OCCASIONAL PAPER

SUSTAINABLE DEVELOPMENT:

CONCEPTS, MEASURES, MARKET AND POLICY FAILURES AT THE OPEN ECONOMY, INDUSTRY AND FIRM LEVELS

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Industry Canada Industrie Canada

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CONCEPTS, MEASURES, MARKET AND POLICY FAILURES AT THE OPEN ECONOMY, INDUSTRY AND FIRM LEVELS

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PREFACE

"I have seen the future and it works." (E.F. Schumacher, Good Work, 78.)

"It is unjudicious to comment on a moral doctrine without having, as a first step, undertaken an analysis of its implications under various plausible assumptions." (P. Dasgupta and G. Heal, Economic Theory of Exhaustible Resources, 1979, 261.)

"Unfortunately, sustainable development thinking very often proves to have no coherent theoretical core...One reason for the overlapping meaning of sustainable development is the highly confused question of what development itself means." (W.M. Thomas, Green Development, 1990, 3, 4.)

"Environmental protection may be to the next 50 years what the rise **of** the welfare state has been for the past 50: a drag on growth, true, and a large burden on corporate costs: but also a hard to quantify source of increased human well-being." (F. Cairncross, Costing the Earth, 1991.)

"The range of products and processes that now exist — and the environmentally unfriendly approaches to production and consumption that underpin them — are the result of companies' choices over product and process innovations made during the past 20, 50 and, in some cases, 100 years. For example, the chemical industry's post — 1945 attitude to waste — namely, using the natural environment as a bottomless sink — is an outcome of choices made to exploit the massive economic potential of oil feedstocks without sufficient consideration of waste and pollution as long-term environmental problems. The technological decision that the chemical industry adopted was supported by a

number of political, social and market factors, including the regulatory framework, government policies to support national manufacturing industries and, crucially, public acceptance of mass affluence based on readily disposable plastic products, packaging and synthetic textiles." (K.Green, A. McMeekin and A. Irwin, Techological Trajectories and R & D for Environmental Innovations in UK Firms, Futures, 26 (1994), 1048.)

"Sustainability requires alleviation of poverty, a decline in fertility, the substitution of human capital for natural resources, effective demand for environmental quality, and a responsive supply. These changes cannot take place on a sustainable basis without growth." (T. Panayotou, Green Markets, 141.)

INTRODUCTION

Sustainable Development (SD) has become a political ideology of the current times in developed countries and in some developing countries. It was fostered at the international level by environmental non-governmental organizations and the United Nations and then trickled down to the national and the corporate level. Though the definition of SD remains elusive, it is widely perceived that: 1) economic growth, has been at the expense of the physical environment, at least in the recent past; 2) economic growth does not necessarily have to be at the environment's expense; and 3) a reorientation of growth towards a more environmentally friendly path is urgently needed lest future growth itself be jeopardized. The SD political ideology is based upon the ethical premise that current growth shall not be achieved at the expense of future generations who should not inherit a diminished physical environment and, possibly, a diminished capacity to grow in the future if current growth types are not reassessed.

Even though sustainable development extends beyond economics, this paper identifies the main characteristics of SD in the existing economic literature. The hope is that these characteristics offer consistency within a yet to be built model of SD that can be applied at the international, open economy, industrial and firm level and whose components are measurable. This paper is an issues paper and not a comprehensive survey of the already large literature at hand.

After providing an historical perspective, the paper presents in a first part the three dimensions of SD and eight attributes that are common to most approaches even though these properties are variously interpreted and a common SD definition to most approaches is still elusive. This is followed by a look at the way neoclassical economics has attempted to formalize these properties. The paper then discusses the

concept of carrying capacity, an ecological concept foreign to neoclassical economics yet prominent in some approaches to SD. Finally, this first section shows why SD is perceived negatively by various interest groups.

In a second part, the paper examines SD at the international level from both a theoretical and institutional point of view. In an imperfect world, the compatibility of free trade with sustainability is entirely an empirical matter. Except for certain international agreements, there are no measures of sustainability explicitly developed for the international level because environmental standards are national. The empirical evidence indicates the following: environmental regulation has little impact on trade; environmental standards are not a major locational factor; and, when a country opens to trade, the environmental impact is first negative although eventually full cost pricing sets in. Empirical evidence is weak in favour of the so-called Porter hypothesis, which states that environmental standards trigger innovations whose benefits exceed the cost of the standard. International corporate liability is being extended and international agreements restrict the ability of multinationals to locate in environmentally weak jurisdictions. Multinationals still need to develop strategies to keep firms from competing in the environmental area. Poverty alleviation is required to reduce the positive feedback on environmental degradation and population growth. Free trade may have a negative impact on common property resources and on communities generally and may create dependency relationships that remove the freedom not to trade. The World Trade Organization, International Monetary Fund, the World Bank, the United Nations Development Program and the Commission on Sustainable Development are the major international organizations dealing with trade and SD.

A third part of this paper looks at SD in an open economy. Net National Product (NNP) correctly calculated is a measure of net national welfare interpreted as maximum sustainable value of social well-being, or sustainable income, or return on total wealth in the economy. It is measured through a system of

environmental national accounts. Market incentives to adopt SD are the same as the ones developed by environmental economics, however, their combination or level of application may differ because the goals of environmental economics and SD are not the same. Empirical evidence shows that environmental standards create jobs but that the net gain in terms of jobs is small. Shifting taxation from human capital to natural capital may create jobs. Round-table processes similar to the ones developed in Canada foster cooperation in the definition and implementation of SD at the national level.

In a fourth part, the paper looks at SD at the industrial level. It shows how environmental accidents have affected industries' reputation negatively and how consumers tend to react to perceived health-related risks and to visible unsustainability first. Technological networks, including integrated industrial ecosystems, play a fundamental role in the definition of an industry. Sustainability must apply to the network as a whole and to its three fundamental strategies: niche management (independent of the market); modification of the selection environment (incentives to develop new technologies); and technological nexus (institutional link between the two first strategies). There is little evidence to suggest that sustainability of selection strategies has been a major concern up to now; public sector initiatives will be essential for the first stages of the change towards sustainability. Collaboration with customers and suppliers and the need to invest in new plants are the three major incentives for product change and for process change. In the latter case, the need to increase spending on manpower training replaces collaboration with customers as a leading organizational factor of change. Codes of conduct adopted by industries can address all aspects of sustainability; however they must be accompanied by environmental strategies. The pertinence of Coase's theorem is limited to the extent that both vertical and horizontal (agreements on compatibility standards) integrations are means of internalizing environmental externalities whenever contracts may be extremely difficult to design.

In a fifth part, the paper examines how external and internal factors contribute to promoting SD at the firm level. External factors include the following: major accidents; government intervention as both carrot and stick; green consumerism; investors' pressures; scarcity of available sinks; high cost of entry; ownership type. Internal factors include the following: a new culture of management that is more attune to social responsibilities; pressure from the workforce; fear of costly and untimely regulation; cost savings from clean technologies; new market opportunities resulting from environmental standards; competitive strategies such as a least-cost strategy for a mass market; differentiation strategies for segmented markets and niche strategies for highly specialised products; and Total Environmental Quality Management that eliminates pollution at the source and applies life cycle environmental accounting, green reputation, the Porter hypothesis, rent-seeking behavior whose cost is eventually passed on to consumers, and existing win-win solutions subject to decreasing returns. SD is measured at the firm level by means of Environmental Performance Indicators, Environmental and Sustainability Audits and Green Accounting.

This study provides a somewhat pragmatic conclusion. It emphasizes that SD is an adaptive planning process that cannot be achieved without cultural change and the active cooperation between governments and the private sector.

SD is distinct from environmental economics because the latter simply is a chapter of neoclassical economics while the former questions the very utilitarian ethical premises of neoclassical economics. SD, being an ideology rather than a science, is broader than the realm of economics. The Intertemporal Welfare Function for SD, if it exists, differs from the neoclassical Intertemporal Welfare Function that leads to present value maximization. Present value maximization is incompatible in the very long run and SD is very long-term. Present value maximization does not consider equity issues and much of SD is about integenerational equity. As will be seen, because economic efficiency is neither necessary nor

sufficient for sustainability, environmental economics is neither necessary nor sufficient for SD. However, to the extent that efficiency is one desirable property of sustainability, environmental economics will be useful in bringing about SD. Pragmatically, because no intergenerational sustainable welfare function has yet been unequivocally defined, environmental economics will have to be second best i.e. subject to sustainability constraints.

Part I — WHAT DOES SUSTAINABLE DEVELOPMENT MEAN?

Sustainable Development is a political ideology or Utopia developed by the United Nations initially to entice Third World countries to subscribe to the environmental agenda of the North.[1]
Like all political ideologies, be they the Conservation Movement in North-America at the turn of the century, the free market ideology of Europe at the end of the eighteenth century, efforts to define SD suffer from vagueness and inconsistencies. The free market ideology gave us Adam Smith's Wealth of Nations, later Walras and much later the rigorous theory of perfectly competitive equilibrium of Mr. John Hicks, Mr. Kenneth Arrow and Mr. Gérard Debreu. The Conservation Movement gave us Lewis Gray's and somewhat later Harold Hotelling's neoclassical economics of conservation. Though components of sustainable development have already received rigorous economic analysis, there is no comprehensive economic theory of sustainable development.

It is the role of the economist to begin to develop an economic theory of SD. The effort is similar to developing the theory of perfect competition out of the free enterprise ideology. Like free enterprise, SD is inspired by economic concepts. However, unlike the theory of perfect competition, a single non-contradictory and "meaningful" economic theory of SD is not available (Faucheux et al., 1996). Neoclassical economics has been able to clarify some aspects of SD at the economic level such as the meaning of welfare using the concept of Net National Product (NNP). It has not yet been able to develop an unambiguous model of SD or come up with a commonly-accepted definition. SD goes beyond economic problems. It

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[1] An ideology, confirming social order, is turned towards the past while a Utopia, aiming at changing an existing situation, is turned towards the future (Mannheim, 1936). SD, as an ideology or Utopia, competes with other ideologies such as the free market ideology. Ideologies are synthetic and systemic narratives meant to mobilize action. They are not scientific theories; rather residuals of scientific theories (Dumont, 1974).

links the economy, environment and society in a socio-ecological system. Nonetheless, it should still be possible to develop a theory for the economic subsystem of a sustainable socio-ecological system. Measurements have been developed mainly within or around the Standard System of National Accounts (SNA) or through SD indicators. This means that measurements of SD specific to the international level are essentially non-existant. SNA concepts have been adapted at the industrial and firm level. At the firm level, measurements of physical performance related to materials balance and total quality evaluation have been developed. SD is still a very young field. Attempts to measure SD are about 25 years old. Efforts to measure firms' SD performance are at most 15 years old. One conclusion that can clearly be made from this overview is that cultural change ("mindsets") and government intervention play significant roles in making SD happen even though markets help to promote SD more smoothly and efficiently. Voluntary initiatives are simply not sufficient to implement a political ideology. "The challenge for governments and environmentalists is to spot ways of creating the right incentives so that industry finds it profitable to be clean and unprofitable to be dirty." (Cairncross 1991, 144.)

It is important to repeat at the outset that SD and environmental economics are not identical. Environmental economics aims at efficiency and is based upon utilitarian ethics that lead to present value maximization. It aims at the internalization of externalities. It is also much more theoretically sophisticated than SD, which is based on an ethics of equity and aims at integrating the economy, environment and society.

However, to the extent that efficiency remains an important consideration in sustainable development, environmental economics will be useful to reach the environmental goals of SD. It is definitely not sufficient by itself because SD is also a moral doctrine, as Dasgupta and Heal have noted (Dasgupta et al. 1979). However, in practice it will often be difficult to make a distinction between the two especially when measuring environmental quality.

This section explores briefly the historical roots of SD, its meaning, main features and dimensions, its neoclassical characterizations; the concept of carrying capacity; and, finally, how SD is perceived by various groups. It is important to re-emphasize that there is no consensus on the definition of SD that rallies philosophers, ecologists, economists, sociologists, political scientists and others.

1.1 Historical Roots

The term “sustainable development” was coined in 1980 by an environmental non-governmental organization, the International Union for the Conservation of Nature (IUCN), in its “World Conservation Strategy.” It was widely disseminated by the United Nations Commission on Environment and Development through its report “Our Common Future”, sometimes called the “Brundtland Report,” attributed to the name of the First Minister of Norway who chaired the Commission. The Brundtland Report was published in 1987. It had a widespread political impact, especially in developed countries, and was to be implemented internationally at the Earth Summit in Rio de Janeiro in 1992 through Agenda-21 and the Rio Declaration (IUCN 1980; UNCED, 1989).

The concept originated in the late 1960s when it was widely disclosed that growth and environment were at odds with each other. Until the 1960s, natural resources and environment were considered synonymous to a large extent; the environment was the source of natural resources. In the 1960s, the limitations of the assimilative capacity of the environment as a sink for wastes of the economy were prominently recognized (R. Carson’s 1962 Silent Spring) and were the main focus of the 1972 United Nations Stockholm Conference on the Human Environment. Since the 1960s a new understanding grew about the environment as a support capacity for life on the planet (acid rain, climate change, ozone layer, biodiversity). The environment, as a source for natural resources, a sink for economic wastes and an essential support for life on the planet, became to be known as **natural capital** (a term that many

ecologists abhor because of its instrumental value connotation). The examination of natural capital conservation and economic growth as competing activities probably originated in Mishan's work on the cost of economic growth and culminated in the first Club of Rome report, called "Limits to Growth," published in 1972, which called for an end to economic growth in order to protect the environment. Economic growth (an outcome of combined physical and human capital, enhanced by knowledge or technological progress) and environment were viewed as substitute goods (Mishan 1969; Meadows et al. 1972). In 1968, at a conference held in Airlie House (Virginia), 50 case studies of failed international development projects that did not identify critical ecological factors were reviewed by the Conservation Foundation and the Washington University Center for the Biology of National Systems. Since "Limits to Growth," was published, attempts have been made to reconcile growth and environment; i.e. to find a complementary relationship between them. This was achieved at a preparatory meeting of economists for the Stockholm U.N. Conference in Founex, held to allay the fears of less-developed countries about the effects of environmental policies on economic development and to persuade them to participate in the Stockholm Conference (Caldwell 1984; Thomas 1990). The 1980 IUCN document had a similar goal. One should not underestimate the contribution to SD of Eco-Development and of its French variant (Caldwell 1984; Colby, 1990; Sachs, 1993).

