

INTRODUCTION TO SUSTAINABLE DEVELOPMENT

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Summary

The concept of sustainable development arises from a worldview which sees the survival, progress, and continued maintenance of the human community as dependent on the continued health and viability of the earth's life support systems. Sustainable development implies processes of fundamental change in our social system and institutions. The thrust of this change relates to addressing the challenges embedded in the new global awareness that the earth is finite, and all of the planet's life support systems – including social and economic systems – are globally interconnected and interdependent.

The awareness of unsustainability has earlier been articulated from the perspectives of population growth outstripping resources, or ecological crisis that is caused by the destruction of the life support systems. In the years leading up to the 1987 report of the World Commission on Environment and Development (the Brundtland Commission), contributions to the understanding of sustainability focused on the concept of carrying capacity, planning and intervention in unsustainable practices, as well as the need for improvement in resource efficiency.

When the Brundtland Commission published *Our Common Future*, it ignited worldwide attention to the concept of sustainable development. The Brundtland report defined sustainable development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” The report adopted the perspective that economic inequities will lead to over-exploitation of resources, and economic growth is needed in the poorer countries in order to satisfy basic human needs, but that this development must follow a “new pathway” that does not entail environmental destruction. It also noted that meaningful political participation is needed to ensure that the fruits of economic growth are equitably distributed. The Brundtland report proposed a number of new ways for achieving sustainable development. It also led to the 1992 United Nations Conference on Environment and Development (UNCED) (commonly called the Earth Summit) held in Rio de Janeiro. The fruits of the Conference included *Agenda 21*, the *Rio Declaration*, the *United Nations Framework Convention on Climate Change*, the *United Nations Convention on Biological Diversity*, and the *Statement of Principles for the Sustainable Management of Forests*, all of which were adopted by the 178 governments that attended the Conference.

Agenda 21, the action plan for sustainable development, provides a comprehensive approach to address the pressing environment and development problems of the day, and to prepare the world for the long-term challenges of sustainability in the twenty-first century. It embodies a dynamic program, which considers various aspects of sustainable development, including social, economic, environmental, scientific, educational, and management dimensions. The Rio Declaration presented a set of basic sustainability values and principles “The rights of the environment to protection,” and the need to exercise “the precautionary principle” in decisions that impact upon the environment are among the fundamental tenets.

The Commission on Sustainable Development (CSD) was created in December 1992 to oversee, promote and support the implementation of *Agenda 21*.

The idea of sustainable development has different implications for different decision-makers. For government, a shift in focus from government to governance is anticipated. Increasingly, national governments must form partnerships with other levels of government, with the private sector, and with civil society organizations (e.g. NGOs). Governments at all levels must also develop the capacity to make systems-based, prospective decisions that connect social, economic and environmental aspects. This in turn will require a vast improvement in “horizontal” decision making that breaks down the “silos, stovepipes and solitudes” (Ann Dale’s phrase) that characterize most large government bureaucracies. Government must play a strategic role in stimulating and facilitating changes within government and in all sectors of society, contributing to the building of a strong capacity for innovation that supports sustainability, thus maintaining its vital “steering” function. For business and industry, a new form of capitalism that accepts the significance of protecting and where possible enhancing the life support systems must be adopted. The new practice will include transforming production practices, designing for long-term usage of products, and reducing impact of the transportation of goods and material, as well as shifting emphasis to services and their flow, and ensuring full producer responsibility for all products.

For farming and agriculture, the main objective is to increase food production in a sustainable way and to enhance food security, particularly for the 815 million people who are currently undernourished. Sustainable agricultural practices must be developed with an appreciation of the rising trend in global consumption, and a potential downward trend for arable land availability and soil productivity. It must begin with a better understanding of the overall global land resources, and accordingly devise a strategy that is both sympathetic to the needs of the local community as well as to a bioregional perspective. For civil society, NGOs and individuals, sustainable development implies the creation of a political space in which the public interest of individuals and groups can be expressed and help influence matters that affect the public. Education for Sustainable Development (ESD) at all levels is an important instrument for cultivating a vigilant citizenry. Public awareness is a precondition for citizens to better exercise their freedom of choice. Broad public participation in decision-making and the availability of good information about the environment and society are key prerequisites of successful implementation of sustainable development. In recognition of the fundamental importance of education, the UN declared 2005 – 2014 as the Decade for Education for Sustainable Development (UNDESD).

Technology has given us many tools to observe, monitor, and assess the physical, chemical, and biological aspects of change in the natural environment, and has helped us to learn about the various levels of impact that human activities have on the environment. Our new knowledge of the global system is a product of advances in global observation technologies and integrated research design. New methodologies of assessment and evaluation of progress towards sustainability have also been adopted by the social sciences and applied to measure societal development. Significant progress has been made in the development of performance indicators in the social, natural, economic, and institutional domains.

A long term monitoring program to collect data on key aspects of global ecology and the human community will provide multidisciplinary insights about the world. Reporting is now used as a monitoring and communication tool required by all sectors of society. New information technologies (IT) have created unprecedented opportunities for sharing and exchanging information. However, a wide “implementation gap” still remains between diagnosis and solutions. A lack of financial support to back the commitments made at the Earth Summit, and lack of political will are among the factors blamed for the slow progress toward meeting *Agenda 21* objectives.

It is clear that the private sector, which generates most of the world’s wealth, has a key role in sustainable development. The United Nations has introduced strategically the Global Compact to engage the private sector. Our greatest challenge lies in the formulation of a joint learning, co-evolving process, which is conducive to finding solutions to problems that are intrinsic in the human system. We need the integration of both the sciences and the arts to inspire, motivate and advance the human quest for survival. Ultimately sustainability offers society the challenge and the opportunity of making wise choices that will lead to a brighter future for humankind and the planet.

1. What is Sustainable Development?

The concept of sustainable development arises from a new worldview, which sees the survival, continued progress, and maintenance of the human community as dependent on the continued health and viability of the earth's life support systems. The term "sustainability" derives from the Latin root *sus-tinere*, which means to "under-hold" or hold up from underneath, implying robustness and durability over time. Accordingly, sustainability depicts a paradigm that seeks to protect the planet's life support systems to ensure longevity for humans and other species.

Sustainable development can be defined as the process of strategic changes in our social systems and institutions needed in order to achieve sustainability. The term "development" is criticized by some as connoting growth. Unfettered growth of the "ecological footprint" of the human population, defined as the portion of the biosphere used to support human production, consumption and waste, is, of course, ultimately not sustainable. Others interpret "development" to mean progress in social well-being or improvement in the quality of life. Sustainable development is, therefore, a contentious and thought provoking concept (see "Sustainability in international law"). To respond to the challenge of finding ways in which all members of the human family can live satisfying lives within the means of nature (William Rees's definition), would require collaborative efforts from a multiplicity of talents: thinkers about society, scientists and practitioners, business leaders, farmers, governments, and citizens.

The fundamental premise that underpins the concept of sustainable development is that the peoples of the world depend for their survival on an ecological system that is both global and finite. Therefore, observing nature's limits is important in order to prevent an irreversible depletion of the life support systems. Until recently, the concept of the earth as a finite system was not easy to understand and convey, for the earth had always seemed so vast and limitless. The advent of space travel brought a new awareness. Margaret Mead asserted that the first image of the earth as a small lonely blue ball in space, looking "vulnerable and needing protection from the ravages of the technological man" provided impetus for the environmental movement. Canadian astronaut Roberta Bondar described our planet as "a crisp, bright jewel in space." Some astronauts noted the rising smoke from the burning of the Amazon forest, and others the high-energy use portions of the earth's surface literally glowing at night. All these images have given new visual meaning to the metaphor "spaceship earth," which was coined by Kenneth Boulding in the 1950s.

