SUMMARY PRINCIPLES FOR SUSTAINABLE DEVELOPMENT

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Summary

Economic work treating sustainability questions necessarily must address principles such as justice and equity, the character of relationships between economy and environment, as well as the questions of institutions and decision-making. These principles address the debate around the choice of indicators and models for sustainable development.

There are now a wide range of conceptual frameworks available for the representation of principles for sustainable development. This raises the problem of what sort of methodological and epistemological approach to adopt for this new challenge facing economic analysis. Amongst the many approaches that coexist, some involve a simple extension of existing concepts and theories (such as marginal cost, monetary valuation of natural capital); others involve much more radical rethinking of foundations for economic analysis. Among these latter are perspectives that situate the economy as a set of processes within the larger social sphere, the latter itself within the larger biosphere,

with its own characteristics of function and change. Such an approach necessitates the search for appropriate concepts and representations for describing economic phenomena and their relations to social and ecological dimensions. This involves notably an openness towards the sciences and nature and to the social sciences, in the hope of finding pertinent insights and concepts that can complement the more narrowly economy tools.

The diversity of interpretations of the main principles of sustainable development in terms of indicators, of decision-making processes and of models of sustainable development policies reflects partly the variability of scientific knowledge across different problem domains. More particularly, it is an indicator of differences in character of the various knowledge forms and of the requirements for effective communication, and the diversity of problem perception among the range of scientists and stakeholders involved in the assessment process. The selection of specific methods and procedures for the implementation of principles linked to sustainable development depends thus on the context of the assessment. The simultaneous use of a variety of methods, in a procedure of "dialogue" is vital to the quality and adequacy of the analysis, enabling interpretations and effective communication of the impacts of options and strategies.

1. Introduction

Few concepts have attracted as much attention, popular and academic, as that of sustainable development, brought into prominence with the Report of the World Commission on Environment and Development published in 1987. On the one hand, sustainable development is now a stated policy objective for many nations. It has a central place in the *Agenda 21* declarations concerning actions to be taken worldwide, adopted at the Earth Summit in Rio de Janeiro in June 1992. Equally, it is the cornerstone of the European Community's 5th Program for the Environment and Sustainable Development. On the other hand, large-scale environmental problems such as climate change, biodiversity loss, deforestation, and ozone layer depletion are more and more interpreted in terms of sustainable development.

The formulation of "sustainable development" that is now widely used is the following: "a path of human progress which meet the needs and aspirations of the present generation without compromising the ability of future generations to meet their needs (WCED, 1987)." Another widely known definition, which emphasizes the ecological dimensions of sustainability, is the one offered by Costanza and his colleagues as a keystone for ecological economics:

Sustainability is a relationship between human economic systems and larger dynamic, but normally slower-changing ecological systems, in which (1) human life can continue indefinitely, (2) human individuals can flourish, and (3) human cultures can develop; but in which effects of human activities remain within bounds, so as not to destroy the diversity, complexity and function of the ecological life support system.

These definitions indicate a need to reorient economic analysis on several fundamental points. These include: consideration of intra and intergenerational equity; the treatment of the very long term; irreversibility of ecological change; fundamental uncertainty and system complexity; and processes of technological change.

Whatever the definition, sustainable development is undoubtedly normative, and as such it orients scientific and descriptive analyses alongside policy studies. The word sustainability evokes, for a number of economists, the image of an economic system able to evolve without deterioration from its current state into the long term future—being "in balance with nature," this balance being as much social and psychological as material and energetic.

But all this does not imply that the problems of "taking the environment into proper account" are now solved. There are many different emphases. The term has become a flagship for the diffuse set of concerns regarding the tensions between the exploitation of the potentials of nature in the pursuit of human well-being, and a cumulative undermining through resource depletion and ecological disruption, of the basis of collective welfare—the welfare, that is, of human as well as non-human life on earth. As Norgaard has aptly observed,

Environmentalists want environmental systems sustained. Consumers want consumption sustained. Workers want jobs sustained. Capitalists and socialists have their "isms" while aristocrats, autocrats, bureaucrats, and technocrats have their "cracies." All are threatened. The sustainability calls to and is being called by many; from tribal peoples to the most erudite academics, from Levi-clad activists to bankers in pin-stripe suits. With the term meaning something different to everyone, the quest for sustainable development is off to a cacophonous start.