SD was defined by Brundtland as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs"(UNCED 1989, 8). "Needs" refers to basic needs such as food, jobs, energy, water and sanitation. Though the concept of environmental limits is implicit in the definition of SD, limits are understood by the Brundtland Report not so much as physical limits (carrying capacity) but rather as technological and organizational limits i.e. the socio-economic context of development. The Brundtland Commission was less interested in defining some ecological objective as it was in fulfilling some socio-economic objectives such as access to resources and equitable distribution of the

costs and benefits of development. It wanted human population to be stabilized at a level consistent with the productivity of the ecosystems. It also wanted economic growth to be revived in both industrial and developing countries. However, this had to be a new type of growth—sustainable, equitable, and integrating environment, economic and social development (Thomas, 1990). This leads to the fundamental question of whether SD is "an attempt to have one's cake and eat it too," i.e. whether we can have a high rate of growth and protect the environment at the same time (Lélé 1991).

1.2 Economic, Environmental and Social Sustainability

If SD is to be more than a passing fad, it must be defined precisely and its implications for society as a whole as a "Projet de Société," as well as for society's actors must be explicit (Dasgupta et al. 1979; NRTEE, 1995). One should not attach too much importance to the large number of definitions of SD found in existing literature. The conceptual differences are often superficial while the ethical and operational differences might be significant (Pearce et al.1989: Pezzey, 1989).

A recent "operational definition" of SD based on the framework set forth by IUCN and put forward by the World Wildlife Fund (WWF) summarizes, as follows, the philosophy underlying most definitions: "SD is people-centered in that it aims to improve the quality of human life, and it is conservation-based in that it is conditioned by the need to respect nature's ability to provide resources and life-supporting services. In this perspective, SD means improving the quality of human life while living within the carrying capacity of supporting ecosystems" (Reed, 1996, 5).

SD's sphere of application goes beyond economics. SD has ethical, societal, institutional, environmental as well as economic aspects. The ethical aspects of SD are what really distinguishes it from environmental economics. This also makes SD hard to pin down because the ethical values pertaining to development, quality of human life and respect for nature are

multiple and overlapping, as pointed out by Thomas in a quotation provided at the beginning of this paper. The political process has to resolve the “bounded conflicts” among people who hold different and sometimes conflicting values (Lee, 1993). Values pertaining to SD are not different. Some philosophers have criticized SD for having adopted the “gospel of efficiency” that characterizes environmental economics. These philosophers criticize the utilitarian approach that assigns an instrumental value only to the natural world. Such an approach underlies mainly benefit-cost analysis. These thinkers want environmental protection to be considered as a moral imperative because nature has an intrinsic value; nature deserves respect (Sagoff 1995). However, even if economic efficiency is an SD goal, SD is still distinct from environmental economics because it places an ethical emphasis on equity, especially intergenerational equity.

SD has also been decomposed into economic, environmental and social sustainability by the World Bank literature (Daly et al. 1995). Economic sustainability requires that either the value of all types of capital as an aggregate (weak sustainability) be maintained or at least the value of one of its components, natural capital, be maintained (strong sustainability) indefinitely. The types of capital refer to the following: physical, human, natural and social capital. How to value some of these forms, especially natural capital and social capital, is controversial. Economic sustainability requires internalizing all costs including environmental ones (full-cost principle). Sustainable income from capital becomes the income after capital depreciation, i.e. the one that does not lead to long-term impoverishment.

Environmental sustainability requires that renewable resources be exploited on a sustainable yield basis (a physical harvesting rate that does not deplete the stock of a renewable resource). Non-renewable resources and their potential substitutes (so-called “back-stop technologies” that may include renewable resources such as solar energy) must be considered as a class to which a sustainable yield concept could be

applied. This would consider constancy of flow of services (e.g. energy) coming from various substitutes. Because the assimilative capacity of the environment can be treated as a renewable resource, the concept of sustainable yield can be extended to waste generation. Finally, the long-term integrity of the environmental support system should not be diminished and should be used on a sustainable yield basis as well.

Social sustainability is related to social capital which includes the moral, cultural, organizational and political stock of society. It deals with individual security, social justice, community spirit, ethical, spiritual values and "bounded" conflicts resolution. Generally speaking, it deals with the most qualitative aspects of development.

Economic sustainability must be subjected to rigorous definition within a non-contradictory economic theory or model. Its implications for the behavior of economic agents must be precisely derived if sustainability is not to become "morally repugnant and logically redundant" (Beckerman 1993). Moreover, the fields of Natural Resources and Environmental Economics as well as Development Economics and Economic Theory in general, both micro and macro, all contribute to the theory of sustainability when efficiency is taken into consideration. However, none of these fields sufficiently embody the full measure of sustainability. An example where these theories can contribute is in the connection between efficiency and intragenerational distributional issues whenever one wants to define a politico-economic optimum for an economy subject to external economies (Laffont 1988). An example of the failure of economic theory to adequately encompass sustainability is that there exists no proposition in neoclassical economics that defines conditions needed to guarantee a sustainable economic optimum (Pearce et al. 1990, 24; Common and Perrings' 1992). In other words, a sustainable economic optimum will either have to be a secondary measure (Page 1977; Beckerman, 1993 and Dasgupta et al. 1995 for a negative view) or the result of a specific intertemporal welfare function (Dasgupta et al. 1995).

As in all second-best policy measures, there is no guarantee that a piecemeal incremental approach will lead society closer to a sustainable optimum than inaction (Laffont, 1988). An investigation of an economically precise characterization of sustainable development and its implications at the international, economic, industrial and firm levels is the object of this paper. Economic sustainability requires full-cost pricing and the constancy of the value of the capital stock.

A complete economic theory for SD would necessitate resolving some fundamental ambiguities between development and growth, and weak and strong sustainability. Environmental economics considers managing environmental public goods in an economy without questioning the objective of maximizing present values. Sustainable development is first and foremost, as indicated by the Brundtland Report about intergenerational equity; it requires a fundamental reappraisal of ethics towards the future. This concern was clearly influenced by Rawls' proposal for intergenerational equity, although it is not identical (Rawls, 1967). The normative character of sustainability has been criticized by some (Beckerman, 1993).

It is useful to examine an historical analogy. The Conservation Movement in the United States had objectives somewhat similar to SD. It defined the goal of conservation for natural resources as being the maximization of the well-being of the largest number of people for the longest time. This was unhelpful because it was not possible to give a clear definition of such a goal if only in economic terms. However, although the Conservation Movement began in the 1880s, an economist, Mr. Lewis Gray, was able to define economic conservation rigorously at least for the non-renewable resource extracting firm in an article published in 1914. Mr. Harold Hotelling was able in 1931 to generalize the theory of conservation for non-renewable resources to industry and to society as a whole (Gray 1914: Hotelling 1931).There is currently an attempt, although not quite successful yet, to do the same for SD through neoclassical economics.

1.3 Main features of SD

Eight main features of SD have emerged from economic literature. The first is that SD is about development; not about growth. This was left vague in "Our Common Future." Though some authors have tried to define sustainable growth, sustainability and growth for an indefinite future may be incompatible entities unless there are enough substitutable opportunities in the factors of production (elasticity of substitution larger than 1) or unless there is technological progress in environment-saving areas that lasts indefinitely (Gross et al. 1990). Growth is measured as the rate of change of the Gross National Product (GNP) or of the National Income (NI) of an economy. GNP and NI are given dimension quantities of various goods and services which are multiplied by their prices i.e. dollars per unit of quantity. This distinction between quantity and value is sufficient in principle to allow for the possibility of growth without increase in matter and energy inputs. Inputs of matter and energy have actually decreased (dematerialization) in some sectors of the economy such as the information industry while their value added has increased. If the U.S. GNP is ten times larger than the Canadian GNP, it is *prima facie* because the U.S. economy is ten times "bigger" (physically) than the Canadian economy. In rigour, what GNP comparisons between Canada and the U.S. reveal is that the value added by the U.S. economy is ten times larger than the value added by the Canadian economy. However, in practice, there is a positive correlation between GNP and the physical size of an economy. Large developed countries have large GNPs; small developed countries have small GNPs. Whether dematerialization can lead to a complete decoupling of value-added growth from physical growth is still a matter of speculation.

Some claim that a sustainable society is one that recognizes limits to physical output growth and looks for alternative ways of growing (Pearce et al. 1989, 175). The very definition of "sustainability" is related to the sustainable yield concept adopted in the economics of renewable resources. A

sustainable yield is the rate of harvesting a renewable resource that leaves the size of the stock of the resource physically intact indefinitely. In other words, the rate of harvesting is sustainable only if it is limited to the net growth (natural productivity) of the renewable resource physical stock. Sustainable growth allows the consumption of the increase in the net value added (Net National Product or interest on total wealth) of the economy after all capital, including natural capital, has been properly depreciated. If some resources are non-renewable, this may put a drag on the economy when technological progress is not entirely of the environment-saving type or if renewable resources or other forms of capital are not sufficient substitutes for non-renewable resources. One way to extend the concept of sustainable yield to non-renewable resources, at least theoretically, is to include their technological renewable or physical substitutes in the definition of the resource, the so-called “back-stop” technologies (Page 1977). Because economic sustainability requires the value of capital to remain constant, it is closely related to the definition of the Lindahl-Hicks income; i.e. the largest amount that may be consumed while keeping wealth constant in value terms between the beginning and the end of a period of time (Pearce et al. 1989, 182; Common et al. 1992, 9). One method suggested to depreciate non-renewable resources and assimilate them to renewable resources is to split resource income into a depreciation term and a perpetual income term (El Sarafy, 1989). This method has actually been used in the mineral industry for over a century (Crabbé, 1983). It should be emphasized that the value of the stock of capital, and not its quantity, has to remain constant to be sustainable. Some claim that an economy in dynamic equilibrium with its environment will eventually not see its quantitative output grow (Daly et al. 1994, 72). Others consider the term “sustainability” as nearly synonymous with resilience; i.e. the ability to maintain a function or an activity under stress (Pearce, 1989, 175). The constancy of the value of the stock of capital is compatible with the resilience of ecosystems while constant sustainable yield is not (Gunderson et al. 1995).

On one hand, Daly, by emphasizing the physical scale of an economy and its carrying capacity, and the complementarity of all natural capital to other factors of production, considers the term “sustainable growth” to be an oxymoron. On the other hand, Pearce, by emphasizing value and substitutes for natural capital, considers growth to be an essential ingredient of SD. The empirical evidence for complementary or substitutable opportunities for natural capital is scant (Faucheux et al. 1995). Daly treats natural capital as a complementary and fixed factor of production. This leads to an optimum size for an economy following the microeconomic theory of long-run costs. Pearce recognizes that some natural capital is critical and therefore complementary to other factors of production; however, he does not extend this attribute to all natural capital stocks.

Taking these concepts of growth into consideration following repetition are the eight features that characterize SD, including a summary of the first trait, development versus growth:

(1) Development, not growth, must be sustainable. Development is an ethical concept that refers to a process rather than to a state (Pearce 1989, 1). It entails a pattern of social and structural economic transformations that lead to a more desirable state of affairs (Pearce et al.1989, 176). There are ethical requirements e.g. equity. The definition of development embodies the goals of the process as well as the means to achieve the goals (Lélé 1991). Development refers to amenities that are not taken into account in the standard definition of GNP; there help to define the concept of “quality of life,” standard of living or welfare (Mishan 1973). Development does not refer to economic development alone; it includes social and cultural development (Pearce 1989, 175). Quality of life can be considered as a vector of components that may be measured by indicators. This was done in the 1960s through “social indicators.” The environmental dimension has been added through “environmental indicators.” Now, “sustainable development indicators” are being developed (Hodge et al. 1995). Development cannot be entirely divorced from growth,

especially in poor countries. Quality of life depends upon real per capita income to some extent. The Human Development Index, a measure of development, is closely correlated to Gross Domestic Product per capita (The Economist, July 20, 1996). Though externalities are clearly excluded from the GNP because they are not marketable, internalization is necessary yet not sufficient to overcome the distinction between growth and development. Fundamentally, economic welfare measures are defined over marketable commodities and, therefore, as non-pervasive externalities. Pervasive externalities and non-marketable commodities and services all play an important role in development (Daly et al. 1994). The distinction between growth and development can also be seen in the so-called Easterlin paradox that shows a lack of correlation between affluence and happiness in survey data (Pearce et al.1990, 26; see Sagoff, 1996 for other references). The United Nations Development Program's Human Development Index includes life expectancy at birth, level of education and an unsymmetrical distribution of income as main components of development. Other components could include human rights, access to clean water, proper nutrition and shelter, women's issues and knowledge of indigenous people (Pearce et al. 1989, 180, 183). Development does not rule out growth; however, it dictates the type of growth that is desirable (Pearce et al.1989, 22). Development is also not limited to instrumental values; it allows for intrinsic value considerations. Finally, development is not fully measurable in money terms.