The image of the earth from space provided a first glimpse of the "big picture of sustainability" because it showed the limits and vulnerability of earth's life support systems, and made clear the global environmental impacts of human activities.

David Orr's (1991) overview of the extent of environmental degradation that occurs every day on planet earth is alarming:

If today is a typical day on planet earth, humans will add 15 million tons of carbon to the atmosphere, destroy 115 square miles of tropical rain forest, create 72 square miles

of desert, eliminate between 40–100 species, erode 71 million tons of top soil, add 2,700 tons of CFCs to the stratosphere, and increase the population by 263,000.

(Orr, 1991)

In the decade since this stark assessment was published, some of the numbers had changed but the general direction had not. In its 2001 report entitled “People and Ecosystems: The Fraying Web of Life” the World Resources Institute concludes that most of the world’s ecosystems are stressed and deteriorating.

Echoing this concern William Rees (see “Carrying capacity and sustainability: waking Malthus’s ghost”) cautioned that:

At the dawn of the twenty-first century, the massive scale of human activity ensures that many environmental impacts are global in scope. Stratospheric ozone depletion now affects both the southern and northern hemispheres; atmospheric carbon-dioxide has increased by 30 percent in the industrial era and is now higher than at any time in the past 160,000 years; mean global temperature has reached a similar record high; the world seems to be plagued by increasingly variable climate and more frequent and violent extreme weather events; more atmospheric nitrogen is fixed and injected into terrestrial ecosystems by humans than by all natural terrestrial processes combined; up to one-half of the land on earth has been directly transformed by human action; more than half of the planet’s accessible fresh water is already being used by people; two-thirds of the world’s major fisheries are fully or overexploited; and biodiversity losses are accelerating.

(Rees, 2002)

The global environmental problematique underscores the need for a new approach to knowledge that will extend our capability in problem solving by examining and observing the long term and cumulative impacts of various phenomena. The challenge is complex and multifaceted. John Robinson and Jon Tinker have developed a very useful systems-based definition of sustainability as a creative, integrated response to three “imperatives;” ecological, economic, and social:

- The “ecological imperative” is to remain within planetary biophysical carrying capacity.
- The “economic imperative” is to ensure and maintain adequate material standards of living for all people.
- The “social imperative” is to provide social structures, including systems of governance, which effectively propagate and sustain the values and culture people wish to live by.

Most sustainability theorists and practitioners would expand the dimensions of the social imperative to include a fundamental commitment to both intergenerational and intragenerational equity. A sustainable world must provide for the basic needs of all people living today (“intragenerational equity”) without precluding the ability of future generations to meet their needs (“intergenerational equity”).

The technological ability to view the earth from space has liberated us from the myopic tendency to treat issues, including both environmental and social ones, from a narrow, localized perspective. Pollution knows no political boundaries. And no country can insulate itself from social turmoil, whatever its origins. This is one of the indelible lessons of September 11 2001. With the present technological advancement in communications, no one can escape the shock and horror of seeing another fellow human in agony anywhere in the world. As Marshall McLuhan prophesied, micro-electronics has created a kind of global village and has made visible the human condition in every corner of the world, now more than ever. The new global awareness has exposed the urgency and the multifaceted nature of many societal issues; and at least in concept, has linked every state, every sector, every individual, now and in the future, to the same sustainability challenge and destiny. All of our life support systems – including our social and economic systems – are globally interconnected and interdependent.

Our Common Future, the seminal report of the World Commission on Environment and Development (the Brundtland Commission) provided a compelling analysis of this “new reality from which there is no escape.” In the crisis facing humanity and the planet, the World Commission saw both danger and opportunity. The danger results from carrying on as if “business as usual” were sustainable. The opportunity lies in taking advantage of improvements in science and technology that can increase our understanding of natural systems as well as our capacity to harvest the riches of nature. “We have the power to reconcile human affairs with natural laws and thrive in the process. In this our cultural and spiritual heritages can reinforce our economic interests and survival imperatives.” Thus the Brundtland Commission spoke hopefully about humanity finding a new “pathway” involving a different kind of “economic growth ... based on policies that sustain and expand the environmental resource base” while addressing “the great poverty that is deepening in much of the developing world.”

Their report maintained that the potential for global food production was 8 billion tons of grain equivalent, and estimated that given an average daily consumption of 6,000 calories, the mentioned amount could sustain a little more than 11 billion people. But if the average daily consumption level rises to 9,000 calories, only 7.5 billion people can be supported (see “Malthus’ Essay on the Principle of Population”). The present world population is already 6 billion. T. Robert Malthus (1798) maintained, under optimum conditions, the population can double every twenty-five years. Our global population is growing by 80 million per year, and the Brundtland Commission predicted that the world population will stabilize at about 10 billion around the middle of the twenty-first century.

In 2001 the UN Secretary-General’s report, showed that the world population would reach 8 billion by 2025, and 9.3 billion in 2050. This report also provided statistics indicating that although global food production has continued to expand more rapidly than population in the past decade, some agricultural practices have led to environmental deterioration. During this period, agricultural expansion continued to encroach into forests, grasslands and wetlands. The rate of deforestation for the 1990s is 14.6 million ha per year. This has been caused mainly by the expansion of agricultural practices and urbanization. It was estimated that a 17 percent increase in water supply

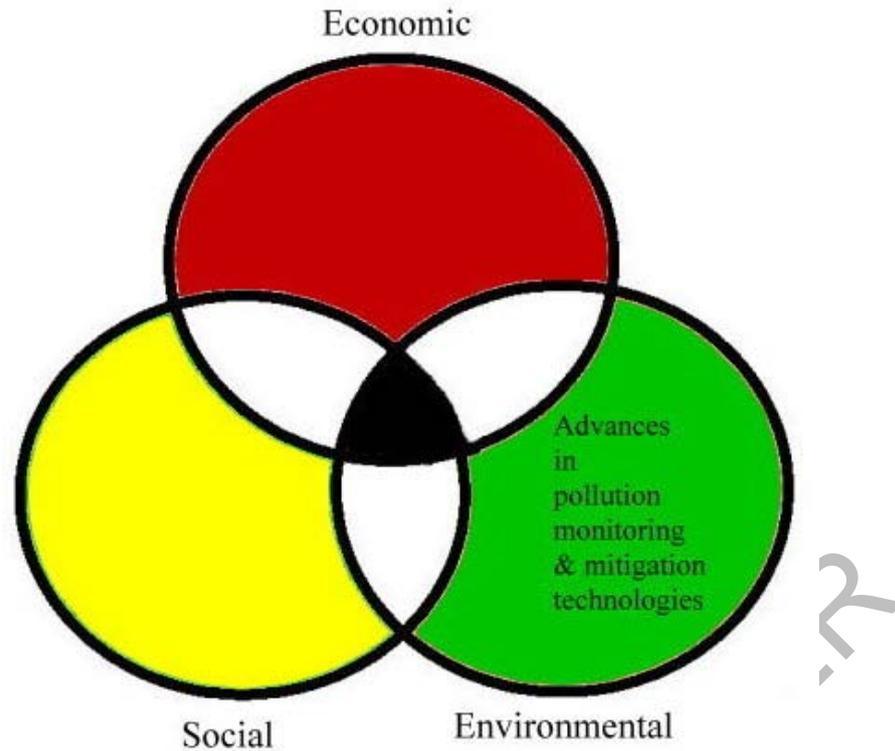
would be needed for food growing in the next twenty years, putting additional pressure on the problem of water scarcity. By 2025, two-thirds of the world's population could be living in countries with moderate or severe water stress. Currently, 815 million people in the world are undernourished. Of these, an estimated 777 million live in developing regions, 27 million in transition countries, and 11 million in industrialized countries.

