Systems and Ethics:
Thinking about Human Needs and Sustainability for the Next Millennium

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Abstract

A system evolves, or responds to change, in ways that depend upon its internal structure and the characteristics of the environment within which it exists. For a social system, the structure of internal regulation (i.e. governance) is human-made, created out of that society's history and culture. In the author's opinion, it is desirable for socio-political reasons that this governance structure has the ability to evolve in order to achieve the changing goals of its citizens. The governance structure should also be able to respond to alteration in society's biophysical environment, to ensure maintenance or improvement of the joint sustainability of the society itself and the greater environmental system within which it exists and upon which it is dependent.

This paper examines aspects of the problem that arises as a result of the systemic incompatibility of the viewpoints of the two main paradigms from which this situation is commonly addressed; the political-economic and the biophysical. It is argued that unless these can be included within a more advanced perspective that acknowledges emergent complexity as its central characteristic, the viability of the global system, let alone that of societies within it, cannot be assured.

It is suggested that this problem can usefully be addressed via Systems Thinking. A framework for addressing the issue is presented, based on Bossel's Orientor Theory, together with examples of its application. The outcome of an exercise of this type will be strongly influenced by the ethical position adopted by societies and the institutional structures put in place to enable them to filter appropriate from inappropriate options..

Introduction

Human societies are complex systems, in turn embedded in a supersystem - the global environment. Since humans are totally dependent upon that environment for the necessities of life, and since human activities strongly influence both human and environmental health, we need to be well-informed about the state of both. This implies the need to identify and monitor key indicators of the state of human development, of societies, economies and the natural environment [1], while acknowledging that a full understanding will always be beyond us (Funtowicz and Ravetz, 1994). Such a course of action inherently implies that we can properly "control" only a small part of that complex system. The effects of our actions - careful or clumsy - on other parts that we do not understand properly, are unlikely to be beneficial.

Sustainable Development therefore requires *responsible management of a* *complex system*, with that complex system being ourselves, individually and collectively in societies. In order to introduce management systems, however, we have to be very clear about both our goals (desired social outcomes) and the criteria that tell us the extent to which the goals are being achieved. The designers of a management system must also have at least a reasonable understanding of the structure and dynamic characteristics of the system to be controlled, but as pointed out above, this is not the case where the system is as complex as the entire social-economic-environmental supersystem. With something as complex as a nation we are inevitably faced with the need to design improvements to its parts without fully understanding the functioning of the whole. Despite this, there appears to be enough understanding of the defects of current models to enable significant improvements to be made.

It is a basic premiss of this paper that most currently-dominant models of societies, economies and environment are scientifically deficient, and contribute to mismanagement of the joint social-economic-environmental supersystem. This means we must go beyond criticism of current models to a synthesis that takes what is useful from them and builds something more suited to the real world of complexity. In order to do so, it is first necessary to address the place of ethics, and then briefly summarise the main features of current mainstream models.

Coexistence and the Ethical Filter

Bossel (1999) makes the following comment:

"Sustainable development of human society has environmental, material, ecological, social, economic, legal, cultural, political and psychological dimensions that require attention: some forms of sustainable development can be expected to be much more acceptable to humans and, therefore, much further away from eventual collapse than others. A just and fair society, for example, is likely to be more securely sustainable than a materially sustainable brutal dictatorship."

Thus, the choice of ethical framework has a major influence on our choice of those criteria (e.g. indicators) we intend to use to guide our actions, in pursuit of responsible management of our own part of the complex socio-economic-environment system. It is also valid to assert a probable consequence, namely that what is not visible within our ethical horizon is unlikely to affect our actions and decisions. In other words, the ethical framework we adopt "filters" what we see and what we do not see, and constrains what we are prepared to use as control criteria.

It is therefore a necessary part of our process to illuminate and examine those social ethics that, implicitly or explicitly, guide us in our relationships with other people, other societies, other generations and other species. These ethics will underlie any statement of goal, such as that stated above.

Bossel's approach builds on an ethic of mutual relationships between subsystems, and between each subsystem and the total system - the supersystem - of which they all are part. Equity and reciprocity in such relationships are of central importance, if they are to remain socially and environmentally viable. His Ethic of Partnership (Bossel, 1999) is a statement that relates to all living or non-living systems, present and future: *"All systems that are sufficiently unique and irreplaceable have an equal right to present and future existence and development"*.