(2) The socio-ecological system is a closed system; the economic system is an open system. A second feature of SD is that it does not view the economy as a thermodynamically isolated system, as is the case in neoclassical economics; i.e. flows of matter and energy are not derived from the economy alone; these flows originate in the environment and return to it; the environment must thus be part of the socio-ecological system. The socio-ecological system is not isolated because it receives a free and essential input from outside the system, i.e. solar energy. In other words, the economic system is an open system with respect to its physical environment. This is

important because it invalidates the concept of circular flows in economics; there are always leakages in the economic system from and to the environment. Treating environment as external has contributed to the lack of considéring the integration between the environment and the economy (Colby, 1990). The socio-ecological system implies the unification of economics and ecology in decision-making at all levels (Pearce et al. 1989, 175). In particular, production functions should not violate the laws of thermodynamics for closed systems; production functions of the Constant Elasticity of Substitution family violate the first law (material balance) because they embrace infinite average productivities. Goergescu-Roegen refers to the second law of thermodynamics when he claims that the useful energy (low entropy) cost of any production process is always larger than the useful energy value of the product. Because low entropy non-renewable terrestrial resources are limited, nature imposes a general scarcity on useful energy. Georgescu-Roegen pleads in favour of substituting renewable solar energy for non-renewable fossil energy, because the former is much more abundant than the latter (Georgescu-Roegen 1979). However, the real prices of non-renewable resource (including energy), whose long-run trend is downward sloping, do not indicate any impending scarcity (Hall et al. 1984). Ultimate carrying capacity is, therefore, determined by the first law of thermodynamics as far as matter is concerned and by the flow of solar energy as far as energy is concerned.

(3) Complementarity of Natural Capital to other factors of production. A third feature of SD is that factors of production are assumed to be complementary to natural capital, which is the source of environmental services (global ecological functions and natural resources) and sink (physical waste). This complementarity is especially relevant at the low level of development. At higher levels of development, more opportunities for substitution may occur (Pearce et al., 1990). The failure to recognize this complementarity could inevitably lead either to environmental degradation or to a lowering of the developmental potential and eventually to both phenomena. Though natural capital is only one form of capital, it has special

features that distinguish it from other types of capital. First, natural capital is essentially physically unaugmentable; it is given as is. Natural capital is the limiting factor of economic growth, according to Daly (Daly et al. 1994). It is related to the ecologists' concept of carrying capacity. Any destruction of natural capital is thus viewed as irreversible. However, this is an economic fallacy resulting from a misunderstanding of the meaning of resources. An economic resource is dependent upon both technology and price. If the world does not run out of oil, it is because the supply of oil is not entirely inelastic; oil is incongruous in physical quality and cost of recovery. When the price of oil goes up, there is more oil to recover; when it goes down, there is less oil to recover. However, certain elements of natural capital are truly irreversible. This irreversibility comes from the fact that ecological services of natural capital are multiple, bunched and poorly known in some cases. It is this combination of irreversibility, uncertainty, multiple services and lack of known substitutes that makes some natural capital unique and essential, i.e. critical (Pearce et al. 1993). In the Economics of Natural Resources, a factor of production is defined as essential if output is nil without it as an input and if the latter's marginal productivity of the input goes to infinity while the input goes to zero. The tropical forest, the ozone layer, watersheds all fall in this category. This means that some parts of natural capital can be substituted for other factors of production to some extent, according to stages of development. Other parts of natural capital are essential and strictly complementary to other factors of production; i.e. they are critical. It is the extent of this irreversibility that is at the source of the differences in Daly and Pearce's positions on natural capital as a limiting factor.

(4) Intergenerational, spatial and intragenerational equity. A fourth feature of sustainable development is that equity, both intergenerational and intragenerational, must be respected. These are clearly ethical principles. In terms of intergenerational equity, it means that the temporal opportunity must not be smaller for future generations than it is for the current one. Putting this general principle into operation is tricky

and has generated a great amount of literature (Toman et al. 1995). One interpretation of intergenerational equity that avoids difficulties linked to the term “needs” in the Brundtland is that the welfare (utility) of society as a whole may not be allowed to decline for the indefinite future (Pezzey 1994). Need is a subjective and elusive concept; non-declining welfare is too vague as a welfare concept (Beckerman 1993). Furthermore, the value of the overall capital stock must not be allowed to decline for the indefinite future. This is called weak sustainability because it assumes that all factors of production are substitutable (Daly et al. 1994, 72). A more convincing interpretation is one that stresses strong sustainability, which assumes that natural capital is an essential factor of production and that the other factors are complements. Strong sustainability requires that the value of the stock of natural capital not be allowed to go down.

Intragenerational equity is conceived more as an instrumental value in SD than is the case for intergenerational equity. The former means the elimination of poverty. The reasoning behind this principle is that the rural poor have a negative impact upon the environment and, thereby, jeopardize economic efficiency along with intergenerational equity since natural capital will be diminished for future generations. This in turn increases poverty through a positive feedback on environment and population. The emphasis on the least well-off in society points to Rawls’ Principle of Justice (Rawls, 1967). However, the efficiency of poverty in terms of environmental conservation are demonstrated in documents from the World Bank (World Bank 1992). Though the concept of spatial equity was not addressed by the Brundtland Commission, it is implicitly included within equity. What it means is that sustainable development cannot be achieved in one nation or region at the expense of another nation or region. In an interdependent world, SD will have to be global (Pearce et al. 1989, 178-79).

(5) Decentralization of socio-ecological decisions. A fifth feature of SD is that socio-ecological decisions must be

decentralized. There are multiple reasons for this. First, this principle is consistent with the free enterprise ideology currently sweeping the planet. Its also underlies the Rio Declaration (Crabbé, 1994). Second, it is an outcome of the collapse of the centralized communist regimes and of the disaffection generally vis à vis centralized planning in developing countries. Third, there is a whole current, originating in the minority issues literature, that encourages a participatory approach to social problems (Maguire 1987).[2] Fourth, governmental institutions, with vertical mandates, are perceived as being inadequate to handle sustainable developments, which requires horizontal mandates. Fifth, a political principle called the "principle of subsidiarity "recognizes various levels of decision-making in which the higher level assists the lower one, rather then the other way around (Daly et al. 1994, 17, 174). Decisions relating to individual problems with only individual consequences should be left to the individual. Decisions that deal with broader problems and have broader consequences, such as localized ecosystem protection, should be left to some kind of regional government. Decisions that affect larger ecosystems or have global consequences, such as climate change, must be left to larger entities such as national governments or the international community.

(6) Increase the value of the environment in socio-ecological decisions. The sixth feature of SD is the need to reinforce property rights on the environment, internalize environmental externalities and determine the public good of many environmental services. This is clearly the efficiency side of SD. Natural capital is not a free good. Non-use values must be added to use values when calculating benefits in a benefit-cost analysis. The objective of all economic instruments is to raise the private value of the natural capital in economic decisions to the level of its social value. To these market failures, one must add public policy failures. Public policy must integrate the environment and the economy and avoid, as far as possible, negative impacts on natural capital.

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[2] I owe this reference to Mr. Harvey Lemelin.

(7) Lengthen the horizon for socio-ecological decisions. This seventh feature of SD recognizes the need to take an intergenerational (spatial) perspective, which considerably lengthens (widens) the horizon of economic decisions. This is in contrast to neoclassical economics, which seldom generates horizons longer (wider) than 50 years (which encompasses the immediate area directly affected by the decision) (Pearce et al. 1989, 2).

(8) Apply precautionary and irreversibility principles to socio-ecological decisions. These two principles bias sustainable decisions in the direction of conservation of natural capital. The precautionary principle implements risk-aversion policies owing to uncertainty about our knowledge of the environment. The irreversibility principle takes into account the value of future learning opportunities based on the fact that no irreversible decision has yet been taken independently of risk-aversion (Pearce et al. 1990, 50-1). In practice, this means that a benefit-cost ratio is not a valid criterion for making irreversible decisions unless costs include the value of the future information one foregoes when making an irreversible decision and that might make you regret your decision. In this sense, all irreversible decisions should be no-regret decisions (Crabbé, 1986).

1.4 Economic Sustainability and Neoclassical Economics

Economic sustainability refers to full-cost pricing or the internalization of environmental externalities and to the constant value of capital stock.

Dasgupta blames SD for having developed independently of both intertemporal welfare economics and the theory of optimal development; “two subjects that have provided for over 25 years a language in which we may usefully ask questions regarding intergenerational justice... It would be difficult to find another field of research endeavour in the social sciences (i.e. like SD) that has displayed such intellectual regress.” (Dasgupta et al., 1995, 116).

Panayotou lists 10 economic manifestations of the inefficiency of environmental degradation; such as, for example, the coexistence of overuse and waste with growing resource scarcity, low return use when high return sustainable use is available or single product management when multiple profitable uses do exist, etc. (Panayotou 1993). Environmental degradation according to neoclassical economics results from institutional failures such as market or policy failures.

There are mainly three types of market failures:

The first is categorized as environmental external dis-economies, such as pollution. These are technological interactions among agents that do not pass through the market. This might be owing to the fact that property rights on certain portions of the environment cannot be created (air) or are too expensive to create (transaction costs). Property rights must be well defined, exclusive, permanent, secure, enforceable and transferable to be efficient. Transaction costs include the cost of information, negotiation, monitoring and enforcement. These external dis-economies have a positive social cost and a zero private cost. Upstream/downstream interactions are examples of external dis-economies. Internalization of the externality may occur through bargaining between the parties according to Coase's theorem if the number of parties is as small as two. If the number of parties is large (e.g. non-point pollution sources), internalization is unlikely to happen because transaction costs will eat up all the benefits of the internalization and the private cost of the inefficiency is too small when its aggregate cost is divided among many different parties; moreover, causes and effects become difficult to unscramble (Panayotou, 1993).

Second, many environmental services can be categorized as a public good (non-rivals in consumption and non-excludable). Such public goods are under-valued (and may not recoup their conservation costs) because they are not provided at a Pareto optimum but rather at an inefficient Nash non-cooperative equilibrium. Moreover, the valuation of public goods is subject to consumer behavior (systematic under-

reporting) that leads to further under-evaluation of the public good (Laffont, 1988).

Third, many environmental resources are subject to open access; i.e. their flows are private goods and their stocks are public goods.

Beyond these three types of failures, market imperfections, myopia and irreversibility create havoc with the efficiency of the markets. For example, a combination of high interest rates and a low natural growth rate may wipe out a renewable resource when one applies the present value criterion (Clark, 1973).

Policy failures occur at the project, sectoral and macroeconomic level. They result from voluntary distortions or myopic interventions in otherwise well-functioning markets. They also result from a failure to intervene in dysfunctional markets. Examples of such distortions are taxes, subsidies, quotas, regulation, inefficient state enterprises, public projects with low economic returns, etc. Failure to consider the external effects of warranted policy interventions such as subsidies for pesticides or fertilizers is one example of myopic intervention. This especially occurs at the project level. It also happens at the sectoral level when intersectoral and long-term effects are ignored. Finally, it occurs at the macroeconomic level through liberalization policies that ignore non-functioning markets and environmental effects.

Neoclassical economics has defined sustainability in different ways. It begins with the concept of the Lindahl-Hicks income; i.e. “the maximum income that can be spent without reducing real consumption in the future.” One attempt of a neoclassical economical explanation of the Brundtland definition of sustainability is as follows: it defines a SD path as a consumption path whose utility is forever non-declining (Pezzey 1994). Sustainability refers to a development path beginning at a given time and with a given capital stock. The neoclassical economics approach has related the Lindahl-Hicks

income to the Rawlsian concept of intergenerational equity: this entails a constant flow of welfare and consequently a constant aggregate stock of capital forever. The maximin path (i.e. the one that maximizes the sustainable path with minimum utility) is the one that entails constant utility forever given an initial stock. The maximin criterion has been shown to create a poverty trap for poor countries because it is dependent upon the initial stock of resources. A constant capital stock is consistent with the possible disappearance of natural capital altogether and is thus incompatible with strong sustainability.

The neoclassical model indicates that optimal growth without exhaustible resources based on the present value of a utilitarian criterion — one known to disregard the very long run — will lead to the so-called golden rule; i.e. the maximum consumption per capita remains constant indefinitely for *any* initial capital stock. This rule holds with non-essential exhaustible resources as long as their rent is invested in reproducible capital (Hartwick rule). Under the maximin criterion the same rule applies and the aggregate capital stock cannot decline over time. In other words, each generation simply maintains the aggregate stock of capital intact. This will hold even if exhaustible resources are essential as long as there are sufficient opportunities for substitute between exhaustible resources and reproducible capital (Common et al 1992). Because factors of production under SD are assumed to be complementary to natural capital, the constancy of capital may no longer obtain.

Neoclassical economics has been searching for a criterion that will give equal weight to the present and the very long-run (neither is to be dictatorial); one that will value the existence of the environment rather than its instrumental value as an input. This new criterion is a weighted sum of the old utilitarian criterion and of a new value for the distant future, both of which include the current stock of natural capital; i.e. a stock effect. If one ignores initial stocks, this can lead to a green golden rule; i.e. the highest constant flow of utility. Because the green golden rule like the ordinary one is not dependent on

initial stocks of natural capital, the inclusion of the latter leads to a solution that lies somewhere between the one corresponding to the utilitarian with stock effect and the corresponding to the green golden rule (Heal, 1993).

Generally speaking, the field of neoclassical economics hesitates between defining sustainability as part of an intergenerational welfare criterion or as an external constraint on a utilitarian criterion. Even this constraint and the utilitarian criterion can be specified and the impacts of these specifications vary according to an open or a closed economy (Pezzey, 1996).

1.5 Is Carrying Capacity an Operational Concept for Economists?

Carrying capacity is an ecological concept that is foreign to neo-classical economics because it depends upon the state of prices and technology very much like a resource. Carrying capacity is the maximum population of an organism that a given isolated region can support indefinitely. The concept of "ecological footprint" claims to correct the notion of carrying capacity when applied to humans by incorporating technological progress and trade. It is the total quantity of land/water required to produce the goods and services demanded by the population of a given region. It is a measure of this population's use of natural capital (Rees et al. 1994). For neoclassical economists, the only limiting factor is knowledge. The definition of natural resources and the environment depends upon the state of knowledge. For example, between 1987 and 1990, estimates of proven recoverable reserves rose 11.4 % for oil and 17.9% for natural gas owing to more sophisticated computer-based seismic methods. Knowledge allows the substitution of resources for resources that have become relatively scarce as indicated by their market price; the only exception would be critical capital. Furthermore, knowledge reduces the amount of natural resources per unit of output. The trend for the real prices of

most non-renewable resources is downward, this is likely to continue to decline (Crabbé, forthcoming; Sagoff, 1995).

Vitousek estimates that humans currently "co-opt" 40% of the primary productivity of terrestrial ecosystems.[3] It is claimed that this proportion cannot increase forever, for two reasons: growth will require more net primary productivity; and net primary productivity is fixed to current levels. Both assumptions are false (Sagoff 1995).

The assumption behind the "ecological footprint" is that a region should not use up more natural capital (measured in areal units) than is contained within its own boundaries. Using up natural capital in excess of this "unit norm" is ecologically "bad" because the region "appropriates" carrying capacity from elsewhere as well as from the past and the future. Is it "bad" for an area to have its carrying capacity appropriated either by itself by any other area? The neoclassical economist wonders about the norm, its definition in terms of one factor of production only, and the latter's measurement in areal extent units. Surely, autarky cannot be considered an optimum economic situation because two regions can increase their welfare by trading. Trade would be allowed as long as the "ecological footprint" of the trading partners does not exceed the sum of the areal extent of their respective regions. If the entire earth were divided in non-overlapping regions trading among themselves, it would be physically impossible for the partners to hold jointly an "ecological footprint" that exceeds the earth's area (unless other planets enter into the economic arena and could be included as well). Lifestyles and population would have to be adjusted and the technological progress saving on "ecological footprint" will have to come into play. The first two can be adjusted; whether the last one will come to the rescue is not guaranteed by any theory. The economic norm is that the bargaining parties including future ones are better off after the bargain is struck. Why are the parties limited to

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[3] Humans "co-opt" the primary productivity of ecosystems when these systems have been "dominated" by humans (Sagoff, 1995).

bargain about the “ecological footprint”? They could trade human capital (consultants), and physical capital (computers) whose ecological requirements are minimal though not nil. In other words, lifestyles in a region are not fixed to their “ecological footprint” even though the “ecological footprint” will never be nil. This is the neoclassical substitution argument that sees only critical natural capital as a limit. Finally, why is “ecological footprint” measured by its areal extent? Why is it unidimensional? Even reservoir water is measured in acre-feet. Oil, for example, that can be found at great depth will be more expensive to extract than oil available near the surface. Converting into areal extent eliminates the quality (Ricardian decreasing return) dimension that is important for natural capital. Suppose that some region of the earth is not subject to an “ecological footprint;” that the footprint constraint is not globally binding. The neoclassical economist will wonder about the opportunity cost of keeping the region in a virgin state. Isn’t there an alternative use that has positive value? Perhaps the virgin state has value because of its integrity, wilderness value, etc. If this value is lower than that under an “ecological footprint,” then the virgin state is inefficient. How can an “ecological footprint” encroach on the past? It can certainly encroach on the future by excluding future uses such as remaining in a virgin state. It is a question of value; does the future use or non-use have more value than the current use or non-use? After all, why is rural population always decreasing? Why do government policies have to sustain farmers’ income? Left to the market, rural exodus would be larger than it is already.

1.6 Varied perceptions of SD

There is a widespread perception that SD will have an adverse impact on trade especially on exports from less-developed countries (LDCs) because full-cost pricing will decrease competitiveness. Moreover LDCs perceive SD as an ideology developed by the North and imposed by the North upon the South to restrict access to the North’s markets. It is alleged that pushing SD of the North forward will be at the cost

of economic stagnation in the South. Within LDCs, there is a tension between those who advocate stricter environmental regulations and those who advocate economic growth as a priority (Makhandya 1994). Generally, SD is viewed as an added cost by some producers (full-cost pricing) and as an opportunity by the others (“Porter Hypothesis”; see infra). If the environmental costs are passed on to the consumers, costs are likely to be divided equally among consumers or possibly along income lines because there is some evidence that the demand for environmental services depends on income. Consumers of green products are a small segment of the market, however. Therefore, shifting costs to consumers might not be easy.

Part II — Sustainable Development at the International Level

SD at the international level is affected mainly by trade, multinational corporations, commercial lending and aid (Lélé, 1991). It was mentioned in Part I that SD must of necessity be adopted by the whole planet. This is the principle of spatial equity, and takes into account the pervasiveness of external environmental economies and global environmental public goods.

2.1 Theoretical and Empirical Perspectives

In a theoretical world in which all goods reflect their full marginal cost, factors of production are mobile, trade is competitive and there is no market distortion, free trade may be compatible with sustainable development. In the real world in which these conditions are violated, this compatibility is uncertain; empirical evidence becomes significant. In particular, environmental services are not mobile (Markandya 1994).

The principle of spatial equity states that an economy may not become sustainable at the expense of another economy. SD may not be achieved in a developed country such as Japan, which has few natural resources and fossil energy, at the expense of LDCs which provide Japan with timber and oil at an unsustainable rate. The U.S. will not become sustainable if it imports tuna fish from Mexico when Mexico harvests in an unsustainable fashion in international waters. The theory of by which developing countries become worse off as output grows because the terms of trade move against them is an illustration of spatial inequity. It often leads the developing country to manage its resources unsustainably (Markandya, 1994).

Even if an economy does not engage in international trade, its energy consumption may affect carbon dioxide and methane emissions, and thereby contribute to an increase in global warming which affects all countries. High seas fishing

operations in an isolated country may deplete ocean fisheries for certain species. If a country contains a cultural or aesthetic site of world significance such as Angkor Wat, the degradation of the site affects the whole world even in a closed economy such as Kampuchea formerly under Pol Pot.

The pervasiveness of environmental externalities and global environmental public goods transforms all economies into open economies that interact with each other through traded and non-traded commodities. The world has become a global technicoltum in which myopic market behavior leads to a non-optimal, non-cooperative equilibrium. There is a need for cooperation in order to achieve a Pareto optimum. This is why the SD agenda began from top-down at the international level and is permeating at the national level. There is also a bottom-up SD movement that has grown from the realization that sustainable individual behavior contributes to overall sustainability. Whether bottom-up and top-down movements are mutually consistent in theory is a moot issue (Faucheux et al 1996).

Measures of sustainability even in open economies are specific to the economy in question unless there are spill-over effects. Environmental standards are national, determined on the basis of a national benefit cost ratio and should not be dictated by any other country unless the environmental effect crosses boundaries. (Markandya, 1994). In such a case, measures of sustainability correspond to international agreements and their implementation. Often these international agreements include trade sanctions against non-participants who violate the agreed ban on trade between members and non-members of some substances such as ozone-depleting substances. It is a moot question whether such arrangement violate the General Agreement on Tariffs and Trade (GATT) especially for non-members. These dispositions are meant to be incentives for non-members to join the agreement. Environmental international agreements also restrict trade in some substances such as hazardous substances (Basle Convention) or in endangered species (Convention on

International Trade in Endangered Species (CITES)). Usually signatories to these conventions waive their GATT rights voluntarily. Allowed trade is sometimes restricted to parties that find such trade mutually beneficial as in the case of trade in hazardous substances (Markandya 1994).

The Organization of Economic Cooperation and Development (OECD) has shown that the impact of stricter environmental regulation on trade is generally quite small (OECD, 1993).

When a country opens its economy to trade, which is now occurring in some developing countries or some economies in transition, does trade liberalization have adverse environmental effects on that economy? Empirical evidence seems to indicate that there are short-term negative environmental impacts while the price system does not yet reflect full environmental costs. However, in the long run, full-cost pricing tends to set in. This underlies the so-called development-environment U-shaped relationship (often called Kuznets'curve), which indicates that environment first deteriorates during the early stages of development (Panayotou, 1993). Some developing countries have taken the view that adoption of stricter environmental standards may be beneficial in the long run. Though given a 10-year grace period, both China and Mexico decided to adopt the phase-out schedules of developed countries for chlorofluorocarbons (CFCs) on the ground that not doing so would put them at a technical disadvantage (Markandya, 1994).

Empirical evidence also suggests that environmental standards are not a major locational factor in international trade. In other words, dirty industries do not, in general, migrate to countries with weak environmental standards. Because developing countries often have weaker environmental standards than developed countries, which is to be expected as a result of the benefit-cost ratio that determines the national standard, one would expect developing countries to specialize in environmentally damaging products while developed countries specialize in clean products. There is conflicting

empirical evidence on this. Even if true, there is no direct link between this specialization and SD. It is worth remembering that the bulk of polluting products is still found in developed countries (Markandya, 1994).

Measures adopted by developed economies to protect natural resources outside the territory of the importing nation are often perceived as unnecessarily restrictive of free trade. They are incompatible with the GATT and may not be the best tool to achieve the end. Cooperative solutions may be more effective environmentally and less restrictive of free trade.

Ecological labelling of products is often perceived as a non-tariff barrier to trade. This need not be if the labelling process is transparent, scientifically sound and not restricted to products that are almost entirely imported.

Free trade does not seem to be incompatible with SD. Trade restrictions, whenever warranted, should be kept to a minimum. One should not forget that trade may be an effective way to alleviate poverty.

Porter claims that the conflict between the environment and the economy comes from a static view of the world. This conflict no longer exists in a dynamic world based on innovation. Environmental standards trigger innovations whose benefits more than compensate the cost of meeting the standard. This so-called Porter hypothesis has implications in international trade (Porter, 1980). Empirical evidence does not support this hypothesis, at least not in American manufacturing (Jaffe et al. 1995).

Multinationals are major environmental actors as producers, managers and distributors of products. Global enterprises shape technological change and commercialization worldwide. “The question is not whether to respond to the new business context, but how; not whether such action will reshape competition, but how fast and how effectively. This is true across the board, in all sectors, in all facets of global business.”

(Choucri 1991, p. 53) After Bhopal, the developing world has discovered that multinationals can be held liable in a court of law to “a vague environmental morality (Choucri 1991).” The entire theory of international corporate liability is being extended to require firms to issue warnings about their hazardous activities. Multinationals may be liable anywhere they operate for their production and distribution activities. For the oil industry, the Valdez mishap was a watershed event at the origin of the first real ecological restraints put on the oil industry, whether at the exploration, extraction, production or transportation stages. In the U.S., oil spills had been occurring almost daily. As a result, double-hull tankers are now being ordered by companies as a pre-emptive move before oil companies are legislated. Other pre-emptive measures include the adoption of codes of conduct. The oil industry was able to adapt to the growing power of host countries by developing new contracts. It should similarly be able to adapt to ecological restraints. Seveso and then Bhopal served as similar stimuli for the chemical industry. The chemical industry is the subject of international agreements such as the Basle Convention that governs trade in hazardous wastes and the Montreal Protocol that governs CFCs. Such agreements give less flexibility to multinationals in locating their activities in environmentally weak jurisdictions. The pressures of environmental interests matter more now than the consent of the prospective buyer. The construction industry is at odds with the environment especially through its handling of hazardous materials and landfill practices. Multinationals need a strategy to influence public policy in the environmental area to keep competition out of environmental issues and focus it instead on technology, management skills and creating and shaping markets (Choucri, 1991).

An important concern for SD at the international level is poverty elimination, especially in rural areas that are biomass subsistence-based economies. As mentioned earlier, the concern for poverty is often based on efficiency as poverty generates environmental degradation; further more environmental degradation increases poverty through positive

feedback effects. Water contamination, air pollution, soil salinization through irrigation, soil erosion and deforestation have a major negative effect on human health and/or human productivity as well as on the environment as an amenity (World Bank 1992). Poor rural families derive over a quarter of their income from common-property resources — resources through which collective property rights are well-defined. These common-property resources are threatened to become open-access resources; i.e. resources through which property rights are ill-defined, whenever population pressures, technological progress, monopolistic and speculative tendencies, and ill-advised public policies alter the scarcity of the resource. Even the establishment in these cases of private property in favour of an individual disenfranchises the poor. Poverty is also affected by population whose growth may further increase poverty through environmental pressures. When physical and environmental capital are almost non-existent, the only asset is children whose productivity is low. The lower the productivity, the more children one needs and the less time there is to allow them to get an education. In other words, among the rural poor, intergenerational transfer of income operates from children to parents, at least when children are relatively immobile. The impact of poverty falls on rural women especially who fetch water and firewood for cooking and fodder for the animals. Their work-load is increased as the environmental resource base decreases. Girls are sometimes considered less desirable than boys because they require by custom a dowry that renders them more expensive than boys to rear (Dasgupta et al. 1995).[4]

Some object to unbridled free trade on the ground that it benefits holders of absolute comparative advantage only and destroys communities. Since no international community exists, multinational corporations can escape responsibilities towards national communities and give free rein to their individualistic tendencies, Thereby bringing community standards to their

[4] These considerations illustrate the quotation from Panayotou at the beginning of the paper.

lowest common denominator. This, in turn, destroys existing communities (Daly et al. 1994). To the extent that free trade contributes to the dismemberment of common-property resources, it could actually have a negative impact upon the poor. Differences in power between the trading parties may lead to the exploitation of one (or some of its constituent groups) trading partner by the other, or to dependency relations that remove the freedom not to trade and create vulnerability, insecurity and loss of autonomy (Ekins, 1991).

2.2 Agencies

The main agencies concerned with trade are the World Trade Organization (WTO), the International Monetary Fund (IMF) and the World Bank. The IMF is accused of having maintained in the past favourable terms of trade for developed countries by manipulating exchange rates. Both the IMF and the World Bank are denounced for advocating downward adjustments of exchange rates within structural adjustment policies imposed on debt-ridden developing countries (Lélé, 1991). The WTO which, since the Uruguay Round, has jurisdiction over agricultural trade, still favors, according to some, trade over the environment despite the existence of its Committee on Trade and the Environment. Fearing green protectionism, the WTO does not address environmental standards. The World Bank has begun to consider sustainability in its decisions. The Commission on Sustainable Development is supposed to monitor countries' progress towards SD and report to the General Assembly in 1997 about the extent of such progress since the Rio Conference in 1992.

The World Bank and the United Nations Development Program (UNDP) both see environment as a way to stimulate public interest in aid (Cairncross, 1995). The World Bank built up its environmental directorate quickly and UNDP's new head came from the World Resources Institute.