Evidently, population growth coupled with an increased rate of resource consumption, and waste accumulation, will lead to environmental decay, and land, food, and water shortages. Resource amenities unevenly captured by the rich and the poor will further polarize nations and communities and create disastrous outcomes. In the decade of the 1990s, an estimated 80 percent of world population increase took place in urban centers, but the urban centers are not always healthy places. Urban centers have a sizeable underclass of people who are poor, sick, unemployed, or exploited (see "Urbanization"). Jim Wolfensohn, the former President of the World Bank called this problematic scenario of environmental degradation and growing social inequity, a "time bomb" which, if we do not take action now, "could explode in our children's faces."

The global environment is undergoing significant changes that are having profound effects on society now and for the future, including climate change, increased waste and pollution, and the depletion of natural resources. Global social problems of poverty, unemployment, disease, and violent conflict have reached staggering levels and are in many respects becoming worse.

Sustainable development is a response to the time bomb alarm. The definition of sustainable development provided by the Brundtland Commission in *Our Common Future* (1987) is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." It is about how to mobilize successfully international, national, community, and human intellectual resources in general, towards solving problems that are, overall, degrading the life support system, compromising the viability of local communities, and hurting the health and well-being of individuals. It is about creating a better alternative to the system at work, because, based on our present understanding, the business-as-usual scenario will bring great disasters to humankind, and is not sustainable.

The sustainable development premise revolutionizes the traditional view of environmental management, which sees the dynamics of society consisting of the interaction and transaction of spheres: economic, environmental, social, and so on. And accordingly, environmental management is about making advances within the environmental sector (for instance, pollution monitoring and mitigation technologies) and in areas where the environmental interest is seen as overlapping with other sectoral priorities (for example, employment in resource extraction and processing industry; new housing in suburbs). The principal disadvantages of this traditional view are that, first, environmental concerns become a tradeoff in every negotiation. The quality and the overall performance of the life support system becomes a mere afterthought. Second, it fails to acknowledge that many environmental problems are systemic, and interdependent. The clue to a solution may well lie in a fundamental change in attitudes, behaviors and world view.



■ Examples: employment priorities in the resource extraction industry; new housing needs in suburbs

Figure 1. Traditional view of environmental management

By contrast, the sustainable development perspective asserts the limits of nature. There has been considerable controversy around this issue, however. The Brundtland Commission was quick to point out that these are “not absolute limits but limitations imposed by the present state of technology and social organization on environmental resources, and by the ability of the biosphere to absorb the effects of human activities.” It went on to insist that improvements in technology and social organization could “make way for a new era of economic growth.”

Some critics contend that ultimately growth itself will become either “uneconomic” (Herman Daly’s phrase), unsustainable, or both. From this “strong sustainability” perspective, the precondition of sustainability is to protect or enhance the ecological heritage we are passing on to future generations. Proponents of a “weak sustainability” approach would argue only that the total stock of “capital” – manufactured, natural, and human – must be constant or expanding.

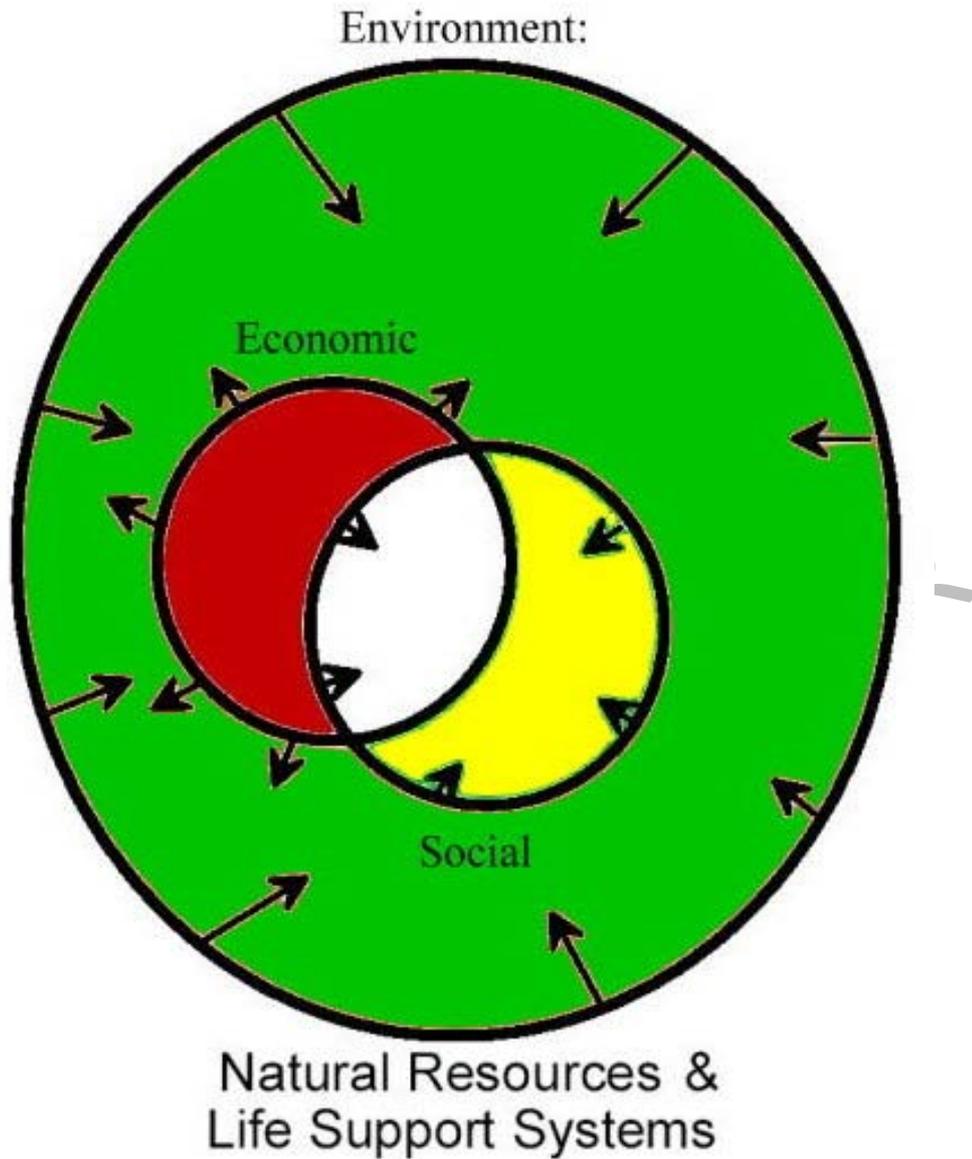


Figure 2. Present dynamics of the three spheres

This view implicitly countenances the depletion of natural capital so long as these losses are compensated by growth in manufactured capital. But as strong sustainability advocates are quick to point out, no amount of expansion in fishing boats (manufactured capital) can make up for a collapse of the fish stocks (natural capital.) Furthermore, nature provides a whole range of “natural services”; rainfall, water purification, heat, and so on that are unaccounted for on the balance sheet of modern economies and businesses. Without these natural services all human life would become hugely problematic.

Hence nature or the life support system must be seen as the outermost sphere because the life support system nurtures and sustains human lives. The preservation of the character of the life support system is important because, if it is drastically altered, it may cease to support the functioning of the human and other forms of life, putting

humankind in serious jeopardy, its very survival at stake. Also, ideally, the alignment of the environmental, social, and economic spheres are concentrically descending (see Figure 3). This recognizes that crucial aspects of social activities devoted to non-economic interests, such as voluntarism, and environmental stewardship are important for the nurturing of future generations (see “Egalitarian perspectives on sustainability”). From this perspective the entire economy serves the well-being of the social sphere, within the limits of nature.