So, differing views exists as to appropriate ways to conceptualize and measure what is to be sustained, or is not being sustained but "should" be, and so on. Though there is a common core in all usages—that of the idea of "limitation" in the "sustainable" use of natural resources, and hence the implication of intertemporal opportunity costs to excessive exploitation—the definition of these limitations and the distribution of these limited possibilities among countries, and among sectors within countries, is and will continue to be a matter of political struggle.

More and more analyses consider concerns for sustainability under the three broad headings of economic, social, and ecological. This distinction refers (a) to the nature of the system of feature being sustained and (b) to the sort of units used in the measure or evaluation. The economic can be deemed part of the social; and the social category can be considered to include features of the natural world that have distinctive social or cultural meanings. So for example, we might be concerned with economic system performance; the sustaining of particular features of the so-called natural environment such as levels of specified natural resources, landscapes, species population numbers, or diversity. We may also be concerned with particular characteristics of a society or features of the natural world or patrimony particularly valued by a society as part of their cultural heritage or specificity (such as types of agricultural production, wildlife, or scenic features).

There are now a wide range of conceptual frameworks available for the representation of principles for sustainable development. This raises the problem of what sort of methodological and epistemological approach to adopt for this new challenge facing economic analysis. Amongst the many approaches that coexist, some involve a simple extension of existing concepts and theories (such as marginal cost, monetary valuation of natural capital); others involve much more radical rethinking of foundations for economic analysis. Among these latter are perspectives that situate the economy as a set of processes within the larger social sphere, the latter itself then considered within the larger biosphere with its own characteristics of function and change. Such an approach necessitates the search for appropriate concepts and representations for describing economic phenomena and their relations to social and ecological dimensions. This involves notably an openness towards the sciences of nature and to the social sciences, in the hope of finding pertinent insights and concepts that can complement the more narrowly economic tools.

This article provides some broad axes of reflection on the diversity of conceptual frameworks and analytical approaches relating to main principles for sustainability. The first section shows that economic work treating sustainability questions necessarily must address principles such as justice and equity, the character of relationships between economy and environment, as well as the questions of institutions and decision-making. The second section analyses how these principles address the debate around the choice of indicators for sustainable development. The third section gives attention to the achievements and limitations of the various models of sustainable development vis-à-vis these principles.

2. The Basic Principles for Sustainable Development

The concept of sustainable development represents an attempt to go beyond the simple assertion of physical limits to economic-growth, and to explore how, in what terms, and to what extent, the socioeconomic objectives traditionally linked to growth can be reconciled with the concern for environmental quality and inter-temporal equity. Beyond that, it operates as a normative concept in the sense of designating a set of objectives that a society tries to attain. The choice of these objectives, both abstractly and in their detailed expression, is thus inevitably a matter of judgments based on social values and ethical norms. This introduces new principles and new challenge for economics to take them into account in its framework.

2.1 Justice, Equity, and Natural Capital

Economists have usually approached the question of environmental limits to the economic development from the standpoint of opportunity costs and economic scarcity. A resource or service is defined to be scarce if its use incurs a significant positive opportunity cost for society, either elsewhere or in the future. When environmental services such as clean air and water were perceived as abundant, they could plausibly be treated as free goods. But increasingly, environmental assets are being perceived as neither non-scarce nor indestructible. The environment furnishes a human economy with a set of exploitation opportunities, but also imposes constraints. Imprudent action by the society can worsen the severity of these constraints.