Funtowicz and Ravetz (1994) describe a somewhat similar ethic, in their comment that: *"... emergent complexity requires something like solidarity to maintain its own sort of dynamic stability"*. Norgaard's (1994) expanded "coevolution" concept develops a related synthesis within emergent complexity.

By seeking to improve the viability - the sustainability - of a system such as Society within its Environment, we are also accepting an implicit responsibility to future generations. Associated with a broad enough basic ethic, that responsibility also extends to other life forms. It is thus more than simple “enlightened self-interest”, because we cannot know the future, let alone our own likely place in it.

To the writer, it appears that a consensus is beginning to emerge on the desirable direction of societies. It is summarised here through the ethic-based Goal:

All people have their basic needs satisfied, so they can live in dignity, in healthy communities, with the minimum adverse impact on Nature, now and in the future.

That statement is arguably more helpful than the overworked and often misleading aim of “Sustainable Development”. It helps open up a picture of People, Society, Economy and Environment all inextricably linked together, with all parts of this complex system continuously engaged in dynamic processes of interplay with each other, directly and indirectly. Inter-generational justice is an explicit part of this value statement. The economic idea of “affluence” as currently pursued by “developed” nations is not [2].

If we accept this general view and this goal, which we might term “Sustainable Living”, we then implicitly accept the responsibility to incorporate the fullest possible range of available information into our consideration of options for the future. This will mean taking account of scientific understandings of issues such as the laws of conservation of matter and energy, the second law of thermodynamics, Time, irreversibility and the existence of nonlinearities, discontinuities, feedbacks, limits and constraints in the physical world. We then have to integrate this information into a process that fully incorporates perceptions of the nature of Value in communities. In Aotearoa-New Zealand in particular, this also requires us to pay particular attention to the stories and understandings of the indigenous peoples, the *tangata whenua*.

It is out of a consideration of basic ethics such as those mentioned above that society clarifies the Ethical Filter which will enable its people to choose those indicators that show whether - and how - progress is being made towards achievement of the Goal.

The Mainstream Macroeconomic Model

The circular flow diagram in Figure 1 (see, for example, Samuelson and Nordhaus, 1989) characterises a basic vision of the economic process. In this model, goods and services made by Employers/firms ("Producers") are sold to Households ("Consumers"), who in turn obtain money by selling their labour to the employing firms.

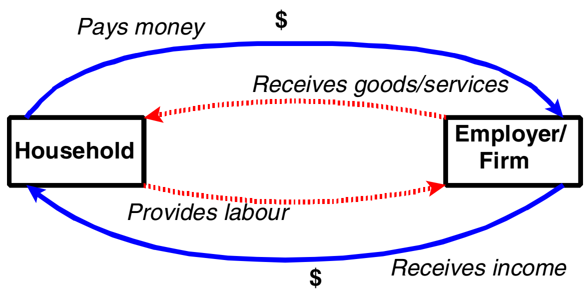

Figure 1 – The basic macroeconomic model

The economic process is thus portrayed as a self-sustaining, circular flow between Producers and Consumers. The logic of this model is that of exponential growth, where production rises to meet consumption sector demand, and increased demand justifies further increases in production, *ad infinitum*.

In the opinion of many workers in ecological economics (see Peet, 1992), the model has serious flaws. In it the economy is treated as effectively isolated from the natural world, embedding the implicit assumption that monetary flows via their associated valuation processes (usually markets) are sufficient to characterise everything of importance. No attention need be paid to the supply of resources and energy from the environment, nor the assimilation of wastes from economic activities. It also ignores the social context, through the implicit assumption that something which is not paid for is not important. Daly (1995) comments:

> *"This diagram has its uses in analysing exchange, but it fails badly as a framework for studying production and consumption. Maintenance and replenishment, in this picture, would seem to be accomplished internally, requiring no dependence on an environment. It is exactly as if a biology textbook proposed to study an animal only in terms of its circulatory system, without even mentioning its digestive tract! An animal with an isolated circulatory system and no digestive tract would be a perpetual motion machine. Unlike this imaginary circular-flow animal, real animals have digestive tracts that connect them to their environment at both ends. They continuously take in low-entropy matter-energy and give back high-entropy matter-energy.*
>
> *"The entropic throughput of matter/energy is more basic than the circular flow of exchange values. No economy can conceivably exist without the entropic flow, while it is easy to conceive of an economy with no circular flow."*