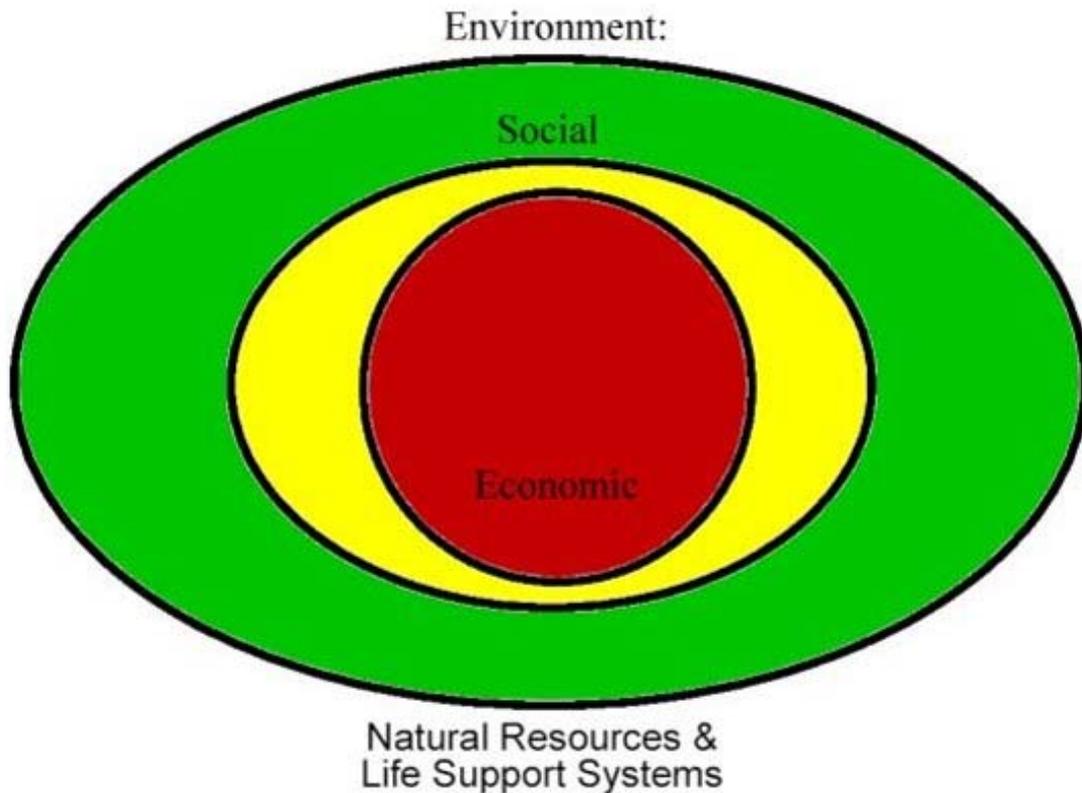


Figure 3. Sustainable Development

In designing a mechanism for stimulating changes in the direction of sustainable development, one must identify the shortcomings of the existing system and learn from experience. The institutions that create wealth in the new economy are changing from being resource based to knowledge based. Technological change has encouraged a shift in manufacturing production from western industrialized nations to plants in Asia and Latin America. Work itself is being transformed, driven by rapid changes in technology, international trade, and economic restructuring. Globalization increasingly exposes all economies, but especially exporter countries, to the dynamics of world markets, with mixed results. The fiscal climate is changing as the role of business expands and that of government shrinks. Even the definition of wealth itself must be modified. Mark Anielski uses the concept of “genuine wealth” which reflects the etymological root of wealth which means literally “the condition of well-being”. Improvements in genuine wealth cannot come at the expense of the natural environment. Nor can the wealth of a society be measured appropriately using outdated concepts like GNP. The path of

sustainable development requires the use of metrics like the “genuine progress indicator” (GPI).

Advanced industrial societies’ traditional response to complexity has been to compartmentalize problems and deal with issues separately, each within its own context. Knowledge is organized in discrete disciplines within academic institutions, societal problems are divided among government departments, and skills are allocated among job classifications and professions. Elites in these societies have specialized to develop expertise, but at the cost of losing perspective on society as a whole. As a result, separate cultures have emerged. A gap has developed between people engaged in social policy and community; the science, technology, and business communities; and those involved in protecting the environment. Each of these solitudes possesses its own assumptions about society, based on different experiences, specialized languages and various interpretations about the cause and effect of common concerns.

These dichotomies become apparent in discussions about government priorities, particularly in the wealthier countries. Finance agencies talk about reducing taxes, debt, deficits, and excessive public spending. Social agencies focus on equity issues; threats to the disadvantaged, unfulfilled needs, and damage to the social infrastructure of health, welfare, and education as a result of cuts in public spending. Environmental agencies focus on issues of climate change, water and air quality, and ecosystem preservation. To all intents and purposes, these disparate groups within government and society appear to live in different worlds, and often regard their fates as independent of one another. They fail to recognize how the decisions taken in one sphere or sector will ultimately impact on all the others.

In schematic terms, the economic, social, and environmental spheres of the present time look like three spheres of varying sizes. The environmental sphere is still the largest, in which both the social and economic spheres situate and interact with each other. The economic sphere is growing in size; the social sphere and the environmental spheres are both shrinking. It may be logical to predict that the alignment of the spheres is moving towards a pattern of concentric circles: environmental, social, and economic in ascending order of size. However, this cannot be a rational prediction, because at a certain point in the transformation, when the limits of nature will be reached, the habitat of humankind will no longer be viable, the social sphere will self-destruct and the economy will grind to a halt. This is the tragedy that one must confront and attempt to avoid.

Scholars, practitioners, and politicians have blamed our present negligent attitude towards our life support system on a host of shortcomings:

- the lack of holistic thinking and practices – compartmentalization of single discipline thinking and of institutional arrangements;
- the absence of global regulatory institutions and legal arrangements;
- the absence of ongoing intergovernmental dialogue, dualism in our power structure and the neglect of feminist concerns represented in realpolitik;
- the short time frames and weak political will of elected governments;
- the lack of co-ordination among the sectors of government;
- the lack of capacity and tenacity in our administrative institutions;

- the lack of agreement amongst citizenry;
- the weakness of public will during bad economic times;
- the short-term horizons of business;
- the lapse in public spirited initiatives.

Disjointedness, and “missing links” within and between the realms of principles and practices are considered the main weaknesses in the present system.

To achieve sustainability, society needs to stop putting knowledge into separate compartments (silos or stovepipes), acting on the mistaken premise that issues can be dealt with discretely. It has to overcome the myopia of over-specialization, and look at the world as one planet, with an integrated set of systems, where “everything is connected to everything else.”

Again, in the words of the Brundtland Commission:

The earth is one but the world is not. We all depend on one biosphere for sustaining our lives. Yet each community, each country, strives for survival and prosperity with little regard for its impact on others. Some consume the Earth’s resources at a rate that would leave little for future generations. Others, many more in number, consume far too little and live with the prospect of hunger, squalor, disease, and early death.

(*Our Common Future*, 1987)

The shift of paradigm from present practices to holistic thinking and strategic actions that link immediate to long-term needs and priorities depends on the successful mobilization of community and human intellectual resources. The transformation depends on a broad base of trust and co-operation. Community solidarity rests upon some basic conditions for human dignity and social cohesion. The challenge, therefore, is to bring all sectors of society (government, business, farming and agriculture, the civil society) into some kind of a basic agreement on values and concerns; a new perspective based on a common understanding of sustainability challenges and opportunities. This will facilitate the sharing of resources that is important for the making of wise decisions by countries, communities and individuals in facing the daunting task of “bending the curve” toward sustainability.

