive, as biology teaches us (converting food, i.e chemical energy, into movement, that is, mechanical energy) –, and thermodynamics is precisely the chapter of physics

that studies energy transformations. Its hard and implacable laws are to be obeyed by the economy, since there is no alternative (Branco, 1999). Viewing the economic process through such a lens, ecological economics implies a fundamental change in the perception of problems of resources allocation and how they should be dealt with, in the same way as a revision of the dynamics of economic growth.

Emphasis in the market should only be reserved for the efficient allocation of *preexisting resources* (which is what static microeconomics studies). When dealing with the situation in which *new resources* are being mobilized (economists of any stripe call this expanding the dimensions of the Edgeworth box), a theme located within the scope of economic macrodynamics, the road opens for unification on biophysical bases of ecological and economic systems as interdependent and co-evolving forms – to Georgescu-Roegen (1971) the chief task and challenge of EE.

Transdisciplinarity of Ecological Economics

By proposing a paradigm shift – or a change of pre-analytic vision, as Joseph Schumpeter (*apud* Daly, 1996) might put it –, one is not defending a new dogma. What must be recognized is the unquestionable evidence that society (or the economy) cannot exist without an ecological system, but an environment can exist without society (and economy). Conventional economics deals only with the human species, forgetting all others, and conventional ecology studies all species except for the human. Both cases reveal a narrowness of perspective that prevents an integrated vision of the ecological-economic problematic. EE emerges without disciplinary dependence, either on economics or on ecology, resulting, on the contrary, in an attempt to integrate both. Its worldview then would have to be *transdisciplinary*, with a focus on the relations between ecosystems and economic systems in the broadest possible sense. As Costanza *et al.* say (1991, p.3), "By *transdisciplinary* we mean that *ecological economics* goes beyond our normal conceptions of scientific disciplines and tries to integrate and synthesize many different disciplinary perspectives."

It is imperious to state here that *no discipline has intellectual precedence over another* in the matter of realizing sustainability. This applies to physics, biology, ecology – *and to economics*. Fragmentation of disciplines is an academic convention, while the problems that interest us are not found within the scope of discipline A or B. The University has (one-dimensional) disciplines; the real world has concrete (multidimensional) problems (as in the case of the socio-environmental ones).

Disciplinary boundaries are arbitrary academic constructs. The emergence of EE is oriented toward treatment of this convention. The conclusion can be no different: *EE does not constitute a branch of economics* (nor, it is clear, a branch of ecology). It could be called ecological economics as well as eco-economics

or economic ecology just as well. José Eli da Veiga (2007) has proposed that, in place of EE, one should talk of a socio-environmental economics. The fact of having adopted the term "ecological economics," which can easily lead to confusion with the notion of environmental economics, is reason to no few mistakes. For a better clarification of the question, one can imagine a scale which runs from the ecological to the economic, as is done in Figure 4.

The disciplines of ecology and economics can be placed on opposite points of the scale. The first cares only for the world of nature, excluding humans, while the second considers exclusively human reality – as is also the rule in the case of other social sciences –, considering the ecosystem as an externality. Closer to ecology, a little to the center of the scale, ecological economcis appears. To its right, nearing economics, environmental economics is located. There is no normative sense in this configuration. Environmental economics applies the tools of neoclassical economics to ecological problems. It looks at the environment, but its aim is simply to internalize it within the economic calculus. In other words, to value it in money terms: to provide prices with the property of reflecting hypothetical values for the services and functions of nature. In the meantime, the purpose of EE is to discover to what extent the use of nature can be made sustainable.

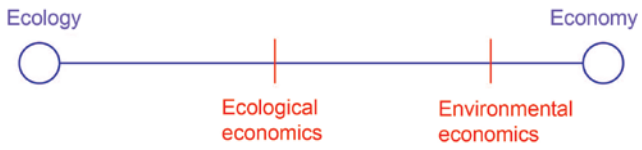

Figure 4 – Relations between the disciplines of ecology and economics.

Implications of the Integrated Vision of Ecological Economics

As an ecological economist, questioned about the primary task of the economic science, I feel inclined to follow the current that emphasizes its role of explaining human behavior conditioned by scarcity. Life is a continual succession of choices that represent the confrontation of different valuations. This happens because, in some way, resources – including, and above all, time – are scarce. Therefore, the fulfillment of human ends is restricted by the scarcity of means. If one end is preferred, this involves the sacrifice of others – a reality that underlies the economist's crucial concept of opportunity cost.