The theory of natural capital has become one of the central themes of economic literature on sustainability. Natural capital is a hybrid concept. The conventional accountants' concept of assets is extrapolated to refer to environmental systems and natural resource stocks, in recognition of the benefit streams that they do and might provide to society. The sustaining over time of these benefits streams is one of the preconditions of sustainable development. This requires, in turn, the maintenance of adequate levels of the key "natural capital" stocks themselves. So, this is a much broader concept of natural resources than specific minerals and fuels sources alone. It refers to the earth as a life-support system. In effect the entire environment is considered as a finite stock, needing to be managed for a sustained yield of services to human economies.

The specificity of natural capital stocks hinges on qualitative differences between natural capital and human-made (or manufactured) capital, related closely to issues of irreversibility and uncertainty. These features include:

- The insight that natural capital is, in a first approximation, an endowment of nature and not producible by human societies. The endowment can be modified in important respects, but it remains substantially irreplaceable. Its use or modification is irreversible and/or outside of human control.
- Natural capital, in the sense of the stock of environmental resources and infrastructures, fills a multiplicity of economic functions to an extent not shared by manufactured capital. These include basic life-support. In this sense, natural capital is structurally more fundamental than manufactured capital.
- It is not always possible to substitute manufactured capital for natural capital as a basis for human welfare.
- Changes in the natural environment caused by human activities are often irreversible to degrees not matched by economic activity. The irreversibility of energy use for production was emphasized on thermodynamic grounds by Georgescu-Roegen, while energy analysts during the 1970s explained the significance for economic growth and sectoral structure of the non-substitutability of primary energy.

Discussions by economists on environmental irreversibilities date back at least to Pearce who argued for the inadequacy of cost-benefit analysis as a means of dealing with risks of irreversible degradation of the environment or species extinction. The scarcity of the environmental stocks and derivative services has particular importance because of the multiplicity of service roles played by complex ecosystem structures. Economic activity requires, one way and another, some inflows of natural resources and of services derived from natural capital. But the converse is not true. Manufactured inputs are not intrinsically necessary for production of environmental stocks, since these stocks are substantially autonomous productions of nature. Nor are they sufficient, since we lack the capacity to replicate natural systems. Once an area of Amazonian jungle has been cleared on a large scale for timber or farmland, it is effectively impossible to recreate a comparable ecosystem. It is often not realized how, when a resource is exploited, or an area is modified for one economic purpose, how this may cut across other life-support roles played by these components within larger cycles, geophysical structures, and ecosystems.

One approach to the operationalization of sustainability, put forward by Pearce et al., is to elaborate a set of minimum conditions for development to be sustainable. For these authors, inspired by Ciriacy-Wantrup, Baumol and Oates, and Bishop, development is indicated by “a vector of desirable social objectives.” In such a vector of objectives, there is a two-fold equity concern:

- That present generations’ economic activity not prejudice the welfare of generations to come by running down irreversibly the stocks of environmental assets presently available (intergenerational equity); and
- That within a given generation, patterns of use aim at a more equitable access to resources and hence to greater distributional justice.

The development vector would thus include real income per capita, improvements in health and nutritional status, educational achievement, access to resources, a fairer distribution of income (who decides what is fairer?), and increases in basic freedoms. Development is then characterized as a process by which the elements of the development vector increase over time. Among the necessary conditions for achieving sustainable development, according to these authors, would be “non negative change in the stock of natural resources such as soil and soil quality, ground and surface water and their quality, land biomass, water biomass, and the waste assimilation capacity of receiving environments.” These intergenerational and intra-society equity objectives, together with a “precautionary” principle in decision-making, now command wide acceptance among sustainable development proponents. Their operationalization, however, runs up against a host of ambiguities.

First, as the time horizon of relevance is pushed out towards infinity, as is implicit in the goal of “sustainability indefinitely,” economic as well as ecological uncertainties become all-encompassing. There will be scientific as well as distributional disagreements over the severity of the risks and constraints to be considered.

Second, choices have to be made on how the monotonocity requirement of the development vector is to be interpreted: whether it should be applied for all elements for every time period, or as a positive trend in time. There may be disagreements as to priorities between objectives, including whether or not trade-offs between them are regarded as acceptable.