2. When did it Emerge?

The notion of unsustainability has existed for centuries. Thomas Robert Malthus, a Cambridge trained mathematician, economist and priest, often credited as father of the concept of human carrying capacity, in his seminal work, *An Essay on the Principle of Population* (1798), wrote that “the power of population is infinitely greater than the power in the earth to produce subsistence for man.” He argued that, under optimum conditions, population increases exponentially. A population can double every twenty-five years, quadruple every fifty years, and increase by a factor of eight every seventy-five years ... whereas agricultural output increases in a linear fashion. Malthus, while recognizing that there are intervening factors (positive and preventive checks) that interfere with the geometric pattern of population growth, believed that there is a point

in time where population size will be too large to be supported by the limited availability of food (see “Malthus’s Essay on the Principle of Population”).

Paul Ehrlich’s *The Population Bomb* (1968), and *The End of Affluence* (Paul and Ann Ehrlich, 1974) brought back the debate on population expansion overshooting the carrying capacity of the planet earth, and furthered the debate in their own contemporary terms.

The idea of unsustainability as a result of pollution was raised by Rachel Carson’s 1962 publication, *Silent Spring*. This very influential book gave a sensational account of the fact that pesticides not only control pests, they also have a serious impact on the environment and human health. The publication is generally regarded as a turning point in the perception of the global system as resistant to long term damage. It sparked a whole new wave of public debate, and intellectual pursuits on nature’s despoilment. It is generally cited as the catalyst responsible for modern environmental movements.

In 1969, the moon landing and the picture of the earth taken from space definitively transformed the consciousness of earth as a finite entity. Margaret Mead observed that the photograph of the earth taken from space would become a powerful visual metaphor for the environmental protection movement. *Our Common Future* opens with the observation that “Historians may eventually find that this vision [of our planet from space] had a greater impact on thought than the Copernican revolution ... which upset the human self image by revealing that the Earth is not the center of the universe.”

Thus the awareness of unsustainability stemming from first, population growth outstripping its resource demands, and second, the ecological crisis or the destruction of the planet’s life support system, has given rise to a common aspiration for the sustainability of human civilization. This also has led to a growing understanding that:

- All elements in the ecosystem are interrelated and interdependent: population growth and the quality of life can be modified by the quality and availability of the natural resources in the life support system.
- The system is finite, there is a need for responsibly managing and justly sharing limited global resources.
- Even well-intended technological breakthroughs, which are designed to solve problems, such as pesticides, could impose undesirable effects on human and ecosystem health.

Pollution as a by-product of human activities is a global issue, and is affecting the life support system of mankind. (see “Natural resource perspectives on sustainability”)

It has also become clear that population, technology and knowledge (including knowledge formation and communication) are the three strategic areas, in which some measures of human intervention and effort may produce results. Consequently public participation or broad recruitment of partners in the effort is fundamental for success. In the early nineteen seventies, the Club of Rome used quantitative models to test and project a number of growth scenarios on a global scale. The resultant report entitled, *Limits to Growth: A Report to the Club of Rome* (1972) painted a very dark vision of the future that included population overshooting natural limits in food supply, fossil fuels

and minerals, and serious degradation of the environment with pollution. Their findings were severely criticized, and many proved to be incorrect, but their work expanded the debate and concern over earth's carrying capacity. The concept of a sustainable future was first articulated in *A Blueprint for Survival*.

The 1972 United Nations Stockholm Conference on the Human Environment marked the first occasion on which the environment was recognized as a global problem to be addressed by all nations. It was attended by some 6,000 people from 114 countries. At the Conference the Declaration of the United Nations Conference on the Human Environment was adopted, and the United Nations Environmental Programme (UNEP) was formed to provide an essential coordinating function, informing and assisting with the work of existing UN specialized agencies. UNEP has since played a major role in focusing attention on environmental issues in the international arena, and in encouraging many countries (especially in the developing world) to improve environmental governance (see "Sustainability in international law").

Another international effort in norm setting for environmental stewardship was the development of the World Conservation Strategy by hundreds of people world wide, working under the leadership of the International Union for the Conservation of Nature and Natural Resources (see "World Conservation Strategy (WCS) of the International Union for the Conservation of Nature and Natural Resources (IUCN), 1980"). The World Conservation Strategy was published in 1980. Unfortunately, it had no direct instruments or plans for promoting its recommendations. The strategy's emphases were on life supports, genetic diversity, and species and ecosystem sustainability. It has contributed significantly to the biophysical definition of sustainability and should be viewed as a stepping stone to, or a companion of, the Brundtland Commission's report, *Our Common Future* (1987), in which the term "sustainable development" was given a central focus.

In 1982, the IUCN published a comprehensive set of five broad requirements (definitions) of sustainable development:

- integration of conservation and development
- satisfaction of basic human needs
- achievement of equity and social justice
- provision for social self-determination and cultural diversity
- maintenance of ecological integrity.

Also in 1982, the independent Commission on International Development Issues under the leadership of Willy Brandt, published a report, entitled, *North-South: A Program for Survival*. The publication expressed serious concern over the worldwide deterioration of the environment:

The environment is another obvious area where there is the clearest common interest. Important harm to the environment and depletion of scarce natural resources is occurring in every region of the world, damaging soil, sea and air. The biosphere is our common heritage and must be preserved by cooperation – otherwise life itself could be threatened.

(*North–South: A Program for Survival*, 1982)

The Brandt's Commission ended up badly divided and could not reach a full consensus on its recommendations. However, the North–South report injected some practical dimensions into the debate on the global system including wealth disparities, the need for economic growth in the poor countries, and the new roles of transnational corporations in the global economy. It highlighted the disparities of the realities between the prosperous developed countries and the poverty stricken developing countries. This work informed and inspired the World Commission on Environment and Development, which was formed in 1982.

The year the Brundtland report was published, 1987, also saw the establishment of the South Commission, which published *The Challenge of the South*. The purpose of the South Commission was to develop an alliance or a common stance among the Least Developed Countries, and to draw international attention to their developmental needs. The report saw the traditional industrialization process as the model for development. And this stance became a barrier to congenial discussion and co-operation on the protection of global environmental resources.

In the years leading to the Brundtland report, there were also some major contributions to the definition of sustainability from different disciplinary perspectives:

World Bank economist, Herman Daly, depicted sustainability as requiring:

1. The rate of use of renewable resources not to exceed the rate of regeneration.
2. The rate of use of nonrenewable resources not to exceed the rate of development of sustainable alternatives.
3. The rate of emission of pollutants not to exceed the capacity of the environment to absorb them.

The founder of The Natural Step (TNS), Swedish oncologist Dr. Karl-Henrik Robért's four conditions for sustainability or "system conditions" build on Daly's work. They are:

1. Substances from the earth's crust must not systematically increase in nature; nature cannot withstand a systematic build-up of dispersed matter mined from the earth's crust.
2. Substances produced by society must not systematically increase in nature; nature cannot withstand a systematic build-up of substances produced by humans.
3. The physical basis for the productivity and diversity of nature must not systematically be diminished; nature cannot withstand a systematic deterioration of its capacity for renewal.
4. We must be fair and efficient in meeting basic human needs; therefore, if we want life to go on, there must be fair and efficient use of resources.