It is for no other reason that one of the best known definitions of economics underlines the fact that economics "is the science which studies human behaviour as a relationship between ends and scarce means which have alternative uses" (Robbins, 1984, p.16).

In the conception of the founder of neoclassical economics, Alfred Marshall (1961, p.xv), in turn, economic theory refers especially to human beings who

are impelled toward change and progress. His definition of economics, which he equates to political economy, consists in emphasizing that it is dedicated to examining "that part of individual and social action which is most closely connected with the attainment and with the use of the material requisites of wellbeing." (ibid, p.1). This is an interpretation of economics as a discipline dealing with choices, as in the analysis of consumer behavior within conditions of unlimited want and *finite resources.* Implied in this view is the idea that to behave economically means to make one's activities and one's organization "efficient," rather than wasteful (Knight, 1965, p.510). In other words, it means choosing the least costly course of action, or the one whose benefits are maximized.

From the economic-ecological perspective an obvious implication is that the economic system's expansion gives rise to positive environmental opportunity costs (the environment is scarce). If these costs up to a certain moment were so low that they could be ignored, the fact is that *more economy implies less environment.* It would be good if this were not so. It is here that we arrive at the conclusion that the prevailing worldview, which gives unusual emphasis to economic growth as the solution for everything, as an absolute priority in relation to other objectives, ends by allowing that this priority assume the meaning of a faith, a fetish, an obsession, a dogma. Without question, at the same time, there is room for confusion between *growth* (an increase) and *development* (evolution, transformation or "promotion of the art of life").

The economic vision of the economy establishes that there are no environmental opportunity costs for the macroeconomic process. At the same time, some economists have even come to say, as in the example given by J. R. McNeill (2000), that "the world, in effect, can continue its business without natural resources." In microeconomics, as known, the calculus (concept) of optimality (maximum efficiency in the allocation of scarce resources) prevails. This is the rule for stopping the expansion of scale (of the firm). In the meantime, in macroeconomics the quest for unlimited growth prevails. Optimal growth (or when growth should stop) has no appeal to it.

The perspective of EE is that there exists a maximum sustainable scale of the economic system with respect to the ecosystem That scale is to be determined by comparison of economic benefits with marginal environmental costs – as in the case of the equilibrium of the firm. In driving the economy, in fact, the depreciation of natural assets (natural capital) is real and cannot be ignored. That is to say, there are ecological opportunity costs. Increasing economic production implies sacrifice of resources, such as forests, soil, water, air, biodiversity, climate stability, and so on. Having an idea about this problem raises the need for an ecological vision of the economy.

In brief, this is a question of finding the optimal scale of the economic macrosystem, allowing separation between (i) genuinely *economic* growth (when the marginal benefits of the increase of the economy surpass the marginal environmental costs of the process) and (ii) *noneconomic* growth (when, in

contrast, the marginal benefits of the increase in the economy become inferior to the corresponding marginal costs). One supposes, of course, that, at some point, marginal benefits and costs are equal. The EE cosmovision internalizes the economic system in nature. This is in line with the warning of a distinguished exponent of conventional economics (*The Economist*, in the column "Face Value," 7.4.2009): "you cannot negotiate with nature."

The problem is that economic priorities systematically trample considerations of an ecological character. When prices are attached to natural resources – which is the case for those that have a market such as petroleum –, such values constitute invariably an underestimation. In traditional national accounting, zero value is implicitly conferred on all resources of nature, giving them the condition of "free goods." But what values could be used in these calculations? It is difficult to say, especially when there are things such as life in general or as a biological species threatened with extinction, in particular, that certainly have an infinite value. However, reality imposes a search for some form of valuation. For it is worse to see the economic value, for example, of the standing Amazon Rainforest reduced to zero, although the jungle constitutes, as is known, an irreplaceable source of a cast of ecological benefits that range from regulation of the climate and water, from the cycle of nutrients, waste treatment, recreation, non-timber products of the forest, biodiversity conservation, etc., to the so-called option and existence benefits.

The danger of assigning monetary value to ecological goods and services, in turn, is as much leading to the belief that they are worth what these calculations show as making it thought that natural assets can be added to human-made assets (both referred to the same money basis), making them substitutable. In the essence of the concept, however, ecological sustainability must be seen as maintenance of the physical stocks of natural capital, not of its corresponding money values – a question that leads to what is called "strong sustainability". It is here that the necessity of an ecological vision of the economy arises, one that cannot be confused with environmental economics. The economic analysis with a basis in ecological knowledge has as one of its missions promoting the modeling of the ecological bonds that determine the interfaces between natural and economic (or "productive") systems.

Ecological and Economic-Ecological Thinking

Summarizing: conventional economics excludes nature as foreign to the economic process; environmental economics is concerned with giving price to nature, with the tendency of seeing it as an amenity (an idea implicit in the vulgar notion of "green"); and ecological economics attributes to nature the condition of irreplaceable support for everything that society can do. The traditional economic vision includes not only the thinking of the neoclassical economics of Hayek, Milton Friedman, Robert Solow and their followers (in Brazil, an ilustrious name is that of Mário Henrique Simonsen), as also the Keynesians,

Marxists, institutionalists, structuralists, monetarists, political economists: a truly unique thinking.

Among the non-neoclassical Brazilian economists, Celso Furtado (1974) outstands in not being part of this pattern of unique thought. As a matter of fact, he attempted at giving emphasis to environmental factors in economic development The same thing does not happen in the work of Luiz Carlos Bresser Pereira, Maria da Conceição Tavares, Edmar Bacha or Affonso Celso Pastore, for example. Chief representatives of environmental economics in the world are Harold Hotelling, Partha Dasgupta, Anil Markandya, Joseph Stiglitz, Nicholas Stern, David Pearce, R. Kerry Turner. In Brazil: Ronaldo Serôa da Motta, Maurício Tolmasquin, Carlos Eduardo (Cadu) Young, Antônio Evaldo Comune, Francisco Ramos.

As to ecological economics, citing its practitioners requires defining the array of tendencies that show up as to perspectives of understanding this area of investigation. In truth, EE is not to be defined as a science. What emerged at the June 1990 meeting at Wye Island was the suggestion of considering it as a "new *transdisciplinary* field of study" (Costanza et al., 1991, p.3) with a view of covering spaces not approached by existing scientific disciplines. It would be an "orchestration of sciences" (Martínez Alier, 2007, p.67), involving a diversity of thinking among even environmentalists. Martínez Alier (2007, p.21) distinguishes three main currents of environmentalism, with various common elements that identify them, all of them, however, disqualified, ignored or deprecated by anti-ecologists (those who see the environment as a "barrier to development"). One environmentalist current is the one of the "cult of the wilderness," of the sacred value of nature, of deep ecology, of the biocentric attitude.

Another current could be called the "gospel of eco-efficiency:" an environmentalism of results that is concerned with the effects of economic growth. Finally, the third current is that of the "environmentalism of the poor," characterized by material interest in the "environmental resources and services for human subsistence provided by the natural environment" (ibid, p.335). The line of argument of the environmentalism of the poor proposes that the struggle between the economy and ecology cannot be resolved by internalizing the externalities, either by advancing ecological modernization or by eco-efficiency. It raises the discussion of the "unequal incidence of environmental damages in face of not only other species or future generations of humans but in our own epoch" (ibid, p.89). Central for the ecologism of the poor is the theme of incommensurability of values. In this particular, the task of EE is to study different processes of decision-making in a context of "week comparability of values," besides distributive conflicts and "uncertainties without solution" (ibid, p.55).

In money valuations, the relevance of a service of nature to the market is the factor that counts. However, services of nature have multiple meanings. A mangrove, for example, besides its economic role, is important from the standpoint of the landscape, of the survival of neighboring populations, of

culture, of the sacred. This leads to different values that require an integrated vision of the physical, social, cultural and spiritual dimensions of the ecosystem. It is as Martínez Alier (2007, p.355) underlines: "When colored people were required to travel seated in the last row in vehicles in the United States, this could not be compensated on the scale of human dignity by a cheaper ticket."

The most important name of EE in the world today is that of Herman Daly, who attempts to combine elements from the three currents of environmentalism. He was a student of Georgescu-Roegen, and has elaborated the thermodynamic vision of the economic process in new directions. Another name of substance is that of Martínez Alier, who was president of ISEE (in 2006-2007). He belongs to the current of the environmentalism of the poor (he has dedicated himself to the study of popular environmental movements such as Chipko, in India, and the extractive reserves' of Chico Mendes). Robert Goodland, ecologist, is close to the cult of wilderness. Ann Mari Jansson, economist, was connected to eco-efficiency, as also, in Brazil, are Peter May (ex-president of the Brazilian Society for Ecological Economics, Eco-Eco, and the ISEE), Maurício Amazonas (ex-president of Eco-Eco) and Ademar Romeiro (also ex-president of Eco-Eco). José Eli da Veiga is in a category that combines eco-efficiency and ecologism of the poor. Osório Viana approaches it close to the position of Martínez Alier. Charles Mueller identifies himself with Georgescu-Roegen and Herman Daly. Armando Mendes tends more to a vision of ecological humanism.

Classifications are always arbitrary. In the case of ecological economists, a division of tendencies could be among those who defend a strong sustainability (the case of Herman Daly) – the situation in which natural and man-made capital are not substitutable – and those inclined to weak sustainability (the two types of capital being perfect substitutes, as postulated by conventional economics). One name belonging to this last line is that of the Swede Karl-Göran Mahler.

In general, however, ecological economics is grounded in the thinking of Georgescu-Roegen (1971). According to him, the economic system consumes nature (low-entropy matter and energy, which are the fundamental means available to the world), inexorably furnishing waste (high-entropy matter and energy) that is returned to the natural system (Figure 3). Simultaneously, it provides a flow of pleasure or psychic well-being to the individuals who make up society, thus justifying its existence. The production of economic goods and services, without question, is nothing more than the opportunity for people to achieve the material component of happiness. It is in this that the mission of the economy, an organized system for converting low-entropy materials and energy into waste matter and high-entropy heat energy, consists. The duty of humans is to define how the economy will make life easier – the function of reason, according to Whitehead (1985).

In this understanding, order in the economic system, its capacity for producing useful things and offering us the means for our satisfaction, can only

be maintained by a constant flow of low-entropy matter-energy. In other words, our ultimate source of well-being is a natural system where order prevails. The totality of the authors of the founding book of EE (Costanza, 1991) are inclined to follow this way of thinking, as well as new-generation ecological economists like Joshua Farley and Amélia Rodrigues Enríquez (current president of Eco-Eco). In the end, a common denominator of the practitioners of EE resides in the defense of (ecologically, but also socially and economically) sustainable development. At bottom, this implies qualifying something that does not need adjectives. In truth, if development is not sustainable – which means that it is *unsustainable* –, it will not be development. It will constitute a process destined to failure, a lie (generally wrapped by the force of the growth credo). In essence, ecological economists lean toward adoption of this last stance.

Note

1 Among them: Charles Perrings (economist), Colin Clark (mathematician), Cutler Cleveland (geographer), Enzo Tiezzi (chemist), Garrett Hardin (1915-2003, biologist), Herman Daly (ecological economist), Joan Martínez Alier (ecological economist), Kenneth Boulding (1910-1993, ecological economist), Mary Clark (biologist), Richard Norgaard (natural resources economist), Robert Costanza (oceanographer), Silvio Funtowicz (philosopher), Talbott Page (environmental economist), Tomasz Zylicz (environmental economist). I was one of the participants, perhaps inadvertently invited by the organizers.

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ABSTRACT – The paper deals with nature-society relationships with a view to enlarging the scope of available socio-environmental theories. It makes a review and critical evaluation of traditional economic thought in front of the environmental dimension of the economic process. It shows the effort to incorporate the environment into the economic model and explores the perspective of the economy under environmental restrictions. It introduces the notion of ecological economics and a cross-disciplinary approach, examining some implications of its integrating view. It closes with an appreciation of tendencies in economic-ecological thinking, suggesting some names that represent them, with an emphasis on Nicholas Georgescu-Roegen.

KEYWORDS: Economics, Environmental economics, Ecological economics, Thermodynamics, Sustainable development.

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