Biophysical Models

In Figure 2 the model of Figure 1 is extended to incorporate the special place of energy in the thermophysical view of economic production, using the model of Gilliland (1977). In this model, the (generalised) energy sector is separated out to show how it is involved in every single production process in an economy. Nothing of social or economic importance happens - in industry, in commerce, in agriculture or in the home - without the associated consumption of high quality "source" energy and rejection of waste, low quality "sink" energy. This process is unidirectional (from "source" to "sink") and irreversible, in comparison to the circular, reversible macroeconomic model.

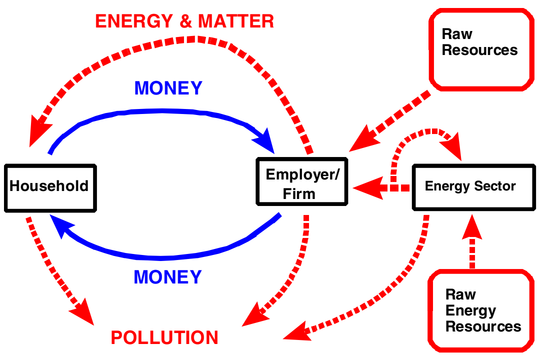

Figure 2 – Thermophysical macroeconomic model

Figure 3 shows the system boundaries of the model extended further, to illustrate the inherent and inescapable "metabolic" functions associated with each economy. It indicates the centrality of the energy concept in describing the thermo-biophysical "engine" that enables the global ecosystem to function, just as it enables the functioning of everything else - economies included - that has life within the global ecosystem.

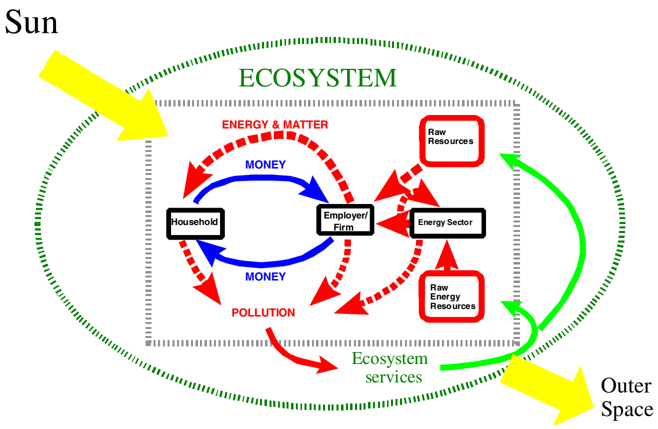

Figure 3 – Thermo-biophysical view of the economy

Economists have responded to these criticisms by extending basic neoclassical theory into Resource Economics and Environmental Economics. In both, the key issue is that of clarifying Property Rights as an essential step towards illumination of "externalities" (see, for example, Common, 1995).

In environmental economics, according to Beder (1996):

"... the solution to environmental problems becomes one of 'marketising' the environment through the creation of markets in pollution rights, imposing taxes or subsidies so that prices reflect social costs and awarding quotas of right to pollute". "*... the assumption in internalising costs is that environmental damage can be paid for and that this is as good as, or even preferable, to avoiding the damage in the first place*".

Related tools in resource economics involve application of discounting of possible future events such as resource depletion or environmental damage, in order to determine the most efficient use of resources over time.

A problem with these attempts to incorporate the reality of environmental degradation into social policy development is that they require biophysical concerns to be interpreted via economic theories. But as Beder comments:

"... if environmental resources and pollution are seen merely as an adjunct to production, then economic instruments will merely perpetuate the problem and subvert any potential for political or value-based change".

From a scientific viewpoint, one may also observe that in this approach the needs of the total system are put behind those of one of its (dependent) subsystems (the economy), for reasons that appear to owe more to ideology than to science (Peet, 1992)

Despite these criticisms, there is no doubt that the use of macroeconomic policies and business practices specifically designed around assignment of a very high ecological "value" to resources and the environment would give rise to markedly more environmentally benign (and often more profitable) outcomes, via the use of improved technologies for converting resources into end-use human services (see, for example, Lovins et al, 1999; von Weizsäcker et al, 1997; Roodman, 1998). Such practices are essential steps towards an improved policy synthesis.

The World View of "Post-Normal Science"

Despite its improvements over Figure 1, the model of Figure 3 is still oversimplistic. Further development is necessary, to clarify the features necessary for development of realistic policy alternatives.

The world view implicit in the macroeconomic model of Figure 2 is that of 17th Century Newtonian Classical Physics, and its 19th Century economic analogue, Neoclassical Economics. In this perspective, the world - and systems within it - are isolated and tend towards a state of equilibrium, where departures from that state are temporary and reversible. Markets are similarly believed to show self-regulating behaviour, via the equilibrium price auction mechanism.

From a 20th Century scientific perspective the situation is markedly different. Reality (whether economic or ecological) comprises thermo-biophysically open complex systems, which at all times exist in a *far-from-equilibrium* state. Their behaviour is characterised by a capacity to evolve and self-organise, rather than self-regulate (see Allen and Peet, 1994). The global bio-geo-chemical system of life on earth and the meteorological processes of the global atmosphere are prime examples of such complex open systems, as are human economies.

Nature as a whole is an incredibly complex closed thermo-biophysical system, made up of a vast number of complex, interrelated open subsystems. Open systems tend to maintain a metastable state of dynamic instability. All living organisms and natural systems (including societies and economies) come within this description. Nature and her ecological and other subsystems have a considerable ability to regulate their own functions, but they can also react to changing circumstances by rapidly altering their internal structure and organisation. No matter how much is known about their past, their future behaviour can never be predicted accurately.

For scientists to give advice on complex bio-geo-chemical systems using only the tools of Newtonian physics would nowadays be regarded as absurd, yet modern economies are still organised largely according to the perspectives of neoclassical economics. Under conditions of complexity the future is incapable of prediction, whereas in the Newtonian paradigm it is a simple - often a linear - extrapolation from the present.

Those who attempt to control human activities via understandings obtained from a model such as that of Figure 1 inevitably ignore the complexity of biophysical problems that risk destabilising the global ecosystem. On the other hand, the models of Figures 2 and 3 fail to incorporate economic issues, and are also incomplete. None of them addresses institutional or socio-structural issues properly.

In a context such as this, an understanding based on appreciation of Complexity is essential. In situations of emergent complexity, where *"facts are uncertain, values in dispute, stakes high and decisions urgent"*, the perspective which Funtowicz and Ravetz (1993) have termed "post-normal science" is probably the most appropriate one from which to work. Moral and procedural examinations of the roles of science, economics, technology and ecology are essential preconditions of the process (Funtowicz et al, 1998).

Given our lack of deep scientific understanding of the ecosystems which sustain us, it is appropriate to adopt the Precautionary Principle when developing policies likely to have significant environmental or social consequences. As used by Perrings (1991), the Principle: *"... implies the commitment of resources now to safeguard against the potentially adverse future outcomes of some decision"*.

The System of which Society is Part

In order to make our approach operational, we should represent important component subsystems in our conceptual model of the system of society within its super-system environment, while at the same time attempting to allow for the realities of emergent complexity. We should try to assess the role and function of each subsystem, and the various and often crucial linkages within and between them and the total world supersystem, now and in the future. In this context, acknowledgement of the importance of institutional structures is vital, in expanding the validity of our models of economy, society and environment.

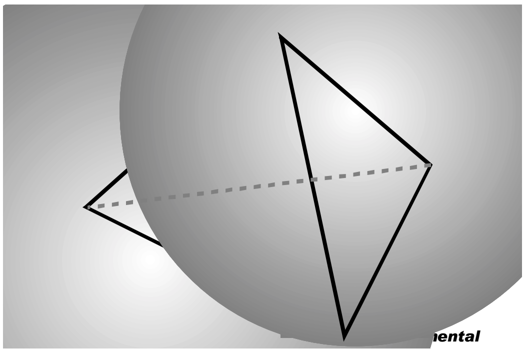

Figure 4 – Four dimensions of sustainability (the Wuppertal Prism)

A useful approach adopted by Spangenberg and Bonniot (1998) at the Wuppertal Institute has been to represent the "Four Dimensions of Sustainability" of the UN Commission on Sustainable Development as a prism. Figure 4 shows that, as a means of illustrating a number of important points it has distinct value as a pedagogical tool, since it takes an otherwise unconnected set of dimensions and brings out the interlinkages that exist between them.

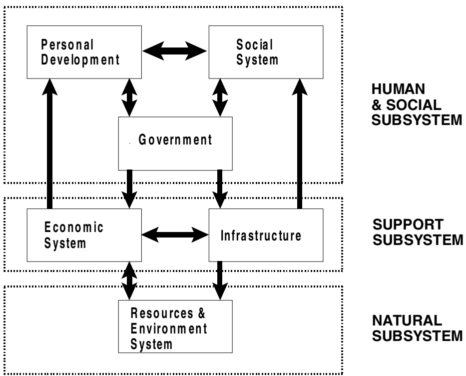

Figure 5 – Links between the subsystems of society and its (supersystem) environment

Figure 5 shows Bossel's (1999) perspective. This is also a simplification of reality, used for pedagogical convenience. It nevertheless makes it clear that all parts are interconnected, with each part connected, directly or indirectly, to all others, with (as in Figure 3) circular flows, and feedbacks, where reciprocity can be seen as the key relationship.

These subsystems are all essential parts of the anthroposphere - that which affects and is affected by, human society. Each represents a structure - a stock (or state) that some call “capital” and others call “endowment”, which has been received by us from earlier generations, and in one form or another (i.e. presumably undamaged) will be needed by future generations. Flows between these structures govern whether they grow or depreciate and determine whether they are maintained in order to contribute to the development of the whole.

System Needs

A consistent analytical framework has been constructed by Bossel, to assist in identifying those parts of a complex system where the condition of one or more key state variables may threaten the viability of the whole system. This framework is designed to identify the fundamental Needs of a system, to ensure its viability or sustainability, over the longer term (Bossel, 1999; Peet and Bossel, 1998, 1998a).

Every System exists within a surrounding Context, or Environment. That Environment has a minimum number of fundamental system properties, each of which is unique; i.e. no one fundamental system property can be expressed by any combination of other fundamental properties. Their content is also system-specific, in that the same physical environment will present different characteristics to different systems existing within it. As an example, a cow and a bee may share the same meadow, but “resources” will probably mean grass to the cow and nectar to the bee.

One would expect the properties of a system’s environment to be reflected in all of the systems that have been shaped by it. Bossel calls these reflections of the minimum number system properties *Basic Orientors* (Bossel, 1999). They not only influence the structure and function of the system itself, but also influence that system’s behaviour and viability in relation to its surrounding environment. *Orientor* is a general term which applies at any level of the orientor hierarchy (including the context of local or subsystem goals). A *Basic Orientor* is more fundamental, and relates to the system’s overriding goal or driver.

Basic Orientors are the Basic System Needs. A minimum level of satisfaction of each need, each basic orientor, is essential; an oversupply of one cannot substitute for a deficit of another. In other words, *the key to the viability and sustainability of the system is a sufficiency of each and every orientor*.

When assessing the viability of a social system it is imperative that planning, decisions and actions must always respond to at least the basic orientors, or derived criteria such as indicators, simultaneously. Multi-criteria assessment is therefore the norm. If any basic orientor shows a greater deficiency of satisfaction than others, the conditions that affect that salient orientor’s viability must receive attention first, before we select any other basic orientor for attention.

Below are listed Bossel’s six generic Basic Orientors of system behaviour (in bold italic type), each of which is related explicitly to the fundamental property of its environment (in bold type).

Six Basic Orientors of System Behaviour

Existence: Necessary to ensure the immediate survival and subsistence of the system in the **normal environmental state**.
Effectiveness: The system should over the long term be effective (not necessarily efficient) in its efforts to secure **scarce resources** from, and exert influence on, its environment.

Freedom of Action: The system must have the ability to cope in different ways with the challenges posed by environmental **variety**.
Security: The system must be able to protect itself from the detrimental effects of environmental **variability**, such as fluctuating and unpredictable conditions outside the normal environmental state.
Adaptability: The system should be able to change its parameters and/or structure in order to generate more appropriate responses to challenges posed by **change**.
Coexistence: The system must be able to modify its behaviour to account for behaviour and orientors of **other systems** (i.e. actor systems) in its environment.

Three Additional Orientors of System Behaviour are appropriate in some situations, such as those involving higher organisms:

Reproduction: **Self-replicating** systems must be able to reproduce.
Psychological Needs: **Sentient beings** (which can feel pain) have psychological needs.
Ethical Reference: **Conscious actors** are responsible for their actions and must comply with an ethical reference.

In addressing issues such as that represented by our goal, we deal mostly with self-organizing systems and the humans constituting them. That means we will usually have to make sure that the full spectrum of nine Basic Orientors is satisfied.

The use of basic orientors for assessing the viability/sustainability of a wide range of systems is illustrated in Bossel (1999) and the other listed papers of ours.

The Importance of Stakeholder Involvement

Expert scientific knowledge (e.g. of physical fundamentals such as the Second Law and/or of Time and rate-related phenomena) will influence the process of search and selection of (for example) indicators that can appropriately reflect basic orientors of system viability. However, if the outcome is to respond to the needs of the people within the system, as well as to the encompassing ecosystem, that process should actually be *shaped* by the values of a much wider community than that of experts. As mentioned earlier, it is vital that the overall process incorporates the fullest possible range of available information in the consideration of options for the future.

How could such an approach be used in practice? More to the point, how can local knowledge and accumulated wisdom of people in communities be incorporated into the expert-dominated process of determining whether a system is viable, and whether it is proceeding towards or away from its - implicit or explicit - goal? Related to this is the question of how experts can be induced to let go of power they have to control the process, while remaining within the loop and continuing to contribute to the process as a whole.

The process of values clarification would benefit markedly from Funtowicz and Ravetz's suggestions of "extended peer reviews" within "post-normal science" (Funtowicz and Ravetz, 1991). Such forms of participatory process can help ensure that local knowledge and values are appropriately incorporated into the process, as they suggest (Funtowicz and Ravetz, 1994):

> *"Emergent complexity provides a theoretical justification for post-normal science, in which the peer group for quality assurance is expanded beyond the certified experts to include all those with a stake in the issue.*
>
> *"... no particular partial view can encompass the whole. It is therefore necessary and legitimate for the dialogue on such issues to include persons representing all different interests, which may also include concerns for children, non-human*

species and ethical values.

"Post-normal science provides concepts whereby in debates on policy issues lying 'at the edge of chaos', the contradictions appearing as differences of perception and value, normally involving debate and even tendencies to conflict, can be contained and made the occasion for mutual learning and respect."

In a related discussion, Hayward (1997) suggests that:

"Deliberative democrats aim to foster public space for citizens to come together to reason about collective concerns in a free and open speech situation.... Deliberative democracy fosters practical reasoning (the giving of good reasons) in a process of critical argument as an alternative to technocratic domination of decision making.... Citizens transform their preferences by reasoning together about public minded ends or a common good rather than competing for the promotion of the private good of each".

In the context of the proposed methodology, community values would be most appropriately summarised via the Ethical Filter that is used to guide the process of selecting indicators. These in turn focus on basic orientors of system behaviour.

Emergent "Value" in a Complex System

It is entirely to be expected that by drawing on both expert and lay wisdom, it will be possible to identify, via their indicators, those basic orientors of viability of a particular subsystem in which we are interested that are (to use Liebig's term) "in the minimum". Effort can then be concentrated on means to overcome those constraints, to improve the viability of the subsystem and in turn that of the whole system. By so doing, the key areas will be identified, where supply of a scarce vital resource or removal of a damaging substance or process will have a major effect on the future state, and therefore the viability, of the subsystem (also see Bossel, 1999; Peet and Bossel, 1988, 1988a).

It would then be reasonable to describe the supply of such an input or the making of such a corrective change as actions that are "valuable" to the system. In other words, in the context of a complex system, *something can be regarded as being "of value" to a subsystem if it is necessary to ensure the ongoing viability of the subsystem itself and of the other systems, subsystems and sub-subsystems to which the subsystem is connected and with which it coexists.*

In this framework, Total System "Value" is an emergent concept. It has components, also arguably reflecting value, that contribute to the value we attribute to the whole. If those basic criteria that are "in the minimum" point towards constraints on the ability of the whole to achieve its potential, then by removing those constraints that are under our control - supplying a scarce resource or substituting or changing things so they are no longer scarce - we improve the value of the whole.

Once the constraint on a basic criterion in a complex system has been eased and it ceases to be "in the minimum", it is reasonable to expect that, in the course of time and as a result of coevolutionary or other dynamic circumstances, another may reach the state of being "in the minimum", and become a new constraint. In other words, that to which we attribute value is not necessarily fixed in time or space, and the components that are of value in ensuring the viability of the whole are also subject to change. Prices determined in a marketplace (e.g. by variants on willingness to pay) are quite inadequate to indicate value in contexts such as this.

When dealing with human/social systems, the need to satisfy additional criteria can introduce further issues. For example, the existence of cultural and spiritual components of the "value" attributed to a thing or a process by people is often central to their own identities and to their community and their environment, and relates to their being conscious actors, with moral, cultural and other referents.

In some relatively simple situations (where the Value of the whole can be seen as a conserved entity), this concept could be seen to subsume ideas such as an Energy Theory of Value. In others it may be related to the conventional concept of Economic Value or Utility. In more complex social situations it could have a meaning that is closer to Pirsig's (1989) use of the word, in his discussions on the Metaphysics of Quality, where value inherently involves both subjects and objects, as explained by his comment *"Value is the predecessor of structure"*. A related idea comes from Pirsig's closely-related use of the word Quality: *"Quality is the continuing stimulus which our environment puts upon us to create the world in which we live."* .

O'Connor's (1994) statement about Intrinsic Value can also be seen as relevant here, in that it is *"... a matter of ethical stance or disposition - that is, an affirmation or assertion of worth or standing of some objectively existing being"*. In a context such as this, indigenous peoples, as demonstrated by the *tangata whenua* (the Maori) of Aotearoa, often have a much clearer understanding of relationships, reciprocities, priorities and values in complex systems than is available from the more circumscribed notions of conventional Western European, including "scientific" and "economic", belief structures [3].

In all of these situations, a more system-oriented holistic worldview, that accepts the reality of interconnectedness and reciprocity is needed to move on from the individualistic/atomistic world view of the neoliberal political economy.

Conclusions

The needs of the total socio-economic-environmental system within which human life exists are exceedingly complex, to an extent that humans can barely comprehend. When addressing issues of the viability (i.e. sustainability) of parts, let alone the whole of such a supersystem, our tools have been patently inadequate, and in most cases demonstrably harmful. We have been left with the imperative of doing the best we can with incomplete perceptions of the whole.

When developing policy which addresses the sustainability of human socioeconomic activity, it is clear that the needs of the system(s) expressed through mainstream macroeconomics are fundamentally incomplete. They are also incompatible with those expressed through biophysical models.

Policy development requires a hierarchy of processes. First is identification of requirements such as Kantian-type "categorical imperatives" and "environmental bottom lines". These are ethically-determined, and include preservation of the ozone shield, avoidance of potentially catastrophic human-induced accelerated global climate change, further substantial loss of biodiversity and so on, should be clarified through the best of available science and participatory valuation processes. Human activities that put these at risk must be reversed, as a matter of urgency. Development of an "ethical filter" is critical.

In practice, this stage can be addressed by concentrating on identifying, and determining the extent of satisfaction of, basic orientors of viability of the system. After achieving satisfaction of all basic orientors, it is then possible to develop further options by "balancing" the positive and negative consequences of possibilities, via Benthamite-type "consequentialist" (e.g. cost-benefit analysis) ethics.

Above all, however, is the need for policymakers to acknowledge that our models are, and will never be other than, partial. No one group of experts or political ideologies must be permitted to capture the process; all must be involved. That is why a community-determined “ethical filter” must be to the fore in our efforts, and that in turn must come out of a process that is as well-informed, transparent and responsible as it is humanly and scientifically possible to be. Systems thinking, such as illustrated here, has a potentially vital contribution to make to this essential task.

Notes

1. The idea of separating Humanity, Society, Economy and the Environment into independent “compartments” reflects a modern myth. In reality, we are all inseparably parts of the totality of Life on Earth. The images and methodology described in this paper are therefore put forward as *tools, not blueprints*.
2. Arguably, “all living things” should also be included in the Goal, but one suspects this is more than most people are currently ready to acknowledge. Thus, the last part of the Goal statement falls short of explicitly calling for interspecies justice.
3. Understanding of some of the realities of indigenous peoples worldwide is accessible via, for example, the *United Nations Draft Declaration on the Rights of Indigenous Peoples*.

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