Economist David Pearce's definition was:

1. That we live only off the “income” generated by the wealth-creating process where wealth has now to be defined as the nation’s stock of capital equipment and its stock of nature.
2. As a corollary of point 1, that we do not run down either the capital stock in its conventional accounting sense or in the sense of the stock of natural environmental assets.
3. That we may actually seek to increase the stock of environment assets in the same way as the capitalist ethic teaches us to accumulate capital.
4. That the pursuit of sustainable economic development is consistent with the pursuit of sustainable use of resources and environment: in the economist’s language, the critical feature of the sustainable economic development and sustainable use of resources and environment philosophy is that we can be on an equilibrium growth path in the two broad sectors, the economy and the environment.

The objectives of the World Conservation Strategy can also be considered a biophysical definition of sustainability:

1. To maintain essential ecological processes and life support systems such as soil regeneration and protection, the recycling of nutrients, and the cleansing of water, on which human survival and development depend.
2. To preserve genetic diversity (the range of genetic material found in the world’s organisms), on which depend the breeding programs necessary for the protection and improvement of cultivated plants, domesticated animals and microorganisms, as well as such scientific and medical advance, technical innovations, and the security of the many industries that use living resources.
3. To ensure the sustainable utilization of species and ecosystems (notably fish and other wildlife, forests and grazing lands), which support millions of rural communities as well as major industries.

The foregoing definitions have suggested a set of mutually reinforcing insights on the requirements of sustainability. Rather than totally surrendering to the Malthusian premise that the population would reach a point where the food supply would just not be enough, the ideas embodied in the above ecological economic and biophysical definitions together suggested that first, population growth is limited by how much our resource base can provide for its sustenance, and second, there is potential for better harnessing the resource base that is locked up in nature. The former would relate to paying attention to the concept of carrying capacity, planning and intervention into unsustainable practices. The latter points to the improvement of resource efficiency. The Brundtland report later reflected this in its deliberation, calling for “population stabilized at a level consistent with the productive capacity of the ecosystem.” Thus its concept embodies the more contemporary concept of carrying capacity (see “Carrying capacity and sustainability: waking Malthus’s ghost”).

The manner that resources are harnessed is often related to the question of equitable distribution of wealth. The Brundtland report adopted the perspective that poverty and environmental conservation are incompatible because economic inequities will lead to over-exploitation of resources, and economic growth is needed in the poorer countries in order to satisfy basic human needs. Underprivileged people whose basic needs are not

met are often driven to meet these needs through behavior that can lead to destroying the environment, for example in some settings the gathering of firewood as an energy source leads to desertification; poor people live in substandard housing, which is often under-serviced, unhealthy and unsafe for the whole community.

Brundtland also noted that meaningful political participation is needed to ensure that the fruits of economic growth are equitably distributed. Accordingly, the Brundtland Report sought to advance the very significant concepts of equity and citizen participation. The report was criticized severely, however, for paying too little attention to the role of women. Without sufficient resources (equal rights, education, finance) women were excluded from contributing to sustainability. Strong pressure by women's groups, both domestically and internationally, ensured that these concerns were incorporated into the sustainability agenda from the Earth Summit onwards (see "Feminist perspectives on sustainability").

The Brundtland report proposed a number of new ways for achieving sustainable development and continued to support some instruments that were already in use, including the "polluter pays principle" (PPP). This principle was adopted by the OECD in 1972 to encourage industries to take into account the environmental costs of their activities and to reflect this in the pricing of their products and decisions in investment. There were new proposals, which included changes in the use of resources, in the priorities of investments, in technological development, and in political and social institutions, including mechanisms for participation.

Sustainable development is premised upon some possibility of strategic intervention in the present system. It argues that we can create a better understanding of our problems and generate solutions. Building systems-based knowledge (including analytical and anticipatory power, new science and technologies) is a key element of what Thomas Homer-Dixon calls the "ingenuity" required to avoid various forms of human disasters in the twenty-first century. Sustainable development cannot be accomplished by one country, in one place, at one time; it has to be truly global in scope and long term in perspective.

In the pre-Rio period, before 1992, much of the international effort had been to foster the idea that environmental concern is a global issue, a concern for the maintenance of ecological integrity, and environmental considerations are related to development. These were rallying calls for greater cooperation from all governments of the developing and developed countries in this important matter. There was no central authority in existence, nor any equivalent of a global government. The closest to approximating global environmental governance was the plethora of international environmental conventions and the non-legally binding declarations. The sovereignty of nation states, the absence of a governance mechanism for sustainable development, the absence of an established central international government, the absence of a judicial system on the environment, and the absence of effective machinery to enforce international law, were, and still remain, the major constraints on concerted international cooperation for global sustainability.

The Brundtland report succeeded in spawning the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in 1992. The fruits of the Conference included *Agenda 21*, the *Rio Declaration*; the *United Nations Framework Convention on Climate Change*; the *United Nations Convention on Biological Diversity*; and the *Statement of Principles for the Sustainable Management of Forests* all of which were adopted by the 178 governments that attended the Conference.

The *Rio Declaration* (see the more detailed discussion in “Sustainability in international law”) fosters a global environmental stewardship approach to achieving sustainability through twenty-seven principles, which include:

- Mobilizing individual sovereign states to foster environmental sensibility in development, and creation of social equity.
- Asserting the “common but differentiated responsibilities” maxim to acknowledge the existing unequal environmental status and differentiated responding capacities in technologies and finance in each state.
- Encouraging states:
 1. To target demographic policies and the related production and consumption trends.
 2. To build capacity for sustainable development through development in science and technologies, and also encouraging adaptation, diffusion and transfer of technologies.
 3. To raise public awareness and encourage participation in problem solving. This involves making information widely available and giving the public access to judicial and administrative processes that are key to decision making.
 4. To strengthen environment legislation and standards.
 5. To encourage free trade for economic growth.
 6. To foster national laws regarding liability and compensation for victims of pollution and other environmental damage, and to develop, with international cooperation, international laws regarding liability and compensation for adverse effects of environmental damage.
 7. To stop the export of toxic substances.
 8. To apply widely “the precautionary principle.”
 9. To use instruments of ecological economics to facilitate the internalization of environmental costs.
 10. To establish environmental impact assessment (EIA) processes and institutions to assess and make decisions on undertakings that are likely to have significant impacts on the environment.
 11. To communicate the occurrence of natural disasters and other emergencies in a timely manner to other states.
- Mobilizing the voluntary sector, specifically the women, youth, and indigenous people groups, as global partners in achieving sustainability, and including their concerns.
- Asserting the right of the environment to protection.

- Establishing the state's responsibility to protect the environment in destructive times of war and armed conflict.
- Linking peace, development, and environmental protection as interdependent and indivisible.
- Seeking peaceful resolution to environmental disputes.
- Seeking cooperation between states and people in achieving the declaration's sustainable development objectives and in the development of international law for sustainable development.

The *Rio Declaration* presented a set of basic sustainability values and ethics that was adopted by over 178 governments at the Earth Summit: an expression of global solidarity. "The rights of the environment to protection" and the need to exercise "the precautionary principle" in decisions that impact upon the environment became the fundamental tenets. The introduction of the precautionary principle to decision making is revolutionary. The principle is to try to avoid some of the most serious forms of environmental damage before it happens. Its application implies the reversal of the traditional concept of the burden of proof by passing it back to the potential polluter, who would then have to prove that the activities are not going to cause harm to the environment.

According to the *Rio Declaration*, governments are given the leadership role in implementing sustainable development. The twenty-seven principles of the declaration delineated the general areas of responsibility and accountability, as well as outlining the strategic means for achieving sustainable development: by creating and integrating institutional, legal, and policy frameworks, and in promoting informed decision making, all of which gives critical consideration to the linkages between social, economic, and environmental factors, at the international, national, and local levels. The key resources for achieving sustainable development are new technologies, finance and investment, and public participation (or global partnership); the three are not mutually exclusive. (For example, the shifting in the investment regime to support research and development of sustainable development technologies would depend on new discoveries and innovation, as well as a good measure of popular support. The private sector, the government, and the civil society all play an important part.) The "common but differentiated responsibilities" premise of the Declaration is significant in drawing support from the developing countries, and the endorsement of free trade in this document is just as important for the general reception of this declaration.