Two measures of SD have been developed at the national level, with international comparisons in mind. One is

the UNDP Human Development Index and the other has been put forward by Aitchinson and Pearce. The latter is purely experimental and has been established within a one-year time frame. It aims at measuring SD by the excess of a country's gross savings rate over its depreciation rate for physical and natural capital. Human and social capital are excluded from the computations. This interpretation as an SD index is certainly subject to caution (Pearce et al. 1993). The Human Development Index is a composite of the three following components: average life expectation at birth, average education level and income distribution. Because environmental considerations are not included, it cannot be interpreted as an SD index.

Part III — Sustainable Development at the Level of an Economy

3.1 What is Sustainable Development at the Level of an Economy?

As mentioned earlier, it is difficult to conceive of a single economy as sustainable short of having the whole world be sustainable - unless this economy is completely self sufficient. Moreover, such an autarkic economy would have to be without externalities affecting the rest of the world and without environmental public goods. For example, the contribution of this economy to carbon dioxide emissions would have to be negligible. In other words, SD recognizes that we live and will be living in an increasingly interdependent world and that the sustainable “Projet de Société” must be international. It is not by accident that the SD ideology took off at the United Nations initiated by environmental non-governmental organizations. This means that we cannot discuss SD at the national level without discussing international trade.

3.2 Difference with International Perspective

A primary feature of SD has been described as emphasizing development rather than growth. This does not mean that SD is anti-growth; far from it. The theory of SD recognizes that real NI per capita is a necessary component of development and that improved development may require increases in real per capita income. This is certainly true for poor countries. In developed countries, SD emphasizes that growth has sometimes been a mixed blessing because it has generated negative externalities such as urban blight, noise, and pollution, which are not taken into account in the Standard System of National Accounts (Mishan, 1973; Daly et al. 1994). Because development is a process that affects welfare, comprising a vector of components, one of which is real national income per capita, there may be trade-offs between growth and development. The non-income components of

welfare may be non-tradeable commodities or services such as public goods or “goods” that are substantially outside the realm of economics such as happiness, authenticity, spirituality, beauty, sacrifice, etc. This pertains to ethics, culture and religion.

A long-standing controversy has developed since the 1970s in order to determine whether GNP measures a nation’s welfare. This is when “social indicators” became fashionable and when Tobin and Nordhaus developed the New Economic Welfare (NEW) Index (Nordhaus et al. 1972). Daly and Cobb recently developed another analytical tool called the Index of Sustainable Economic Welfare (ISEW), which is geared more towards environmental externalities and amenities neglected by his predecessors (Daly et al. 1994). Net National Product (NNP); i.e. GNP after proper deductions for depreciation of all types of capital, may be interpreted as a measure of economic welfare. If NNP is to be interpreted this way, it should also substract environmental damage and add the value of the net change in the stocks of all assets including natural capital. The NNP can be interpreted both as sustainable income - in the sense that it yields the maximum constant flow of consumption - and as the maximum sustainable value of social well-being. This flow can also be interpreted as the return on total wealth in the economy (Maler, 1991). The NNP has been called the Net Welfare Measure by Weitzman (NWM) (Weitzman, 1976). However, if technological progress is taken into account, NWM is a gross understatement (possibly by 50%) of the economy’s sustainability (Weitzman, 1995). Repetto and his colleagues at the World Resources Institute have attempted to correct the GNP of Indonesia over the 1980s by including natural capital depreciation and were able to show that the actual rate of growth of Indonesia was (neglecting technological progress) roughly half of its apparent rate of growth without such depreciation (Repetto et al. 1989).

3.3 Measures

The Standard System of National Accounts (SNA) measures NI according to a set of conventions adopted for convenience sake. It is known that the contribution of spouses to the household are not included in SNA because their services are not marketed. When considering the environment, remedial measures taken to improve damaged environments are counted as a positive contribution to national income because such measures are marketed. Stocks of natural resources do not depreciate-like physical capital; the contribution of the natural resources sector of an economy is thus overstated in SNA. In particular, non-sustainable yields of renewable resources are not depreciated. The depreciation of environmental resources is not easily estimated because it often requires value estimates of these resources, which are not traded on markets. Though non-market valuation methods are available, their degree of precision makes it impractical to include the depreciation of some environmental resources in the National Accounts. The United Nations has proposed an Integrated System of Environmental and Economic Accounts, however, few countries including Canada and the U.S. follow the system (United Nations 1993). The environmental accounts are often kept separate from the SNA and are called satellite accounts. To avoid valuation problems, satellite accounts are often kept in physical quantities. The non-marketable components of GNP are measured by indicators (Hodge et al. 1995).

3.4 Market Incentives to adopt SD

Besides regulation, nations also adopt measures called economic instruments that encourage businesses to pay more attention to the environment. These include indirect taxation instruments that act as a price on natural capital inputs and outputs; administered markets on transferable quota be they for natural resources such as fish or for pollution, which allow businesses to reach environmental standards efficiently; liability instruments such as strict liability in the case of toxic pollution,

or still firming up property rights especially in LDCs. These incentives are not distinguishable from environmental incentives.

The OECD has concluded that environmental standards do create jobs although the net gain is small (OECD, 1994). Some argue that shifting taxation from human capital to natural capital (eco-taxation) creates jobs. This is called the double dividend hypothesis (Crabbé et al. 1996). Though economic instruments have been developed in the field of environmental economics, it is quite possible that to apply them to SD might entail different combinations and levels of application. This is mainly because environmental economics is essentially a first-best theory while SD is secondary. Furthermore, the goal of environmental economics focuses on discounted present value maximization while the goal of SD is targeted at intergenerational equity.

3.5 Round-table Processes

Round-table processes that have developed in Canada at various levels such as the Federal National Round Table on the Environment and the Economy and its provincial, local and sectoral equivalents are a means to encourage participation in defining and implementing SD at a broad level. Various stakeholders are involved in seeking consensus about courses of action that could be taken to achieve SD. This is a fairly effective way of inducing cooperative behavior. Round Tables, particularly at the sectoral level, have given rise to opportunities for formulating SD principles to which individual firms are willing to adhere. The Canadian experience has shown that there are limitations to the process as well, especially in the realm of intragenerational equity (Geddes, 1996).

Part IV Sustainable Development at the Industrial Level

According to standard microeconomic theory, an industry is a set of firms producing close substitutes. An industry per se does not raise issues of sustainability other than those raised at the firm level, unless a common component of natural capital (e.g. fish stocks) is shared or its output is ecologically essential (e.g. drinking water).

Sustainability issues arise for the salmon industry on the West Coast, for example, because fishers share a public good; the salmon stock. The traditional concept of the firm as a transformer of resources whose exclusive ownership is in private hands becomes inadequate. There are (social) issues common to the whole industry that do not arise directly from the firm level. These issues are similar to externalities that relate to the industry except that the latter are understood as pecuniary externalities rather than as technological externalities. In principle, firms belonging to an industry that shares a common sink for waste would fall in the same category; however, it is difficult to find an example of a sink that is accessible to one industry only (perhaps the ozone layer for the CFC industry). Industrial sustainability issues arise only if the “Tragedy of the Commons” is limited to a single industry.

Some ecosystems services (e.g. clean water) are life supporters and, therefore, absolutely essential. They are subject to a sustainability assessment. Moreover, when ecological goods or services do not have substitutes, the same sustainability concern applies. This is why one speaks of sustainable agriculture, forestry, fishery, chemicals (which may exceed the assimilative capacity of the environment) and not of sustainable consulting. The so-called primary sectors provide the economy with ultimate and useful (low entropy) inputs and the waste sector with ultimate sinks.

4.1 Industrial Perspective on SD

4.1.1. Description of Failures: Industrial Accidents, Polluting and Wasteful Activities and Failure to Keep the Public Informed

Large-scale industrial accidents such as Seveso, Bhopal (3,000 immediate deaths), Basle and Chernobyl (10,000 immediate deaths) have undermined public confidence in certain industrial sectors. They have exposed the fallibility of expert judgement and undermined the power of the technocratic elite (Davis, 1991). The chemical industry's image fell during the 1980s as public familiarity of the industry rose. Compared to a favourable rating of 50% during the period 1969-79 in the U.K., public support of the chemical industry fell to a low of 33% in 1987 (Tombs, 1993). Accidents cost the industry increased insurance premiums and generated tougher environmental regulations (Cairncross, 1991).

Thermal power stations are responsible for most sulphur dioxide, nitrogen oxide and carbon dioxide emissions; the transportation sector is responsible for most carbon monoxide emissions; and industry in general is responsible for most volatile organic compounds. The chemical industry produces huge amounts of polyvinyl chloride (PVC), which is used in a large number of products (toys, home sidings, sewer pipes, textiles, food packages, etc.) replacing wood, cotton, copper, and paper. This creates huge quantities of hazardous wastes. PVC is a known carcinogen directly linked to liver disease and affects workers of plants that produce the chemical. PVC used in construction material is noxious to consumers when it burns because its smoke. Many synthetic materials based on chlorines (Dichloro-Diphenyl-Trichloretan (DDT), Polychlorinated Biphenyls (PCBs)) or heavy metals stay toxic for decades (Geiser, 1991). Water pollution in developed countries results mostly from oil spills, sewage discharges, farming activities and chemicals, in that order. If industries are concerned about public perceptions of their activities, they

should be prepared to provide more information about these activities to the public.

SD concerns industries that acquire inputs from the environment and reject wastes from their production processes into the environment. The more an industry is dependent on primary inputs of materials and energy, the greater the concern about sustainability. This is why sustainability is especially important in the primary sector: it concerns agriculture, which uses renewable resources including the soil and often water for irrigation; it concerns the fishery, forestry and water, mining, oil and gas sectors. Industries that generate quite a bit of waste including hazardous wastes through their processes and products (e.g. chemical, mining, energy generation, transportation, and manufacturing processes that use water for cooling), and industries that use extensive packaging all fall under the scruting of sustainability.

Clearly, any unsustainable activity that has a direct impact on human health will be a priority for the public. It is not surprising that toxic substances were the first to be regulated. Sometimes consumers' perceptions about industry's unsustainable actions play an important role. Irrigation in dry areas, extensive uses of fertilizers, mine tailings, clear cuts, freshwater that is undrinkable and unswimmable are all obviously unsustainable in the eyes of the consumer.

Sometimes consumers take environmental actions without the best backing of information, as illustrated in the public's opposition to clamshell styrene wrappings for hamburgers by McDonald's (see infra; Cairncross, 1995).

4.1.2 Discussion of Vertical and Horizontal Integration and Other Linkages That Encourage Sustainable Development: Technological Networks

The traditional economic definition of an industry has already been described and is slowly being replaced by a systemic definition of a group of firms producing

complementary products and being part of a technological network of products. In this sense, there is an automobile industry with all its network of suppliers of parts, oil, roads, service stations and even the drivers; the environmental and congestion effects are tied to the network. Similarly, there is an information industry, a finance industry, etc. The "emergent" property of the system is the technology; it is a symbiosis of sources of materials and energy and consumption patterns. Environmental changes thus require systemic innovations. If one designs an electric car, for example, one has to design the context in which it will operate. Technological development involves more than technology alone; the specific social environment in which technology is to be applied will have to change as well (Cramer et al. 1991). Environmental changes must, therefore, have an affect on the entire technology; otherwise there will be a broad range of barriers such as technologically and economically superior competitors and a hostile selection environment towards innovation (Schott et al. 1994). Systemic innovators have a harder time to appropriate the benefits from innovations because such benefits often require complementary assets (e.g. special materials, machinery, skills, etc.). Control of the assets may be necessary. This favours vertical integration owing to the complexity of contractual arrangements based on uncertainties, technological interdependence and needed exchange of information (Kemp 1994). On the other hand, vertical integration may slow down the pace of environmental innovation because vertically-integrated firms have made large technology-specific investments both upstream and downstream. Horizontal integration in networks is established through negotiations leading to compatibility standards through which firms agree to make compatible products. This standard eliminates competition between technologies (Besen et al. 1994). These networks are not efficient according to economic theory. They are subject to multiple equilibria and are often monopolistic (Katz et al. 1994).

The vertical or horizontal integration of industry may also have an impact on sustainability through the creation of

integrated industrial ecosystems or networks within natural ecosystems (eco-industrial parks). This has given rise to the burgeoning field of industrial ecology or ecological engineering (Karamanos 1995). These industrial ecosystems seek to create interdependent industrial networks modeled on biological ecosystems. Production facilities can take waste products, heat, water and other resources from each other to minimize overall resource consumption and waste of the entire network. They use one another's waste as raw material. They attempt to close the loop within the network rather than within the firm. And they try collectively to minimize waste and conserve energy, raw material and water. With ecological information flowing freely within the integrated network and the risk of loss of competitive advantage through technology transfer being minimal within the network, opportunities for closing the loop are considerable (Shrivastava 1995a). An example of an industrial ecosystem is found in Kalundborg, Denmark. The earliest deals among firms in Kalundborg were based on strictly economic criteria (Karamanos 1995). This is an example where raw materials and waste are strongly complementary and form a system with interface, instead of the firms' products as is assumed in the economic theory of network externalities. The industrial ecosystem is truly a network since it creates network externalities; i.e. a new member of the network may confer a benefit to existing members; that is to say, a new member may create positive feedback effects. The relation between the industrial ecosystem and the markets for products would be worth examining. The question about whether an industrial ecosystem really creates a network externality or simply a network effect remains open. It seems that the latter is more likely because the benefit of the network does not depend so much on its size than on its degree of interactions (Liebowitz et al. 1994).

Technological networks may be changed through strategic niche management; through the development of technologies that are not developed in the marketplace (e.g. solar power). They may also be changed through regulations and other instruments (modification strategy for the selection

environment) aimed at forcing industry to develop and commercialize new technologies. They create new expectations about viable technological futures. Institutional links between strategic niche management and strategies modification (technological nexus strategy) help in translating selection pressure into criteria and specifications for the design process (Schott et al. 1994). A combination of the three strategies (niche management, modification and technological nexus) will bring changes. California illustrated the second strategy through the imposition of stringent clean air standards in 1988. California can afford stringent standards because it does not have a domestic car industry; at the same time, it hopes to develop one through the adoption of electric vehicles that would create alternative activities for its defence-based industries. On the other hand, California's atmosphere is one of the most polluted in the world (Schott et al. 1994). There is no evidence that the development of new technologies has up to now taken environmental effects into account. Selective environmental strategies will have to be adopted (Cramer et al. 1991). Green technologies will replace older technologies after a long period of trial and error in a wide variety of applications. Public sector initiatives and public investments have generally been essential in the first stages of a new technological system and the inter-industry diffusion path tends to follow a predictable course. In other words, the selection process or modification strategy does not depend on a menu presented by various innovators and offered to "customers"; instead it depends far more on the initiatives of the "selectors" and of the political process (Freeman, 1994).

A survey of firms conducted in the U.K. indicates that environmental regulations and the anticipation of regulation strongly influence both product and process innovation and, therefore, the primary role of modification strategies. The market prospects for green products also influence product innovation; cost savings on materials and energy also influence process innovations. However, anticipation of regulation is strongly correlated with commercial factors such as threat of rival products and market shares. The next most important

factor for process innovation is internal pressure from a personnel committed to the environment. Environmental pressure groups, insurance claim threats and pressures from ethical investment funds are perceived as negligible influences. The three top organizational factors that affected product innovation were collaboration with customers and suppliers and the need to invest in new plants. For process innovation, the three top organizational changes required were the need to invest in new plants, collaboration with suppliers and the need to spend more on training (K. Green et al. 1994).

Industries adopt codes of conduct such as the Business Charter for Sustainable Development, the Coalition for Environmentally Responsible Economies (CERES; formerly Valdez), and Principles or the Natural Step (Schmideiny et al. 1992; Shrivastava 1996: Hawken 1995). These should cover all aspects of operating a company, the impacts on people and the role of each part of the company in implementation. The mission statement should be followed by an environmental strategy, which evaluates all the environmental and social impacts of the products, processes and projects so as to minimize their impacts. A Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis may be useful (North 1992, p. 42 for details).

4.1.3 Meaningful Examples of Applications of Coase's Theorem

Coase's theorem states that the assignment of property rights to one party to an externality rather than to another is indifferent in the absence of transaction costs. Examples of meaningful applications of this theorem are difficult to find because Coase's theorem applies to two parties externalities only (Dasgupta et al. 1995). In the context of network externalities, vertical integration is a means to internalize the externalities because the design of a contract may be extremely difficult. Contracts may also be passed at the development stage of a network where an agreement on standards for compatibility is made; horizontal integration through

agreements on standards eliminates the need for complex contracts. Examples of environmental applications of Coase's theorem may be found in the formation of industrial networks.

4.2 Measures

The depreciation of non-renewable and renewable resources used as feedstock applies to the industrial level and in national accounting. Pollution activities may be measured in physical units or be assigned a monetary value as in national accounting. There is no method to measure SD specific to the industrial level and distinct from measures used at the firm level.

Part V — Sustainable Development at the Firm Level

5.1 Firm's Perspective on SD

Firms are the primary engine of SD. They have the financial resources, the technical knowledge and institutional capacity to implement SD. They account for a large portion of the world's economic activity — the 1,000 largest firms account for 70% of the world GNP — and control much of the world resources and technological innovations. The majority have much influence on consumers' choices while multinationals hold much of the international power (Gray, 1994). However, consumers must play their part, if they want to help implement sustainability, by consuming fewer and better quality products and using them more wisely. Governments must set property rights on natural capital and be the watchdogs for sustainability. Governments can insure full-cost pricing by setting up and implementing environmental standards for parts of natural capital in which property rights cannot be established. These environmental standards may be set up through benefit-cost analysis or more likely through the political process. They may be enforced by means of Pigovian taxes, regulations, markets for property rights or liability instruments. Firms may be forced into SD through regulations, and given incentives through taxes, administrated markets on environmental services (e.g. pollution permits) and through liability assignments (see section 3.3). They may also adopt SD voluntarily, seeing it as a business opportunity with the view that SD can be profitable in the long run.

The firm does not optimize a utility function. Therefore, sustainability does not constrain one firm to produce one product rather than another. The product mix is determined by profit alone.

Firms' attitudes towards the environment have been changing. They are now willing to take voluntary measures to improve their environmental performance. Part of this shift can

be attributed to external circumstances, such as the following: industrial accidents, government intervention, shifts in consumers' preferences, investors' pressures, increasing scarcity for sinks, barriers to entry and firm ownership type. Another part of the shift is owing to internal conditions with the firm. For example, management attitudes have changed due to shifts in management culture. Other internal factors include employees' pressures, fear of untimely and expensive regulation, cost savings, new opportunities, Total Environmental Quality Management (see infra), competitive strategies, and green reputation. Some of these internal factors are closely correlated to external factors such as regulation, opportunities and reputation.

5.2 Changes in Attitudes

5.2.1 External Causes for Change

5.2.1.1 Experience of a Major Industrial Accident

An ecological mistake may cost the firm valuable time, cleanup activities, customer disapproval, boycotts, fines, suits, etc. Major environmental industrial accidents include the following:

- Chernobyl 1982, radioactive emissions, 10,000 fatalities
- Bhopal 1984, release of methyl isocyanate, 2,000 fatalities, 200,000 injuries
- Mexico City 1984, explosion of Liquid Petroleum Gas, 650 fatalities and several thousand injuries
- Seveso
- the Exxon Valdez
- Basle (Sandoz)
- Love Canal, etc.

These have had a profound impact on the environment and in changing attitudes towards the benefits of maintaining a healthy, sustainable environment. An accident costs a company its reputation and an immense bill. Accidents carry financial

penalties especially in the U.S. There is evidence that larger companies are penalized the most as examples to others and because they have the resources (Cairncross, 1991).

5.2.1.2 Government Intervention

Government intervention has played an important role as the enforcer/motivator behind changing attitudes and action in support of the environment. The obligation to report toxic emissions, the establishment of strict liability rules (independently of fault or negligence) for toxic pollution, the obligation to include costs for clean-up in financial statements, the establishment of personal penal and civil responsibility for managers for environmental law violations beyond civil liability for the firm, including heavy fines and imprisonment, have all played an important role in forcing ahead the environmental priorities on the corporate agenda. Clean-up costs are recouped from companies for abandoned and uncontrolled hazardous waste sites. Liability for these costs is strict under the Superfund legislation in the United States. The only way to avoid such a liability is if a company conducts a comprehensive environmental audit of the site at the time of acquisition, which explains the popularity of these audits. Strict responsibility is a logical consequence of the Polluter Pays Principle and does not require the damage to be intentional (Cairncross, 1991). Title III of the 1986 Superfund Amendments and Reauthorisation Act (SARA) require all companies in the U.S. to report the pollutants they are emitting. This is equivalent to the imposition of a compulsory audit.

Government offers a carrot as well. It has invited businesses to participate in round-table discussions on the economy and the environment. Government has also distributed ecolabelling in some cases, and has contributed funding to the development of environmental technology. There are also subsidies for the adoption of green technologies. The environmental record of the firm is treated as an extenuating circumstance in industrial accidents.

5.2.1.3 Green Consumerism

Companies that experience direct pressure from clients, such as retailers, consumer goods manufacturers, suppliers or service companies, are the most likely to make comprehensive changes (North, 1992).

What is a green product? It is a product that requires as little as possible use of scarce non-renewable resources, energy, water and hazardous substances during the production process. The product must be recyclable, energy efficient, durable and should not be hazardous. Quality of both product and process is important. In particular, the product should not require frequent repairs (McCloskey et al. 1993).

Green consumerism started in the 1980s and was especially successful in Great Britain after the publication of the “Green Consumer Guide” in 1988. Its U.S. equivalent came out in 1989 and was titled: “Shopping for a Better World: a Quick Guide to Socially Responsible Supermarket Shopping”. Green consumerism did not ask consumers to consume less but rather to consume in a more discriminate way. The guides named the companies whose products could satisfy the discriminating green consumer. Before the publication of the green guides, phosphate-free detergents had been a market success in Europe despite attempts to discredit them by competitors. Proctor and Gamble had invented products that could be sold on their environmental merit alone (powder detergent). When McDonald’s was hit by a bout of bad environmental publicity from its customers about its clamshell wrappings, it turned to an environmental organization for solutions.

Ecolabelling by governments or private organizations also dates from the end of the 1980s. The European community used the Blue Angel to label its ecologically friendly products. Ecolabelling is a very difficult process; the environmental impact of a product does not depend so much on how it is made but on how it is used by the customer. Companies do

have to educate their customers about how to use their products in an environmentally correct manner. Too many ecolabels trivialize the product; too few discourages green producers and wastes educational opportunities for the public.

The advantage of green consumerism for companies is that green customers are willing to pay a premium for green products and that green customers are generally well off.

There is a presumption that the income elasticity for green products is above one. With the exception of a few niche companies, green consumerism will never be the driving force behind corporate environmentalism (Cairncross, 1995). Green consumerism affects a narrow band of goods only. The environmental impact assessment of many goods is very hard to make by the consumer. Moreover, empirical evidence shows that two-thirds of the American consumers are unable to identify an environmentally conscious company (Cairncross, 1995).

The green consumer has a choice between green and regular products. Obviously his/her choice is affected by relative prices. His/her utility function is affected directly by the state of the environment which in turn affects the purchasing attitude toward green products. In other words, at equal prices, more green products will be consumed if the state of the environment is relatively worse (Beaumais et al. 1994).

5.2.1.4 Pressures from Investors

Financial fund managers and especially institutional investors, such as pension-fund managers, are increasingly considering environmental factors in their investment decisions. Specialized green investment funds are being created. Studies of ethical investment funds have failed to show that they either over or underperform. Ethical investment raises its own contradictions because the “nasty” industries are the ones that need the most investment for cleaning up their act.

Financial markets are not rewarding good performance by polluting firms because either investors are green (“ethical investor hypothesis”) or they know that in the short run the firm’s profitability will be negatively affected by required heavy investments in pollution abatement in order to meet environmental standards that are not currently met.

5.2.1.5 Scarcity of Available Sinks

Sinks for waste are becoming increasingly scarce. The ocean has become off limits and landfills are harder to find and getting more expensive (Cairncross, 1991).

5.2.1.6 High Cost of Entry in the Industry

It is easier for a firm to become green if it knows that the risk is low for its greener production techniques to be adopted by a competitor and if it knows that non-green competition is almost non-existent (Cairncross, 1995).

5.2.1.7 Ownership Type

Short-term profit orientation counters profound change (North, 1992). An enterprise less subject to short-run pressures such as a consumer co-op or a foundation owned firm both tend to be more open to pressures to become green. In Switzerland, the largest supermarket is a co-op that has been path-breaking in the area of products and packaging. A foundation associated with the co-op provides research in alternative forms of economic development (North, 1992).

5.2.2 Internal Causes for Changes

Ten years ago, firms nominated themselves for environmental awards for compliance with government regulations. Today, they nominate themselves only if they go beyond the law — ahead of their industry and ahead of their customers (Kleiner 1991). Why do companies adopt SD voluntarily? Following are some internal reasons:

- management culture
- pressures from the work force
- fear of costly and untimely regulations
- cost savings
- new market opportunities
- competitive strategies
- Total Environmental Quality Management
- green reputation
- Porter hypothesis
- rent seeking
- existence of win-win solutions

Each is examined more closely below.

5.2.2.1 Management Culture

Management of the post-Stockholm UN conference time period demands environmental performance to be part and parcel of good management. It wants to impress new recruits, the community and government authorities. It has a strong sense of corporate responsibility, particularly towards the community with which it wants to establish better relations. “Sometimes a company needs to feel that its influence on the community is beneficial and not just profit-driven.” (Cairncross, 1995)

The new management paradigm, which blossomed in the 1980s under the influence of Peters and Waterman (“In Search of Excellence”), Drucker, Halal, Morgan, etc., although it germinate as early as the mid-twentieth century, replaces hierarchies by networks of stakeholders, employees, suppliers and customers that strive for human and social fulfilment as well as for the accomplishment of an economic goal. Organizations are now perceived as knowledge-based networks or teams without external boundaries rather than physical entities with walls. They function through shared values, visions and communication systems. This new management paradigm is a replacement of the Taylor and

Weber mechanistic model in which organizations are goal-oriented entities made of coordinated parts. People in these organizations work for a manager whose objective is to make profits and to cut costs through constant reorganization of the staff: hands matter more than heads. From originally being commanders, managers have become information processors who lead ad hoc teams around an innovative idea by crossing organizational boundaries for resources, people and information. Hierarchies were a logical means of processing limited information from the decision-making level to the production level when information was scant. In an information-rich environment with sophisticated electronic information-processing capabilities, hierarchies become dispensable. Hard growth (i.e. quantitative physical increase in commodity production), will be replaced by smart growth (Halal); that is, an increase in the quality of life through the transformation of environmental constraints into opportunities. Systems thinking (interactions) replaces linear thinking (cause-effect) and recognizes the holistic relationships among product quality, customer satisfaction, company positive image and sales (Senge, 1990). Though profit remains an important goal for a corporation, multistakeholders considerations require the organization to formulate multiple goals that respond to social, environmental, political and economic concerns, and to develop adaptive strategies.[5] Ethical reasoning must underlie these strategies to enable managers to analyse who is affected by the decisions, how they are affected and what human rights the parties have. The new management paradigm thus means that, justice, equity and social welfare are also the business of businesses (Stead et al. 1992).

Good management is applied both at the strategic level and at the operating level. Corporate responsibility means going beyond legal and contractual prescriptions ("Social obligations" in Sethi's terminology) and attempting to conform to

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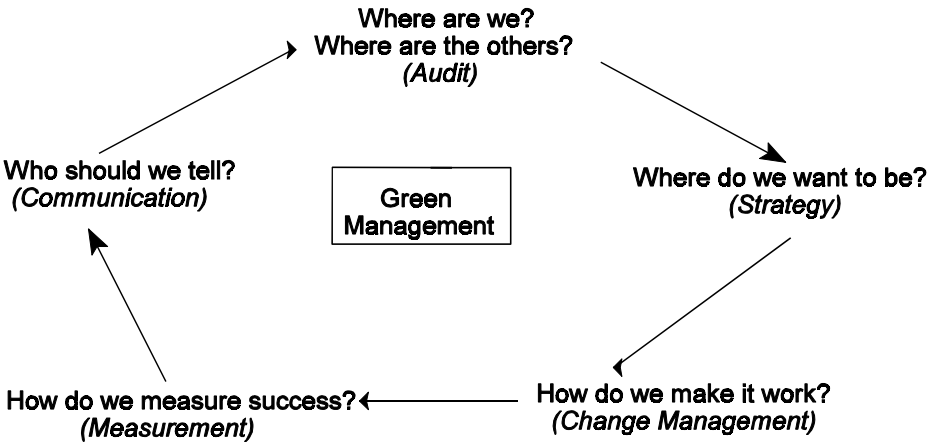
[5] A comment in a recent article of the Globe and Mail to the effect that firing part of the work force invalidates these multiple goals is inappropriate (Corcoran, 1996). Having to fire part of the work force simply reflects the fact that profits are still the bottom line and that there is a threshold under which profits are not allowed to fall.

the current demands of society ("Corporate responsibility" in Sethi's terminology) (Smith, 1993). As Sethi puts it, good management means "bringing corporate behavior up to a level which is congruent with the prevailing social norms, values, and expectations of performance... While the concept of social obligation is proscriptive in nature, the concept of social responsibility is prescriptive in nature."(Sethi, 1975; Smith, 1993) The ultimate stage of corporate responsibility, according to Sethi, is "Social Responsiveness" which means "not how corporations should respond to social pressures, but what should be their long-run role in a dynamic social system." Taking this into consideration, a first objective of the new management is to identify the stakeholders (IISD, 1992). The adoption of codes of conduct containing environmental provisions will aid in the establishment of a corporate culture that is environmentally responsible (Singh et al.1996).

Management must decide upon the degree to which it discloses the polluting activities of its firm to its stakeholders. Often firms do not know the harm these products are causing. Greater disclosure insures greater acceptability by the public and better monitoring. People want to be protected against harm and, therefore, want information to be openly available to individuals they trust (experts, government, physicians). The sheer amount of data required to be released by law seldom prompts citizens to act recklessly. It often results in more exchanges among the various divisions within the firm and makes firms aware of problems. These data may be used to assess a company's environmental health. This in turn can be useful for insurance purposes and for dealings with lenders (Kleiner, 1991).

The new attitude of business towards the environment is depicted in Taylor's green management wheel (Tyteca, 1996) as shown below:



The green management wheel (Taylor 1992)

5.2.2.2 Pressures from the Work Force

Employees generally live near their plant and are part of the community. They do not want to associate with a firm that has a poor image in the community. Many employees today are young people who want the corporate world to change according to community values. Employees might also suggest solutions to environmental problems.

5.2.2.3 Fear of Costly and Untimely Regulation

Companies know that environmental costs increase with regulation and especially with its unpredictability. Companies adopt voluntary environmental measures to benefit from flexibility and proper timing; however, they do this under the threat of regulation. If they feel that regulation is able to be implemented, they will not adopt environmental measures voluntarily. Though management culture is an important factor in promoting environmental policies, the ultimate purpose of a

corporation is profit-making; management must report to the shareholders. Environmental regulations are still needed because firms are profit-driven and therefore cannot respond to moral obligations as individuals can. It is, therefore, a mistake for a government to rely exclusively on voluntary measures to implement SD.

5.2.2.4 Cost Savings

Companies are discovering that reducing material and energy intake, increasing energy efficiency and decreasing waste all saves money. With the increase especially in the real cost of waste disposal these savings are significant. Firms are realizing that retrofitting is a more expensive way to fulfill government regulations than meeting environmental concerns at the initial investment stage of a business (North, 1992). Given the uncertainties that surround environmental regulations and their fragmentation, running a polluting business could actually be more expensive than running a clean one. A forestry company will soon realize that cutting more trees for short-run profit may mean long-run disaster because it may run out of trees. SD is often similar for the forestry company, or to lengthening one's decision horizon and, therefore, to investing in natural capital. Electric utilities invest in energy conservation rather than in new nuclear plants because it is cheaper. They do this independently of the green public's reaction against nuclear energy.

Greater ecological X-efficiency; i.e. greater attention to optimization, also reduces costs and wastes. An example is the application of pesticides only when required, which apparently increases farm productivity. Often firms within a same industry exhibit a wide variance in environmental efficiencies. This may be due to the low level of compliance owing to low penalties for non-compliance. In contrast, it could also be owing to over-compliance to take advantage of an opportunity, or to anticipate a change in legislation. Or it could be a reaction to consumers' pressures.

In fact, clean technology is not becoming common practice. A 1987 OECD survey found that clean-technology projects accounted for no more than 20% of all industrial investments in environmental protection. Industry has preferred conventional add-on (end of the pipe) technology to installing entirely new production equipment. Add-on equipment tends to cost less up front even if process changes save money in the long run. Add-ons are readily available and come up with service contracts that distributors prefer. Add-on equipment is often widely accepted and proven so officials accept them as a token of strong intentions to comply with regulations. Add-ons do not affect production much and can fail without disrupting the latter while faulty process equipment can slow or shut down an entire production line. Few firms have experience with clean technologies (Geiser, 1991).

5.2.2.5 New Market Opportunities

Although a profitable recycling business needs a low collection cost and a large final demand, it has become a multibillion dollar business with high growth rates. Providers of clean process technology and environmental consultant are all capitalizing on environmental opportunities. Advertising companies, auditors and lawyers have entered into the environmental field. Prospects for new products such as waste management, phosphate-free detergents, ozone non-depleting aerosol chemicals and green investment funds are opening up. Market opportunities are both internal and external to the firm. Opportunities have to be recognized as such and picked up by the firm.

5.2.2.6 Competitive Strategies

Competitive strategies are means by which companies attempt to gain market-place advantages over their rivals. Porter identified three generic competitive strategies. These are least-cost, differentiation, and niche strategies (Porter, 1980). The least-cost strategy works best when demand for standard products is large. The differentiation strategy involves

producing a range of well-differentiated products that meet the needs of customers' segments. These products have unique features and are difficult to imitate. This strategy enables a company to lock in clients and charge a higher price than is the case with the least-cost strategy. The niche strategy focuses on a narrowly defined segment of the market and fulfills the needs of special customers in that niche. Usually this means producing highly specialized products and marketing them through limited focus delivery systems. The total demand for the product might be low yet it is constant. Niche firms possess specialized knowledge about customers, and distribution and production systems that give them long-run competitive advantages (Shrivastava, 1995a).

Creating a sustainable least-cost strategy involves standardizing environmental product designs. Production systems are designed as closed-loop systems; they emphasize energy and resource conservation and use of clean technologies. Because of the large production volume, even a small per unit reduction of resources and energy can result in significant overall savings. Owing to the ecologically friendly standardized product designs, it is sufficient to provide employment with only basic training on safety, health and environmental issues. Customers simply receive accurate product labels. Environmental impact assessment and emergency planning is essential given the large scale of the systems. To squeeze ecological efficiencies, it is essential to build partnerships with both subcontractors and suppliers and to encourage them to reduce packaging, waste and costs. Standardized mass-production technologies can be transferred inexpensively and with limited competitive risks through licensing.

Sustainable differentiation strategies focus on environmental product features and packaging to create differentiation. Ecologically friendly packaging is a source of competitive advantage particularly for products that need a large amount of packaging. Manufacturing plants are of moderate size; improving operation simply through

environmental and safety regulations may therefore suffice to make manufacturing ecologically sound. The differentiated nature of the products requires that employees and customers receive specialized training on safety, health, and environmental issues. Such a strategy further requires specialized energy plans. Management of the numerous vendors involved in this strategy is important; through creative partnerships with vendors, it is possible to reduce packaging, waste, transportation costs and the duplication of material. Although the transfer of environmentally sound technologies is desirable, it is expensive and comptetively risky as a strategy.

The sustainable niche strategy seeks ecologically friendly product niches. Customers who use this strategy are usually very knowledgeable. Ecologically friendly product niches can be an added source of health, safety and environmental information. The right choice of niche minimizes precautionary measures. However, there is a need to protect safety, health and environmental programs from cost-cutting measures. Specialized technologies are the key resource and often pose distinctive environmental and health hazards. Transferring such technologies is very expensive and risky.

These ecologically oriented strategies allow companies to gain first advantage into environmentally sensitive market segments and inimitable production advantages. However, in order to gain these benefits, companies must establish compatible organizational structures, systems, and operating sizes. Organizational structures must be such that the free flow of ecologically relevant information exists within organizations. and between organizations, their vendors and their customers. This facilitates cooperation. Organizational systems must be designed to accept, process, and integrate ecological signals from the external environment. The size of the operation must be determined in correlation to its ecological impact. Very large-scale operations may irreversibly overwhelm bioregional ecosystems. This problem might call for designing operations in the form of smaller, decentralized modules (Shrivastava, 1995a).

5.2.2.7 Total Quality Environmental Management

Firms must take a hard look at the products they bring to the market, how they are produced, with what inputs and how they are packaged. Firms must apply Total Quality Environmental Management (TQEM) to their activities in order to ensure clean manufacturing processes that eliminate pollution completely at the source rather than at the end of the pipe. TQEM allows firms to deal with environmental problems from a total systems perspective. Just as Total Quality Management demands improvement in the design and production process at each stage, a TQEM perspective seeks to optimize the ecological performance of the entire corporate system. It uses life-cycle analysis as a holistic approach to understanding the linkages between an organization and its natural environment (Kleiner, 1991; Shrivastava, 1995a). This understanding prevents a shifting of ecological costs from one medium to another or from one stage to another stage. This is accomplished by extending the system boundaries to include all aspects of product development, production, use and retirement. In this context, achieving zero discharge is no more ludicrous than achieving 100% quality (i.e. quality so high that all need for inspection is eliminated). In quality control, one wants to eliminate dependence on end of the line inspection; in pollution control, one wants to eliminate end of the pipe dependence. “Garbage barges and toxic trains...are the environmental equivalent of production-distribution breakdowns.” (Kleiner 1991) Fewer materials and energy are used in processes and what was previously waste is now sold.

The International Standard Organization created a management system for Total Quality Management called ISO 9000. It is now in the process of producing a compatible management system for TQEM called ISO 14001 (ANSI 1996). This encompasses a five-stage approach: policy, planning, implementation, checking and corrective action, and management review (Kirpatrick et al. 1996).

Employees' involvement in TQEM is as essential as it is in quality control. As in quality control, the first 25% of progress is easily reachable through reorganization and the adoption of simple technologies; the next 25% are a lot more difficult to achieve.

On the input side, TQEM encourages energy and natural resource conservation and the substitution to renewable resources by reducing virgin materials and energy intake through product redesign. This makes greater use of renewable resources; it also requires developing ecologically sensitive purchasing policies and inventory management systems, designing closed-loop materials and energy production and recycling systems, leading to high energy efficiency. It seeks to eliminate effluents, emissions and accidents. Just as a zero-defect goal for quality control demands preventive action and continuous improvement at every step of the production process, a zero-discharge goal and a zero-risk goal can direct a company's efforts toward the virtual elimination of waste. Products that lack durability and are difficult to repair and recycle place a greater demand on natural resources and create unnecessary waste and disposal costs. TQEM aims at minimizing the life-cycle costs and improving the quality of products. Improved quality product design and packaging is a competitive advantage.

Green consumers know what products harm the environment and fully expect firms to develop alternative products that are less harmful. However, alternative products are not always friendlier to the environment. One example of this is McDonald's shift under public pressure from styrene to paper in its packaging; however, it seems that styrene may actually be less harmful to the environment than heat-preserving paper. So firms should not respond to consumer pressures only. This is why life-cycle accounting of environmental effects should be carried out. Life-cycle accounting attaches costs to all potential environmental effects of a product. The greenness of a company results from its willingness to experiment continuously with the various life

cycles of its products. For example, the shift by McDonald's from styrene to paper applies to only 20% of its wastes.

5.2.2.8 Green Reputation

Companies with a polluter image, such as chemical companies, are more likely to become green (North, 1992).

Green reputation is about retaining or improving one's public image. It is achieved by demonstrating to the outside world, including clients, investors, community and government that one takes environmental issues seriously and that one practices environmental protection successfully. This may make pollution prevention pay off. A firm's internal demonstration of environmental commitment to employees is equally as important as building a positive company image to the outside world. The adoption of a master code is one way of enhancing a green reputation. Another is to make one's own SD statement. These should encompass all aspects of the company's operations. The appointment of an environmental coordinator who reports to senior management is another positive step. Top management is the ambassador of the company to industry and government while employees are the ambassadors to the community. A green reputation is further advanced through publishing environmental audits along with financial audits and annual reports. A charismatic leader can also foster a green reputation. Well-publicized monitoring and public participation programs and green recruitment policies contribute as well. Firms know that by being proactive, they can avoid suits and regulatory pressure. Such action could also be a ploy to deflect adverse publicity in one area of poor compliance and focus the public eye on other environmental pledges (Cairncross, 1995). Green reputation embraces both internal and external factors to the firm.

5.2.2.9 Porter Hypothesis

The Porter hypothesis maintains that environmental standards act as a catalytic constraint on firms, projecting them into more competitiveness. This is like trying to use one instrument (environmental innovation) to aim at two targets — a better environment and a better economy. It is also an example of a win-win solution. It applies to firms as it does to nations. It is not obvious that this hypothesis is universally true because standards are not without cost (Palmer et al. 1995). If it were true, why should it be limited to the environmental area (Cairncross, 1995)? The empirical evidence in favour of the Porter hypothesis or its converse, that environmental standards decrease competitiveness, is weak as indicated earlier (see section 2.1).

One should not underestimate the cost of environmental compliance by highly polluting industries. Major polluters such as pulp and paper, food processing, iron and steel production, aluminium, chemicals, cement manufacturing and electricity generation face costly retrofitting that may fall between 5 and 15 % of new capital expenditures. Here, the Porter hypothesis demonstrates its internal and external aspects.

5.2.2.10 Rent Seeking

Rent seeking also plays a role in encouraging companies to adopt SD measures. First, a cleaner environment benefits companies through external economies that are not limited to an industry. Second, tighter regulations may benefit the company which produces a substitute to the product being regulated or the company which directly benefits from the regulated product (e.g. catalytic converter). Third, regulation benefits companies that have invested in meeting tougher standards. Invariably, the customers end up paying for rent seeking.

5.2.2.11 Existence of Win-Win Solutions

Selling consulting on integrated pest management could be a substitute for selling pesticides. The recycling of one ton of aluminum saves 4 tons of bauxite and .7 tons of petroleum coke on top of the enormous saving in electric energy and the reduction of aluminum fluoride emissions by .035 tons. These are examples of win-win solutions. While they do exist, they are increasingly more difficult to find. There are decreasing returns for win-win solutions. This is explained by the fact that in a world of rational expectations, if the opportunities had been there in the first place, they would already have been exploited (Cairncross, 1995).

A green strategy for voluntary measures has also been put forward: First, it calls for compliance with legal obligations; second, it proposes to adopt green measures that are beneficial for the company (green products, etc,); third, it aims at adopting measures that are revenue-neutral; finally, it proposes adopting costly measures to the extent that they are consensual and have a short-run propaganda effect (using only recycled paper even if it is more expensive than regular paper) (North, 1992). Firms want to be perceived as good corporate citizens as well as profit makers. Environmental costs will be passed to the customers in any case according to the standard principles of microeconomics (Banks, 1992).

5.3 Measures

Five environmental performance criteria for firms have been suggested in existing literature. They are: cost control, TQEM, investors, community and industrial leadership. Ideally, one should be able to measure Taylor’s great management wheel (see graph p. 38).

Several firms use environmental performance indicators that are specific to the company’s objectives and are seldom disclosed. They are constructed without concern for

comparisons between firms and over time (Shell Canada Ltd, 1995; Tyteca, 1996).

ISO 14001 specifies that indicators should be objective, verifiable and reproducible (art. 4.4.2, ANSI 1996). It also gives the following examples of indicators: (art. 4.2.5): quantity of raw material and energy used, emissions such as CO_2, waste produced per unit of finished product, efficiency of material and energy used, number of environmental incidents, percentage of waste recycled, percentage of waste used in packaging, number of vehicle km. per unit of production, specific pollutant quantities, investment in environmental protection, number of prosecutions, and land area set aside for wildlife habitat.

One measure worth noting is the SNA practice. It uses the value added by the firm, subtracts the value of the damages caused to the environment by the firm and adds the value of the pollution abatement investment.

Another measure is Total Cost Assessment. This is a project analysis system that helps a business measure more accurately the return on its environmental investments using benefit-cost analysis. It includes factors such as avoided liability, reduced staff time for monitoring and paper work, and image enhancement.

Another tool is to calculate the ratio of the sum of actual emissions to the sum of the standards (Tyteca, 1996). Yet another measure is to compute the pollutant risk. This measure equals the weighted sum of pollutants where the weights are the toxicity weight of the pollutant. The pollution intensity index is then the pollutant risk divided by total manufacturing activity. The overall pollution index is computed by calculating the ratio of various pollutants to their maximum value in the sample and summing them.

“The key problem of environmental performance is converting large amounts of data into managerial, useful

information via approppriate metrics." (James cited in Tyteca 1996)

Another problem is not to confuse quantitative inefficiency with price-related inefficiencies.

5.3.1 Environmental Performance Indicators Based on the Theory of Productive Efficiency at the Industrial Level

These experimental indicators are used to compare the performance of various plants in a firm, various firms in an industry and various industries against each other. They have not been tested empirically.

Pollutants are considered as peculiar outputs that one wants to minimize. Parametric approaches include productivity indexes derived from multilateral productivity indicators using either exogenous shadow prices or endogenous ones. Non-parametric approaches include Data Envelopment Analysis (DEA), which is essentially a linear programming approach, and its extension (which does not require a convexity assumption), the Free Disposal Hull approach (FDH). They both enable one to derive an ideal frontier for environmental performance (Tyteca, 1996).

5.3.2 Environmental or Sustainability Reports or Audits

Companies have developed environmental audits to measure their impact on the environment. When they want to communicate their results to the world they use an environmental or sustainability report. It is worth pointing out that an environmental audit measures only environmental sustainability. The environmental audit and the sustainability report provide information on SD corporate policy and yield a baseline against which to measure performance. Environmentalists hope that investors will use these reports to funnel cash into green companies.

Originally, the environmental audit was developed in the U.S. to help companies comply with complex environmental legislations. Environmental auditors checked compliance and newly acquired sites to make sure that they did not contain surprise liabilities. Companies had to report their most toxic emissions for about 300 pollutants and their potential environmental liabilities to the Securities and Exchange Commission usually for clean-up of contaminated land. As a consequence, they attached an environmental statement to their financial statement. In Europe, environmental auditing is not a universal requirement, although change is imminent, and environmental auditing has focused instead on environmental friendliness of production processes and on where companies acquire their raw materials.

Since there are no rules for environmental reporting, there is a great diversity in report formats. Many groups publish quantitative data but almost none publish the reliability of these data. A systematic survey of corporate reports should be undertaken in order to develop a desirable format. Sometimes, these reports are verified by outside consultants and even environmental organizations; however, the verification process is seldom rigorous. It is estimated that perhaps 5% of the data are based on continuous measurement and about 30% on frequent measurements. Most of the other data may be based on single reading (Cairncross, 1995; Owen, 1993).

There are roughly two models of environmental corporate reporting. An Anglo-American model that tabulates pollutants to air, water and soil from individual plants and lists the extent to which they have increased or decreased against a specific baseline period. In each case, the name of a contact person is given. A variant adopted by some chemical companies is to assess performance against “responsible care.” It gives details of pollution prevention and safety and targets for future improvement. Another more German-European model is the “ecobalance” report, which is based on the thermodynamic law of mass balance. It computes the difference between the mass of the inputs measured in physical units and the mass of the

outputs again measured in physical units. This approach does not measure compliance with regulations.

There are few companies that have attempted to assess the cost of environmental damage. As in National Accounting, a large degree of arbitrariness affects the estimation of these figures. For example, one company uses a very sensible economic procedure: it estimates damage by the marginal cost of abatement required to bring marginal pollution cost to par with the marginal benefit of doing so. Different pollutants require different rules; for example, the cost of treating wastewater is evaluated on the basis of turning it into drinking water. From this evaluation, the company subtracts environmental expenditures (taxes, etc.). The net value added then becomes the gross value added minus net environmental damage. The ultimate purpose of costing environmental damage is to evaluate the burden that a product puts on the ecosystem throughout its life cycle. Using this "extracted value," the government could levy an "extracted-value" tax to help restore the environment.

Many companies have found that the main audience for their environmental reports is their own employees. Customers were found to be more important than shareholders. The media are also important. Shareholders' relative lack of interest is owing to the fact that environmental reports do not link environmental performance to such financial performance indicators as the following: likely environmental liabilities, percentage of capital expenditures possibly required to meet environmental goals or future regulations, and the efficiency of meeting environmental standards.

The standardization of reports will be difficult given the different circumstances of various industries.

Environmental reporting will not by itself be sufficient to induce firms to behave in an environmentally friendly fashion. They can still conceal too much. They will never be substitutes for penalties for violating environmental standards.

A fundamental challenge is how to expand accounting for financial information to include environmental and social information. How does one integrate externalities in the accounting exercise of a firm? How does one expand financial accounting? Does the financial community's concern go beyond matters that directly affect financial returns? Accounting and reporting cannot be done in isolation. Organisational change is necessary to enable and/or encourage both the internal information and reporting systems to be developed and used; at the same time, institutional, regulatory and market changes are necessary to encourage organisations to report, and financial participants to respond positively.

The company can be audited against its own code of conduct. Accounting and monitoring for energy, waste and emissions can be developed. Environmental costs can be tallied separately. Environmental considerations can be included in investment and project choice. Wider environmental interactions can also be reported.

Reporting for sustainability must take into account the fact that corporations are not able to know the ultimate sustainability impact of their actions. Sustainable choices must be made by society as a whole and not by management or financial participants alone. Therefore, reporting for sustainability involves transparency and accountability.

The Inventory Approach to reporting is concerned with identifying, recording, monitoring and then reporting, probably in non-financial quantities, the different categories of natural capital and their depletion and/or enhancement.

The Sustainable Cost Approach to reporting is appropriate for a sustainable organisation, which is defined as an organisation that leaves the biosphere no worse off at the end of the accounting period than it was at the beginning. If this is not the case, the organisation will incur a notional cost equivalent to the restoration cost and this notional cost should

be subtracted from profits. Any use of critical capital must be included at infinite cost.

The Resource Flow/Input-Output Approach is aimed at reporting the resource flows of the organisation and its leakages in terms of wastes. This might be done both in physical units and in monetary units. It does not give a direct report on sustainability. Given the amount of detailed information that such a report contains, the company might want to keep the report confidential.

5.3.3. Green Accounting

The Canadian Institute of Chartered Accountants requires all Canadian financial statements to include an explicit estimate of the cost for future waste removal and site restoration (Conklin et al. 1991). Environmental expenditures should be seen as investments and must be capitalized by the firm.

5.4. Is the Need for Government Regulation Changing?

Though politics is no longer limited to the state and though we have to learn to operate politically in a multiplicity of political spaces with different time horizons, the state is still a protected space in which we can live and hold rights to services (Magnusson, 1992). States are still trustees for future generations. State policy is formulated in the political arena. Because of bounded rationality, governments should create incentives for sustainability through economic instruments and economic policy. The market and voluntary business initiatives will never be a substitute for the trusteeship role of governments. However, a cooperative approach appealing to the “social responsiveness” (Sethi) of consumers and producers combined with an adequate system of economic incentives will go a long way towards implementation of sustainable development. Given the large uncertainties surrounding our understanding of ecosystems (witness climate change) and a wide spectrum of ethical values pertaining to the environment, public policy towards SD should be directed

toward implementing social learning. That is, adaptive management should be combined with the political process. Adaptive management consists of using policy as a learning tool about managing the environment, and integrating monitoring into policy (Lee, 1993). Adaptive management is one way to cope with uncertainty, irreversibilities and to implement the precautionary principle. The political process is left to resolve value conflicts and take collective decisions regarding the remaining uncertainties.

CONCLUSIONS

Sustainable Development makes intuitive sense much like the Conservation Movement made intuitive sense almost a century ago. There is now an economic theory of conservation; there is yet to be an economic theory of SD. By definition, SD goes beyond economics and economic sustainability (full-cost pricing and constant value of capital stock). However, an economic sustainable subsystem must make sense to an economist even as an open subsystem. SD is first and foremost a “Projet de Société,” a political ideology. Critical natural capital is one of the constraints in the economic subsystem. Sustainable development is inherently a second-best theory with the standard policy implications. Either the economy is sustainable or it is not; there is no middle ground. There is no economy that is more sustainable than another one and there is no Pareto-improving path towards sustainability. Intergenerational Sustainable Welfare Functions such as the one that leads to the green golden rule and includes sustainability as a property rather than a constraint are still fraught with philosophical difficulties (Toman et al. 1995; Pezzey, 1996).

Consumerism is not identical to welfare; growth is not identical to development. In a world of extreme income inequalities, there is no way citizens of poor countries can enjoy a sustainable livelihood without increased income per capita; that is to say, without growth. The positive correlation between development (as measured by the Human Development Index) and income per capita is very high. Growth is compatible with dematerialization of the economy.

Economic history is the history of substitution among factors of production. The substitution of physical capital and human capital for natural capital and natural capital-saving technological progress (i.e. weak sustainability except for critical natural capital), will continue to govern capital conservation and thus intergenerational equity.

The definition of development, including its ethical, psychological and sociological amenities is necessarily political. It may also differ from culture to culture, from country to country, and from region to region.

If one believes current international rhetoric, SD is already on its way out even though it makes “intuitive sense.” It is now replaced by “sustainable social growth” for which the limiting factor is no longer the environment but the “global commons of knowledge.” Human and social capital and the elimination of poverty have now become the social infrastructure. Results are now assessed in terms of the “quality” of this infrastructure. The 'gospel’ of efficiency has indeed overtaken the moral doctrine (Crabbé, 1996).

SD, like conservation, if it survives at all, may end up becoming a very pragmatic term. Key factors would include more value assigned to unpriced environmental capital and its services in decision-making, more corporate responsibility, more international agreements about the global commons and generally more integration of the environment with economic decisions. Environmental constraints are neither panaceas nor major stumbling blocks on the road to sustainability. Full-cost pricing renders natural capital more expensive even if there are productivity gains to be reaped (substitution effect) through increased efficiency; the question is then whether the scale effect of full-cost pricing will dominate the substitution effect (Crabbé et al. 1996). Environmental economics and SD can go hand in hand towards implementing economic and environmental sustainability. However, social and cultural sustainability and equity are much more oriented toward political objectives than is the case with environmental economics. Concrete steps in the direction of the former objectives have hardly been taken (Lonergan et al. 1996).

SD emphasizes the decentralization of decisions and also a cooperative approach. To be effective, it must adopt social learning as a policy tool. Educating the public in order to change the current culture or mindset from domination of the

environment, to considering its responsibility of stewardship is a necessary complement to social learning through the political process. Though all of natural capital may not be the limiting factor of an economy, some of it will always be essential and critical about SD no matter how we define development.

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