Third, the measurement and valuation of the natural capital stocks poses major difficulties. The diversity of the environmental “capitals” is very great. The variety of benefits obtainable from, especially, non-renewable natural resources, the fundamental life-support functions of the biosphere, and ecosystems as reservoirs of more-or-less unique symbolic (cultural) biological (genetic), and scientific (aesthetic) interest, are not commensurate on a single scale. Pearce and Turner suggest that the norm of preservation of natural capital would seem to be broadly consistent with a worldview which recognizes rights of other species to coexist with humans, or notions of respect for other life or “justice to nature.” Yet this still leaves a wide margin of ambiguity as to the sorts of interests and “values” that might furnish rationales for natural capital stock conservation, including species and ecosystem preservation.

On the plane of human justice, sustainability is linked to the idea that each generation should have access to at least the same resource base as the previous generation. If this is accepted as a policy objective, immediately one has the requirement of measuring the potential services obtainable through time from each natural capital stock (individually or in conjunction with others). Some economists have considered possibilities of aggregate measures of capital stock. Formally the main possibilities are:

- The physical quantity of natural resource stocks;
- The total value (in economic units) of the natural stocks, which would permit physically declining levels of a stock if accompanied by a rising unit value (price) in society;
- The unit value of the resource/service (as measured by a price or shadow price); and
- The total value of the resource/service flows obtained through time from the stock.

The last of these expresses most clearly the conventional economic rationale for the ecological capital approach, namely the management goal of ensuring a non-declining benefit stream of environmental services into the relevant economies. But it also has the most difficulties of operationalization. One of the difficulties is that in the normative appeal to markets, prices are supposed to reflect opportunity costs-on-the-margin. So, correct money valuation runs up against the question of the extent to which natural stocks are substitutable by manufactured capital for their various uses. Any answer on this would require investigation of, among other things, the constraints on transformation and substitution implied by physical conservation laws, and the physico-chemical and spatial complexities of each category of natural resource management problems.

If, on the other hand, physical units are used, a variety of valid measures can be obtained. Yet one is then faced with the problem of the meaningfulness of the aggregate measures for stocks, each with multiple but more or less distinctive uses. So as Pearce et al. concluded, “in general, there is no easy interpretation to the idea of a constant capital stock.” These analysts then go on to suggest that we can define “indicators of physical stocks to allow for critical minimum stocks (which, in turn, might qualify as sustainability indicators).”

If a desegregated set of accounts is proposed, appropriate units must be chosen in each case. One may then consider to what extent substitution is possible, by one environmental capital or service for another. This will, in general, vary depending on the situation and the uses envisaged. It must be possible to interpret and translate the various measures obtained, into indicators that can guide or help appraisal of coherent policy initiatives.

2.2 The Co-evolution between Economic, Social, and Ecological Dimensions of Sustainability

Specifying both economic and ecological sustainability implies a shift in emphasis away from expansion of the vector of produced commodities (such as measured in aggregate by GNP-growth), towards a view of qualitative improvements in life conditions based on:

- Delivery of produced economic goods and services, and
- Management promoting the reproduction and resiliency of environmental functions, or, in other words, of our system of natural capitals.

The joint delivery of ecological and economic components of sustainable development has an important asymmetry. Unlike the sphere of commodity production, the biophysical milieu evolves under the influence of forces that, in many respects, are independent of human action. The various mineral resources and primary energy forms, and the complex habitats that furnish life-support functions for human and other species, are in general not producible artificially. So restoration of ecosystems that are damaged or severely altered through economic activity or pollution, is often impossible.

Increases in economic output can conflict with sustainable use of natural resources (fisheries, forest, land, and water) and can threaten the stability, quality and durability of environmental functions. At a theoretical level, the questions of environmental costs and benefits inherent in public policy for environmental protection and sustainability objectives, can be approached either from the demand side (that is, recognized value of resources or environmental services in future production, and impacts on consumers' utility) or from the supply side (economic costs of reducing negative environmental effects or of delivering defined quality improvements). In practical terms, however, where monetary measures are sought, one encounters a now-well-known set of difficulties. Quantification in money terms of benefits relating to, for example, pollution reduction and biodiversity enhancement is difficult, especially over the longer term.

Market prices may not exist, and even when they do, they are unlikely to reflect the intertemporal user costs (or even present-day opportunity costs). Constructing a set of internally consistent shadow prices is inevitably somewhat arbitrary as well as dogged by the problem of uncertainty. Environmental policy mostly involves conflict resolution, not efficiency considerations (optimal for whom?). The use of surrogate or simulated market methods such as contingent valuation, simply reframes these difficulties without resolving them.

From this structural economics perspective, ecological goods and services (natural resources, amenities, waste reception, environmental life-support functions) are considered as complementary to economic goods and services. The two sets of goods/services contribute irreducibly, but in qualitatively different ways, to human welfare. As such, their welfare significance is specified as complementary but incommensurate.

- Environmental quality is a primary or "basic" requirement for human welfare and for sustainable economic activity;
- Economic resources must be committed, directly or indirectly, in order to maintain the desirable level of environmental functions.

It is thus possible to speak of the "social demand" for maintenance of environmental functions. This demand, which in principle includes some provision for future generations, and which includes demand for protection from environmental harms, cannot be expressed adequately in a market-like institution, because most of the interested parties cannot be present and many of the benefits in question are public (and largely indivisible) in character. The best operational specification will be in non-monetary terms, through defining environmental standards, or norms, which represent a society's objectives from the delivery of the ecological welfare base to present and future generations. Emphasis is then placed on defining the economic resource opportunity costs associated with the achievement of specified environmental quality goals, that is, cost-effectiveness in achieving policy norms.
Such analyses thus need to be integrated into decision-making procedures that take account of differing social perceptions and priorities in relation to long-term considerations, various forms of irreversibility, and environmental complexity. It is useful, in this respect, to make a distinction between substantive and procedural aspects of sustainability concerns:

- The substantive refers to descriptions grounded in physical measures of stocks and flows that are the material/energy outcomes of resource-management choices.
- The "procedural" refers to the collective processes of action and decision-making—qualitative and social institutional dimensions that are not able to be expressed or proxied in input-output terms. Examples are democratic processes, community participation in resource management, scope for individual expression in society, or the vitality and autonomy of distinct cultural groups.

Ecological economic analyses are often concerned to measure physical flows and transformations. These flows are not seen as ends in themselves. Rather the interest is with the significance and benefits to people derived from them. Economic welfare has, in the major schools of economic thought, usually been represented in substantive terms, for example, as a function of levels of produced goods and services either as a stock (capital property holdings) or as a flow level (rates of consumption of produced goods and services). Similarly, the sustainability goal is very widely presented as a goal of tailoring long-term production and consumption demands to biophysical limits. But it is also admitted that such changes in patterns of resource-use activity are unlikely to occur unless there occur changes in social values. When we address the cultural and social meanings of sustainability, it becomes clear that not all the fundamental values issues can adequately be proxied or represented as a direct function of material stocks and flows, or, indeed, as a value-transform (for example, through a set of shadow prices) of the stocks and flows. Quality of life certainly has much to do also with the way people relate to each other, with the spirit in which exchanges are conducted, and in which wealth circulates, and so on. So we can see as complementary, on the one hand, sustainability as a biophysical concept (stocks and flows, environmental functions), and, on the other hand, sustainability in its social/cultural meanings as a collective process lived by people.

Boulding envisaged the need for a sustainable economy's insertion in a "cyclical ecological system." This insertion does not depend so much on minimizing throughput, which is the part he focused on, as on an appropriate structure of transformation across the set of processes involved, from local economies and ecosystems up to the scale of the biosphere. In ecological terms, sustainability means that there is a complementary between the structures (capitals) and the exchanges which nourish and sustain those structures and which, beyond that, induce or allow their evolution and change. Sustainability depends on achieving patterns of reciprocal or mutually supportive exchanges between economy and environment in a sort of spiral through space and time.

Representation of sustainable development in coevolutionary terms as a symbiosis between economic production and ecological (re)production implies emphasis on managing and investing in the reproduction, transformation, and renewal of the terrestrial habitats that are not just raw materials sources, but veritable life-support systems that underpin commodity production systems. These are also habitats in the sense of being the places of life, invested with social and community significance, or meanings. So, valuation for sustainability cannot be separated from the idea of actions whose effect is to sustain this or that form of life, in the cultural as well as ecological-economic sense.

Such a view of sustainable development as a process based on cycles of renewal and regeneration—a symbiosis of ecological and economic reproduction—is already found in the concept of ecodevelopment expounded in the early 197Os by some international agencies, at that time with reference mainly to rural development projects in the developing world. It joined a large array of concepts and terminologies proposing alternative forms of development, whose common feature was rejection of the dominant views of development couched in terms of rapid GNP-growth, throughput of resources, and technological modernization. More specifically, as Ignacy Sachs wrote:

Ecodevelopment is a development of peoples through themselves; utilizing the best natural resources, adapting to an environment which they transform without destroying it… Development in its entirety has to be impregnated, motivated, underpinned by the research of a dynamic equilibrium between the life process and the collective activities of human groups planted in their particular place and time.

Emphasis is here placed on "the cultural contributions of the peoples concerned" in the effort to "transform the various elements of their environment into useful resources." In effect, systems concepts from ecology, such as cycles and functional harmonization, are transposed to the social and organizational domain. Ecodevelopment aims at achieving a lasting symbiosis between humanity and the earth; at the social level the search is for a harmonization of relationships based on cooperation at local and international levels to achieve economic equity.

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Biographical Sketch

Sylvie Faucheux is currently Professor in Economic Science at the University of Versailles-St Quentin en Yvelines in Paris, France, and Director of the research institute C3ED (Centre d´Economie et d’Ethique pour l’Environnement et le Développement) based at the UVSQ. Since 1992, in addition to her teaching, research supervision and other duties as a university professor, she has been responsible for the leadership and management of contract research at the C3ED in the fields of sustainability, ecological economics, environmental policy and scenarios. She has published a large number of scientific papers in French and English, and is associated with several collective publishing ventures. These include: the role of co-editor for the *International Journal of Sustainable Development*, established in 1998 and which publishes a lot of ecological economics contributions; cooperation in the establishment of the International Library of Ecological Economics (a new monograph series published by Edward Elgar); and a new series in ecological economics based in Switzerland, to be published in French with translation agreements for English and German. Recently, she has especially concentrated on problems of governance, risks and technological change, and systems of “vigilance-foresight,” with stakeholder-based approaches to analysis of transitions towards sustainability in European countries. She has worked with several Ministries of the French state, with firms and with the European Commission on these topics, including recently climate policy, nuclear reactor waste management, and futures studies for technological innovation and the environment. As a member of the ISEE Board, Sylvie Faucheux brings a long experience in leadership, organization and resource management for ecological economics activities on an international and multi-language level. In 1994, she led the organization of a major international conference in Paris on models for sustainable development (participation of 400), and in 1996 she played a central role in organizing the inaugural conference of the European Society for Ecological Economics (ESEE), the European branch of ISEE. She was elected the ESEE's first President in 1996, until stepping down from this position at the end of 1999. Under her leadership, the C3ED research institute has acted as host for the ESEE Secretariat since 1996, and has provided the support needed to establish a regular ESEE Newsletter, to maintain the membership list, and other activities. Sylvie Faucheux has also led initiatives to establish partnerships with universities, ministries and industry in the Middle East and parts of Africa (especially French-speaking North and West Africa), in this way broadening the base of ecological economics networking. She is a member of the European Consultative Forum on the Environment and Sustainable Development as well as reporter of the Climate Change Working Group of the former forum.