Agenda 21, the global program of Action on Sustainable Development and the follow-up of *Our Common Future*, is consistent with the *Rio Declaration*. *Agenda 21* is a comprehensive approach to address the pressing environment and development problems of the day, and to prepare the world for the long term challenges of sustainability in the twenty-first century. *Agenda 21* embodies a dynamic program, which deliberates at length the various aspects of sustainable development:

- social and economic dimensions

- conservation and management of resources for development
- strengthening the role of major groups
- means of implementation.

This comprehensive plan serves as a template to be adapted and adopted globally, nationally and locally by organizations of the United Nations system, governments, and major groups in every area in which humanity impacts on the environment.

Together *Our Common Future*, *The Rio Declaration* and the *Agenda 21* are the key documents and events that have elevated the language and meanings of sustainable development into the main stream. Together they provided the first step toward global governance for sustainable development by communicating the importance of sustainable development to all levels of government to all sectors, and to many communities, social groups, and individuals in both the North and the South.

The Commission on Sustainable Development (CSD) was created in December 1992 to ensure effective follow-up of the United Nations Conference on Environment and Development (UNCED). CSD has the mandate to monitor and report on implementation of the agreements at the local, national, regional and international levels. CSD also prepared a review of *Agenda 21*, entitled *Programme for the Further Implementation of Agenda 21*, which was adopted by the UN at the special session of the General Assembly held in 1997 (the Earth Summit+5). In 1998, CSD introduced multi-stakeholder dialogues into its annual sessions, where the business community, trade unions, local authorities, the scientific community, NGOs and governments would have a two-day meeting to discuss the pressing issues from each group's perspective. In 2002, CSD will be the organizer of the World Summit on Sustainable Development (the Earth Summit Plus 10) to be held in August-September 2002, in Johannesburg, South Africa.

To date, about eighty-five countries have developed some kind of national sustainable development strategy. The United Nations Development Programme (UNDP) through its "Capacity 21" programme has assisted more than forty developing countries in building institutional and human capacity to formulate and implement sustainable development strategies. The United Nations Environment Programme (UNEP) has also provided policy, legal and technical advisory services to over 100 countries relating to institutional building for environment and sustainable development. Since the Earth Summit in 1992, a number of new legal instruments, conventions, and protocols have been negotiated, signed, and ratified. These conventions and other non-binding international instruments and mechanisms concluded in the intervening years have expanded the international legal framework supporting sustainable development.

There has been a growing number of sustainable development and related initiatives at the community level. For example, the "*Local Agenda 21*" programme by the International Council for Local Environmental Initiatives promotes awareness, commitment, and contribution of local authorities to sustainable human settlements and global environmental management. The "Roll-back Malaria" campaign of the World Health Organization recognizes the interrelationships of health, environment, and sustainable development and addresses the underlying causes, in turn, strengthening the

capacity to manage, diagnose, and treat the disease. (However, DDT, a “persistent organic pollutant,” is still being used.)

A myriad of innovative programs created by both the public and the private sector have influenced business and enterprise. The United Nations introduced the “Global Compact” in July 2000 to promote sustainable growth and good citizenship through committed and creative corporate leadership. Many industry associations have also developed voluntary codes of conduct, charters and codes of good practice concerning social and environmental performance, some modeled after the “Responsible Care” program introduced by the Canadian Chemical Producers Association following the Bhopal disaster. Environmental management accounting has been used to increase cost-effectiveness by reducing resource consumption and waste production, and is considered a part of the “corporate responsibility” movement that emphasizes voluntary self-regulation by business and industry sectors. Thus sustainable development has remained in the consciousness of the global community, and is expected to continue making new allies and a measure of progress.

3. What are its Implications for Governments?

Governance is a broader notion than government. Both terms trace their etymology back through Latin (*gubernare*) to the Greek word “*kyberbes*,” which means “helmsman.” Both invoke the metaphor of “steering,” a skill which involves knowing where you want to go, making decisions about a preferred course, and taking actions needed to “stay on course.”

Government refers to particular kinds of “public” institutions (the “state”) that are vested with formal authority to take decisions on behalf of the entire community. Governance more broadly refers to the myriad of other organizations and institutions, in addition to government, which take decisions affecting others.

Governance encompasses collective decisions made in the public sector, the private sector, and civil society. The concept of governance is especially helpful in suggesting the need for collaboration among these sectors to address the kinds of broad challenges associated with sustainability.

Sustainable development gained prominence through the efforts of governments and international government organizations. The Brundtland Commission was appointed by the United Nations (following a failed Canadian initiative that was later taken over by the Japanese.)

Sustainable development is a global challenge. It requires the engagement of the world in a continuing process of problem identification and problem solving. A form of global alliance is necessary for taking on the global challenge. The form of this alliance may vary. Due to the pessimistic outlook on the long-term viability of our life support systems, some believe that a centralist planning approach is most effective. This perspective may imply the creation of a global government for sustainable development, which possesses the authority to rule, to monitor and to regulate global affairs relating to life support systems. However, this regulatory approach is severely constrained by

the difficulties of drawing territorial boundaries around environmental phenomena. Also, there is the political reality that each nation-state has sovereign rights to govern within its jurisdiction. And it would not be reasonable to charge an authority with the accountability and responsibility for problems that may originate outside of its jurisdiction. Therefore, unless there are great changes to the concept of national sovereignty, there will be little possibility of creating a centralist global government for sustainable development.

Since the Earth Summit, a number of new legal instruments, conventions and protocols have been negotiated, signed and ratified. These, along with a number of non-binding legal instruments and mechanisms, including the norm-building *Rio Declaration*, have become the embodiment of an international legal framework for sustainable development. According to a recent UN report, however, there is a lack of institutional capacity at the national level for adapting and implementing such international agreements.

Within the United Nations system it is also agreed that a greater interaction and synergy among the various international conventions and agreements is necessary for enhancing the overall impact and effectiveness (see “Globalization, interdependence, and sustainability”). The United Nations Environment Programme (UNEP), the United Nations Development Programme (UNDP), and the United Nations University (UNU) are presently working towards achieving a greater coordination within the UN system. To enhance the central role of the UN system in sustainable development, UNEP has been publishing, on a regular basis, the *Global Environmental Outlook* (GEO), a state of the environment report of the world. GEO publishes synthesized global and regional data and information, gathered at thirty-five GEO collaborating centers around the world.

The centralist planning approach also means that all efforts are regulated, and coordinated within environmental constraints. This concept, when taken to the extreme, would impose great burdens and costs (for information, knowledge, planning and administration, and finance) on the capacity of participating states. There is little prospect of this kind of centralized, world-wide governance structure emerging in the near future (though such an outcome was explored in one scenario developed by a WBCSD (World Business Council for Sustainable Development) scenario planning exercise conducted in the mid-1990s.)

The concept of central planning and administration is greatly opposed by those who insist that people must be trusted to manage their own affairs. They support the belief that the dynamics of the market system can deliver optimum results. Carrying this to an extreme, some would object to all kinds of state intervention, including the provision of social welfare. They would favor “process efficiency,” and the use of voluntary environmental protection measures as the priority requirements for sustainable development (see “Bioregion, eco-polis, and eco(nomic) federation: left-libertarian models of Sustainability”).

The Earth Summit at Rio was driven by governments, but it was widely recognized that governments acting alone would be incapable of addressing successfully the huge range

of issues identified as part of the challenge of sustainability. This fact was made abundantly clear in *Agenda 21*, the forty chapter document endorsed by over 178 countries. Many of the chapters highlight the role of non-government and civil society organizations, including women, children and youth, farmers, scientists, and aboriginal people.

Almost ten years after the 1992 Earth Summit of 1992, a United Nations document, entitled “*Implementing Agenda 21 Report of the Secretary-General*,” contains the following observations:

There is undoubtedly a gap in implementation [of *Agenda 21*]. This gap is particularly visible in four areas. Firstly, a fragmented approach towards sustainable development. The concept of sustainable development is meant to reflect the inextricable connection between environment and development. Sustainable development must simultaneously serve economic, social and environmental objectives. Policies and programs have generally fallen far short of this level of integration in decision making at the national and international level.

Secondly, no major changes have occurred since UNCED [United Nations Conference on Environment and Development] in the unsustainable patterns of consumption and production that are putting the natural life support system in peril. The value system reflected in these patterns is among the main driving forces that determine the use of natural resources. Although the changes required for converting societies to sustainable consumption and production patterns are not easy to implement, the shift is imperative.

Thirdly, there is a lack of mutually coherent policies or approaches in the areas of finance, trade, investment, technology and sustainable development. In a globalizing world, the need for consistency and coherence in these policies has become more important than ever before. Yet, policy on these issues remains compartmentalized, governed more by short-term considerations than long-term determinants of the sustainable use of natural resources.

Fourthly, the financial resources required for implementing *Agenda 21* have not been forthcoming, and mechanisms for the transfer of technology have not improved. Since 1992, ODA has declined steadily, the burden of debt has constrained options for poor countries and the expanding flows of private investment have been volatile and directed only at a few countries and sectors.

(Implementing Agenda 21, 2001)

The report also maintained that the present status of the life support systems has deteriorated in the period since over 178 nations declared their commitment to take on the challenge of sustainable development at the Earth Summit in 1992.

Despite having given the initial impetus that led to the formation of the Brundtland Commission and ultimately to the Earth Summit, governments’ leadership is now in question. Governments are experiencing considerable difficulty identifying an appropriate role as promoters of sustainability.

Faced with new pressures in terms of authority, legitimacy, power, and resources, governments have had to rethink their role. Some have described this process as the “reinvention of government.” It might also be described as a process of “creative destruction.” One aspect of this change process involves the shift in focus from government to governance noted above.

Collaboration for sustainability governance means that, increasingly, national governments must form partnerships; with other levels of government, with the private sector, and/or with civil society organizations (e.g. NGOs). This imperative creates both dangers and opportunities. The danger, according to some skeptics, is that government will fail to recognize its distinct obligations within such partnerships. The opportunity is for the government to extend the commitment to sustainability through new strategies in addition to the use of law and regulation. (see “Moving towards sustainable development: the Chinese conundrum”)

Above all else, sustainability implies a new perspective on choices and decisions. If we hope to “bend the curve” towards sustainability, both individuals and organizations in all three sectors need to make “integrated” decisions and choices that take into account economic, social and environmental costs and benefits; they also need to consider the long term as well as immediate impacts of these choices.

Sustainability favors participatory forms of decision-making, and places high value on openness and transparency. Sustainability encourages processes and structures that can build consensus and collaboration, with input from all stakeholders.

But perhaps most importantly, sustainability calls for some bold rethinking of politics, government and governance. It entails moving from “end-of-pipe” cleanup efforts – the politics of “react and cure” – to pollution prevention, closed loop production, cradle to cradle approaches, and other aspects of “natural capitalism” that will require a new approach based on “anticipate and prevent.” It will insist on participatory approaches to decision-making, and aim for broad consensus wherever possible. It will also require new forms of government organization. As Ann Dale stated:

The core problem for governance for sustainable development is that it has inherited from the nineteenth century a model or organization that is structured around functions and services, rather than around solving problems. Instead, our modern context demands new ways of organizing around the problems of sustainable development. The nature of sustainable development in and of itself demands new ways of organizing, and it is only when governments organize dynamically around the problems and respond to the modern context that they become more relevant to citizens and contribute to a more robust civil society.

(Ann Dale: “The politics of sustainable development”)

The spirit of planning for sustainability, namely, an assertive environmental ethic, a concern with addressing the encounter of environment and development, and institutional innovation for necessary implementing action have been the distinguishing

features of some of the bold and far-sighted endeavors of our times. One of UNESCO's World Biosphere Reserves, Canada's Niagara Escarpment, and the evolution from study to legislation to plan and then to the World Reserve designation, deserves mentioning as an early example of sustainable development planning and government innovation. (See "Early localized issues affecting regional sustainability: the case of Ontario, Canada's Niagara Escarpment")

In approaching the challenge of sustainability and strategizing about the ways to help bring about significant change in governance practices, it is useful to keep in mind Albert Einstein's observation that "The world we have created today, as a result of our thinking thus far, has problems which cannot be solved by thinking the way we thought when we created them." Efforts to advance sustainability in government, the private sector and civil society, will demand fundamentally new ways of thinking and doing. It is here that a desperate need arises for both technological innovation and policy innovation.

What is the role of government in relation to this need for innovation? Government must play a strategic role in stimulating and facilitating innovation within government and in all sectors of society. More specifically it has an important contribution to make in building a strong capacity for innovation that supports sustainability. As pointed out above, however, the role of government today is not so well defined as it has been in the recent past.

For more than the past decade, the dominant political discourse has shifted the focus of governments to deregulation, down-sizing and deficit reduction. Government now, decidedly, does not have a monopoly on governance, if it ever had. The state now governs society alongside a variety of non-state actors, such as business and civil sector groups, increasingly using new policy instruments (economic and voluntary) in addition to traditional forms of legislation, regulation and investment. In this context, government must continue to perform the vital societal "steering" function identified above. And it must do so through the intelligent use of the full suite of available policy instruments which include public enterprise and public-private partnerships (PPP): traditional regulation and taxation; various "economic instruments" including trading schemes, eco-labeling requirements and so on; voluntary and non-regulatory initiatives (VNRIs); and education, awareness, and provision of information for decision-making.

4. What are its Implications For Business and Industry?

Industries manufacture consumer goods that meet the demands of everyday life. Businesses provide services that facilitate a two way process, acting as somewhat of an interlocutor between the consumer and the manufacturer. Business and industry play an essential part in achieving the modern lifestyle. They also create jobs for many people, and form the major component of our economy. The development of industries and businesses is closely related to the dynamics of the consumer market, which is determined by the growing number of consumers, the consumers' needs and their desire to buy new products.

The production of goods and services by business and industry also depends on a steady supply of raw materials – including energy, water, food, mineral resources, and so on – or, in other words, the availability of natural capital. Natural capital is more than industry's inventory stock. It embodies a self-regulating process of recharging and regeneration, which is enabled by the presence and interaction of a system of natural elements necessary for this process (Wackernagel and Rees, 1996). The same concept of self-regulation applies also to the human habitat. If certain elements of nature are being excessively extracted, the change in the balance of the life support systems may in turn also upset the human habitat, affecting the health and well-being of humankind. Therefore, the over-harvesting of nature for manufacturing materials will ultimately impact the quality of life of the human community. For example, the large scale, exploitative harvesting of timber from natural forests also destroys homes of animals, kills the undergrowth and other vegetation, removes the reservoir of photosynthesis for clean air, and disturbs the recharging areas of the underground water system.

Meanwhile manufacturing processes discharge wastes. New product lines phase out old ones and turn outdated items into garbage. