Institutions and Environmental Sustainability
Reflections on Ecological Economics

by

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Abstract

Humans have increasingly become the dominant specie on this planet and there is a breakdown of balance-of-power amongst the various species and generation. This dominance is critically dependent on an energy intensive life style which entails an excess demand on nature for both the supply of low entropy structures as well as for the recycling of the high entropy externalities. This is the crux of the ecological crisis which can be traced to how relationships in nature have evolved and been ordered. Four levels of ordering relationships in nature *(Moral, Ecological, Social, and Physical)* **and how the various inter-specie and intra-human relations may evolve** *(Spontaneous, Negotiated, and Imposed)* **are identified. The moral ordering and the ecological ordering of neo-classical and new-institutional economics are highlighted and their implication for environmental sustainability is sketched. Ecological economics is examined as an alternative way of viewing how the world operates. The complexities involved in the pursuit of three macro goals of efficiency, equity, and sustainability are discussed. Finally, the Rawlsian 'veil of ignorance' is proposed as the guiding principle to construct inter-specie and inter-generation relationships.**

Introduction

Since the dawn of the civilization, humans have continually redefined their relationship with the other constituents of this planet. As humans discovered fire, invented force multipliers, moved from endosomatic instruments to exosomatic instruments, the inter-specie balance-of-power shifted in their favor.[2] Humans now began to exercise significant power to shape the destinies of almost all other species. The human domination was greatly strengthened by the technological discontinuity heralded by the industrial revolution. The resulting human 'hegemony' has lasted for almost two centuries. Now, it seems that this planet is entering an era of 'After Hegemony' where the humans are realizing both the impossibility and the undesirability of exercising asymmetric relationship with other species and generations.[3] From a stage where humans talked of 'war against nature' (Schumacher, 1973), mankind is coming to accept the necessity of living as a part of nature.

Economic revolutions have occurred whenever humans have been able to tap into new resources or develop new technologies to exploit existing resources to deliver both a higher per unit energy surplus (that is, the surplus over the expenditure to extract energy) and a higher total energy surplus. We can identify the following epochs in human history (see the table below) based on the source of energy used to sustain the civilization. [4]

Epochs In Human History

Epoch	Energy Source
Hunting/Gathering	Humans
Primitive Agriculture	Humans
Draft Agriculture	Humans and draft animals
Industrial Revolution	Fossil fuels * Stage 1 : Wood * Stage 2 : Coal * Stage 3 : Petroleum
Post Industrial	Solar Energy

The discontinuity in energy use occurred with the industrial revolution as a) the per capita and absolute volume of energy use increased exponentially, b) non-renewable stocks became the main energy suppliers, and c) energy consumption started imposing sizeable non-assimilative negative externalities on nature. Nature now came to be valued for two scarce commodities - a source for energy and a sink for negative externalities. The human ingenuity - technological and institutional, was now challenged to provide both renewable and non-polluting sources of energy.

Humans, to speak in a rhetorical fashion, are now at a cross-road. They are accustomed to very high energy consumption level to support their life styles. However, nature, in its role as a source and as a sink, cannot sustain such high energy consumption. Thus a need for transition to a more 'sustainable' energy use pattern.

I have arranged this essay in five sections. In section one, I discuss how inter-specie and intra-specie relationships may emerge and be ordered, how the various orders are nested in each other, and how the moral order sets the overall paradigm for the other orders. In section two, I discuss the how the constitution of the various orders, specifically those embedded in neo-classical and new-institutional economics, impacts environmental sustainability. In section

three, I present an overview of ecological economics and how it orders inter-specie relationships in a manner which is different from that in neo-classical and new-institutional economics. I discuss the concepts of entropy, sustainability, and the complexities in the pursuit of the three macro objectives of efficiency, equity, and sustainability. In section four, I highlight some of the challenges facing ecological economics. I propose the Rawlsian 'veil of ignorance' as the guiding principle of creating a biocentric order. In section five, I present the conclusions of this essay.

1. Relationships and Orders

This section deals with two questions : a) what are the various levels of ordering relationships in nature and b) how do these relationships emerge ?

Relationships

Young (1982:104; 1989:Ch.4) identifies three patterns of emergence of relationships - *Spontaneous, Negotiated, and Imposed.* Spontaneous relationships emerge without any premeditation by the participants. To paraphrase Hayek ([1899] 1973), such relationships are a product of the action of many participants but not a result of a deliberate design. These relationships arise as expectations of the participants converge around certain focal points even though there has been no explicit communication on part of the participants (Schelling, 1960:Ch.4). Negotiated relationships, on the other hand, have a contractarian character. They emerge through bargaining and negotiations amongst the participants. Imposed relationships are fostered by the dominating participants without any consultation with the other participants.

I have (or rather Young has) classified relationships to be of three kinds for analytical convenience. I maintain that these relationships cannot be compartmentalized. Rather, spontaneous and imposed relationships may be viewed as the two ends of a continuum with the negotiated relationships in between the two.

Orders

Relationships may be ordered at four levels - *Physical, Social, Ecological, and Moral.*[5] Physical ordering refers to how the physical structures such as canals, cities, telecommunication, railroads etc. have been conceived and laid out. For example, an irrigation system may take the physical form of a huge dam on a river with a network of canals or it may involve a series of minor irrigation works relying on ground water. Social ordering refers to the pattern of rules to order intra-human interactions. These rule-ordered relationships are also known as 'institutions' (Young, 1982:92-94; Ostrom, 1986; Keohane, Haas, and Levy, 1993:4-

5. Ostrom (1986) defines institutions as rules which order repetitive and inter-dependent activities amongst individuals. Rules are linguistic prescriptions which highlight what actions are required, prohibited, or permitted. Examples of institutions are marriage, a constitution, language etc. Ecological ordering refers to pattern of relationships amongst all the living entities in the bio-sphere. As discussed previously, ecological ordering has increasingly become anthropocentric over the course of human history. Further, the relationships seem more and more to be 'imposed' by the humans. Moral ordering refers the philosophical foundation (of humans) of the first three orderings.[6] For example, the ethical basis of the institution of market (a social ordering) is that it promotes efficiency (Taylor, 1993).

I view these orders to be nested in each other and are therefore consistent with each other. I am not arguing for a deterministic relationship amongst these orders. For example, I do not believe that a moral order of type 'A' will lead to ecological order of type 'B', which in turn will lead to social order of 'type C What I am saying is that a certain kind of moral order is likely to engender certain kinds of world views and therefore certain kinds of inter-species and intra (human) specie relationships. A utilitarian world view will certainly have different implications for intra-human relationship versus a covanental world view. Similarly, an anthropocentric world view, as opposed to a biocentric world view, would lead to a different pattern of ecological ordering.

At a certain epoch in history, there seldom exists an all pervasive moral order. Within a moral order, there may be multiple ecological orders. Similarly multiple social orders maybe consistent with a given ecological order and multiple physical orders be consistent with a given social order. For example, an anthropocentric ecological order is compatible with the two competing social orders of'capitalism' and 'socialism'.[7]

How Does a Moral Order Evolve ?

I have briefly discussed how the moral order eventually influences the evolution and the sustenance of other orders (ecological, social, and physical) and the relationships (spontaneous, negotiated, and imposed) in these orders. The question arises as to how does the moral order come into being?

I view the relationship among the various orders to be dynamic and reciprocal. An ecological order influences the evolution of the moral order and is inturn, influenced by it. I believe that all orders co-evolve. However, I am willing to accept other views on the emergence of moral orders as well - from 'Big-Bang' explanations where a moral order is created randomly to 'god created the world with a certain purpose' type of explanations. My enquiry is not directed at how the moral order came into being. This question is certainly important but not for the purpose of this essay and the arguments proposed therein. My enquiry therefore begins with an assumption that there is moral order. I am interested in understanding, inter alia, how moral

orders influence the inter-specie and intra-human relationships and how these relationships in turn, impact on environmental sustainability.

2. Orders and Environmental Sustainability

I pose three questions in this section. First, what kind of ecological ordering is embedded in contemporary economics ? I will focus on what I consider to be the two most influential streams of economics - neo-classical and new-institutional. Second, what are the implications of the ecological world view of these two streams on environmental sustainability. Third, is there any other formulation of economics which may favor environmental sustainability ?

Economics, as Lionel Robbins ([1932] 1937) has reminded us, deals with allocating scarce means amongst competing uses. Neo-classical economics gives primacy to the institution of market in the allocation decision on grounds of efficiency. What is emphasized is the exchange value of a commodity and not its use value or its labor value. The exchange values is determined by the preferences of the existing generation of humans. Though neo-classical economics views the markets to evolve spontaneously (this itself is contestable), [9] the outcomes of market dynamics are presented to the other species (ecological ordering) and to the future generations (social ordering) as a *fait accompli.*

New-institutional economics also gives primacy to the current human generation in determining the societal outcomes. The relationships among human actors are mediated through a variety of institutions - markets being only one of them. Further the institutions may also be an outcome of a conscious design - they may have a contractarian or imposed character (Bates, 1988). Schematically,

Fig. 2.1 : Orders in Contemporary Economics

	Neo-classical	New-institutional
Moral	Utilitarian & Pareto	Utilitarian & Pareto
Ecological	Anthropocentric	Anthropocentric
Social	Only Markets Matter	Institutions Matter

Inasmuch as environmental sustainability is rooted in a balance-of-power among the various species and generations, the existing inter-specie and inter-generation power distribution is inimical to environmental sustainability. This asymmetric power relationship coupled with an absence of a well accepted means of communication, results in the other species not giving

a timely feedback to humans regarding efficiency, equity, and sustainability implication of the existing ecological orderings. When the other species do react or when their reaction gets perceived by the humans, it may have become too late for humans to correct the error. Schematically,

Fig. 2.2 : Relationships, Orders, and Contemporary Economics

	Neo-classical	New-institutional
Ecological	Imposed	Imposed
Social	Spontaneous	Negotiated and Imposed

3. Ecological Economics
An Alternative Approach to Order Inter-Specie Relationship

In this section I will discuss some of the ideas which form the basis of ecological economics. Specifically I will deal with a) the purview of ecological economics, b) the concept of entropy, c) the concept of sustainability, and d) institutions for achieving the three macro goals of sustainability, equity, and efficiency.

What Is Ecological Economics ?

Ecological economics is a "trans-disciplinary field of study that addresses the relationships between the ecosystem and the economic system ... it differs from both conventional economics and conventional ecology interms of both the breadth of its perception of a problem, and the importance it attaches to environment-ecology interactions." (Costanza, Daly, & Bartholomew, 1991:3). Ecological Economics has four domains *(Fig.* 3.1) - conventional economics, conventional ecology, resource economics and environmental economics (Daly, 1990:186). Ecological economics has an explicit biocentric ecological ordering. Non-human species are not viewed for their instrumental value, they are assumed to be having an existence value. This helps in a defining a symmetric power relationship among the various species and thus furthers ecological sustainability.

Fig. 3.1 : Domains of Ecological Economics

To / From	**Economic Sectors**	**Ecological Sectors**
Economic Sectors	Conventional Economics	Environmental Economics
Ecological Sectors	Resource Economics	Conventional Ecology

Source : Daly (1990:185)

Entropy and the Laws of Thermodynamics

Energy, in a thermodynamic sense, exists in two states - *Free energy* and *Bound energy.* Free energy can be transformed into mechanical work. This capacity for mechanical work is manifested as a temperature difference between a body and its surroundings. As free energy is used for mechanical work, it dissipates and the temperature difference erodes. Free energy, unlike bound energy, is always stored in a well-defined order. Entropy is a measure of the disorder in the configuration of energy - low entropy means more of free energy and therefore a greater capacity for mechanical work (Georgescu-Roegen, 1966:68; 1971:5).

According to the first law of thermodynamics, energy can neither be created nor be destroyed. The term 'consumption of energy' is therefore a misnomer. What is happening, according to the second law of thermodynamics, is that we are transforming energy from the free to the bound state in the course of mechanical and technological processes (Ehrlich, Ehrlich, and Holdren, 1977:44). Thus, in the process of mechanical work, energy is degraded and entropy is increased.

The supply of low entropy comes from two sources - *stocks* such as minerals deposits below the earth and the *flow* of solar radiation intercepted by the earth. In the latter, through the process of photosynthesis, high entropy structures are converted into low entropy structures.

Until recently, the contemporary civilization was seen to be dependent on only the stocks of low entropy resources. However, as energy consumption accelerated, the dependence on nature to act as a sink and to recycle high entropy externalities is gaining acknowledgment. The environmental crisis can be viewed as the excess demand placed on nature to provide low entropy structures - directly or through recycling (Georgescu-Roegen, 1971:56-58). Sustainability can therefore be interpreted as an equilibrium between the aggregate supply and demand for low entropy structures.

What Is Sustainability ?

The Brundtland Commission defines sustainable development as the process of meeting the needs of the current generation without compromising the ability of the future generation to meet their own needs (World Commission on Environment and Development, 1987). Before I critique this definition, I will differentiate sustainability from equity. Equity refers to the pattern of allocation of resources across human entities of a given generation (individuals, caste, class, race etc.) found in various sectors (agriculture, industry, service, etc.), and spaces (north, south, USA, Japan, etc.). Sustainability , on the other hand, refers to allocation of resources across generation for the human specie (also termed as inter-generation equity) or across species at a point of time or across time.

The following issues arise when we attempt to operationalize sustainability both at the global level as well at the micro/sectoral level : what needs to be sustained, for how long, and who will decide this? Is sustainability merely concerned with identifying the appropriate discount factor (positive or negative) to solve inter-temporal allocation of resources ? Should we focus on conserving a given set of resources or should we explore alternative means to satisfy the same need ? Should we deliver utility to the future generation on every single need or should we deliver a constant/increasing level of aggregated social welfare ? Is sustainability a public good, a CPR, or a toll good ? [10] What are its characteristics in terms of rivalry in consumption, excludability, and storability ?

I have proposed a working definition of macro sustainability - equilibrium between the supply and demand for low entropy structures. However, we still need a definition applicable to a micro/sectoral level. For renewable resources, we can view sustainability as an equilibrium between the harvest rate and the regeneration rate so that the stock remains constant. The real challenge arises in case of non-renewable resources in which consumption is rival across generations. Three levels of sustainability *(Very Strong, Strong, and Weak)* can be visualized depending on the degree of substitutability possible among the human, man-made, and natural capital (Pearce & Atkinson, 1992). In very strong sustainability, the stocks of all the three types of capital individually must remain non-decreasing. No substitutability amongst the three forms of capital is allowed. In strong substitutability, a substitution between human and man-made capitals is possible and their aggregate must remain non-decreasing. However, natural capital has no substitutes and should therefore remain non-decreasing. In weak sustainability. perfect substitutability among the three forms of capital is assumed. Thus, the aggregate of the three must remain non-decreasing. There is no single version of sustainability that is applicable across sectors. For example, for critical environmental services such as absorption of ultra violet radiation, strong sustainability may be applicable. However, in some other cases such as petroleum, weak sustainability may be appropriate as substitution between natural and man-made capital is technologically feasible.

Efficiency, Equity, and Scale

I have identified the necessity of a macro balance between the demand and supply of low entropy structures. However, sustainability may not be the only goal or the most important goal for a given society. [11] Efficiency and equity are the two other goals which are often found on societal agendas. The question arises a) whether theses goals are independent, b) whether they are consistent, and c) how does one prioritize them ?

Daly (1990; 1992) argues that to achieve the three macro objectives of efficiency, equity, and sustainability, three policy mechanisms are needed. Efficiency, specifically allocative efficiency, is achieved through the price mechanism in the framework of the market. Equity is achieved through the instrument of fiscal policy which is administered through the institution of the State. Sustainability is to be achieved through the instrument of scale. [12] However, we still have not identified as to which is the appropriate institution to pursue the objective of sustainability. Are the options only limited to the two existing institution - the State (Pigou, 1932) and the market (Coase, 1960) ? Can we also think in terms of self-governing institutions (Ostrom, 1990) for this task ? Or can there be a mix of the three? Schematically,

Fig. 3.2 : Goals, Instruments, and Institutions

Goal	Instrument	Institution
Efficiency	Price Mechanism	Market
Equity	Fiscal Policy	State
Sustainability	Scale	?

The above discussion raises the following questions.

1. Are the three goals of efficiency, equity, and sustainability independent ? Are the three instruments of price mechanism, fiscal policy, and scale independent ? If not, then is the Tinbergenian ([1952] 1966) argument of 'three independent goals and therefore three independent instruments' valid ? [13]

2. Should we at all go for this neat categorization of institutions as State, market, or self-governing ? Can we unequivocally relate institution 'A' to goal 'a' and institution'B' to goal 'b' and so on ? Can't the market handle sustainability through the internalization of externalities?

Daly rejects the internalization argument. He says that we don't talk of internalizing inequity through the price mechanism, then why talk of internalizing externalities.

3. If macro sustainability is a public good or a CPR, then its efficient provision cannot be through the market. I am viewing provision as a constitutional level decision. The market may work at a collective level. For example, in case of Sulphur-di-oxide emission quotas, the limits are set by the State (constitutional level) but the collective and operational level choices are handled by the market.

4. Should self-governing regimes be considered only for achieving sustainability or are they may be useful for the pursuit of efficiency and equity as well ?

Markets and State : Are They Really Different ?

When Daly talks of market, he implies (I suppose) a competitive market. Such markets seldom exist in reality. Williamson (1975; 1985) has pointed out that with an increase in contractual complexity, there is an inexorable tendency for hierarchies to replace the market. Neo classical economics has a strong argument for equating (competitive) markets with efficiency. However, if the market has been subverted by a hierarchy, then the argument of 'market therefore competition and therefore efficiency' falls. The question then arises that why not rely on the institution of the State to deliver the goal of efficiency (Lange, 1938) ? As Posner points out, on transaction costs considerations, there is no conclusive basis for arguing that a corporate hierarchy is superior to a governmental hierarchy. I am not persuaded by the contention that the Principal-Agent problem is controlled in a firm as the firm eventually has to respond to the stock market. My counter is that bureaucracies will be controlled as politicians eventually have to face the electorates. Can we not argue that the State itself is a monopoly firm which provides public goods, especially internal and external security (North, 1981, 1990; Eggertsson, 1990:Ch.10). I am therefore uncomfortable in differentiating a hierarchy dominated exchange process from a State dominated one and to equate the former (only) with efficiency.

4. Unanswered Questions and Some Tentative Ideas

Ecological economics has certainly helped us to further our understanding of the complexity of the issues involved in the pursuit of sustainability. The challenge for ecological economics to develop a persuasive and spartan conceptual apparatus which can help us to understand the linkages among the issues as well to formulate falsifiable hypotheses. I am penning some of my ideas which may be considered in this herculean project.

As discussed previously, we have yet to identify the appropriate institution for implementing the goal of sustainability. The need for identifying an upper limit to resource use is

acknowledged - Kapp's *"Social Minimas"* (1963; 1970), Dietz and Straaten's *"Ecologically Bounded Possibilities"* (1992), Hardin's (1968; 1973) *"Carrying Capacity",* Daly's *"Steady-state Economics"* (1980; 1992) refer to the same conception. However, no lead is offered as to how these limits will be decided upon and enforced. Will a referendum be conducted, or will the legislatures decide on behalf of the society ? My discomfort is further accentuated as many of these prescriptions have the character of an imposed relationship. The current environmental crisis is a manifestation of how a surfeit of imposed relationships can disturb the balance-of- power amongst species and amongst generations.

Daly (1990:191) conceptualizes the pursuit of the three goals of efficiency, equity, and sustainability as a two level operation. He says that equity and sustainability are 'price-determining' and not 'price -determined'. Thus, we should first pursue the equitable and sustainable allocation and then let the market handle efficiency. I would instead opt for a three level operation. First, identify (who ?) the appropriate scale, then go for allocative efficiency through the Schumpeterian/Williamsonian (and not Smithian) market, and then let the Keynesian State correct the distributional distortion.

I have discussed how an anthropocentric moral order has led to the emergence of an asymmetric inter-specie balance-of-power. Unfortunately, even if the current generation of humans desires a symmetric and negotiated relationship with other species and generations, the absence of a common language impedes such efforts. Then how do we, the current generation of humans, safeguard the interest of other species and generations and thereby safeguard our interest. I propose that the *Rawlsian 'Veil of Ignorance'* (Rawls, 1971) be the main principle guiding our relationships with other species and other generations specifically pertaining to the scale of use of low entropy structures. Let the current generation of humans notionally divide resources into three parts. The three claimants of these resources are the current generation of humans themselves, the future generations of humans, and other species. The other species will choose first, the future generation of humans will choose subsequently, and the current generation of humans will take the remaining part. The logic of giving the other species the first choice is that current generation of humans have a less 'selfish' relationship with them than they have with future generation of humans. Thus, the least privileged will choose first. I think, given this kind of a mental construct, the current generation of humans will have the incentive to divide the resources in a sustainable manner. We will be able to harness self-interest of the current generation of humans to serve the goal of ecological sustainability.

I realize that my suggestion of adopting a 'veil of ignorance' is radical and seeks to alter the basis of contemporary economics - atomistic and selfish individual. However, as Tocqueville ([1835] 1945) had suggested, self-interest needs to be rightly understood. I think the 'veil of ignorance' principle may help the current generation of humans to make a transition from destructive self-interest to an enlightened self-interest, from ecological crisis to environmental sustainability.

5. Conclusion

Human civilization remains, as always, critically dependent on nature to support its sustenance. This dependence can be eventually seen as the reliance for the supply of low entropy structures and to recycle high entropy externalities. From an attitude of exercising dominance over nature and its various constituents, the current generation humans need to live as partners with these constituents. Since the humans have access to superior thinking ability and therefore superior technology, they have the ability to define the relationships with other constituents. We have seen the negative consequences of such an anthropocentric order. Therefore, in their enlightened self-interest, humans may be guided by the principle of the 'veil of ignorance' in formulating such relationships. The adoption of this principle will enable current generation of humans to harmonize their interest with that of the other species and of the future generations of humans.

Notes

1. A paper presented at the Spring 1994 Mini-Conference organized by the Workshop in Political Theory and Policy Analysis, Indiana University, Bloomington, April 30 and May 1,1994.

I am indebted to Brenda Bushouse, Thrainn Eggertsson, and Sue Crawford for their helpful critique of the earlier version of this paper. I am also indebted to Vincent Ostrom, James Walker, and John T. Williams for demolishing some of my previous ideas and for suggesting some new ones.

2. According to Alfred Lotka, endosomatic instruments are a part of an organism's body and belong to the organism from birth. For example claws, wings, limbs etc. Exosomatic instruments, on the other hand, are acquired post birth and are not a part of the body. For example clubs, swords, guns etc (Georgescu-Roegen, 1975:69).

3.1 am borrowing this term from Keohane's (1984) work *After Hegemony : Cooperation and Discord in the World Political Economy.*

4. The bio-physical perspective of scarcity treats low entropy energy as the primary factors of production. My visualization of the different epochs in human history is in the tradition of this model. A lucid exposition of this model can be found in Cleveland (1991).

5. Many of these ideas can be traced to my discussions with Vincent Ostrom.

6. The Marxian conception of a three levels of societal functioning - productive forces, production relations, and the superstructure gave me the initial stimulus for revisiting how relationships are ordered. However, unlike the Marxian conception, I am not arguing for a deterministic relationship amongst the various levels. Further, my conception is Hegelian inasmuch as I view the moral foundation (superstructure in Marxian conception) to be critical in influencing the evolution of the ecological, social, and physical relationships.

7. I am using 'capitalism' and 'socialism' to highlight two opposite views on who may own the means of production.

8. I am indebted to Sue Crawford for this point.

9. See Karl Polanyi's *The Great Transformation* for how markets have not emerged spontaneously.

10. I owe this point to John T. Williams.

11. Sociologists have argued that 'reproducibility' and not 'efficiency' should the ultimate goal for any institution (Oberschall & Leifer, 1986:235-236). I am inclined to interpret 'reproducibility' to be equivalent to 'sustainability'.

12. According to Daly (1990), the scale problem is germane as the human activities neither encompass all the resources of the biosphere - akin to Boulding's "Space-Ship Earth" (1966; 1973), nor are insignificant in terms of their impact - akin to a "Cow-Boy Economy". Humans are more like a "Bull-In-The-China-Shop". Hence the need to limit the scale of their resource use.

13. For a critique of Daly's thesis of treating sustainability, equity, and efficiency as independent goals, see Prakash and Gupta (1994; 1993).

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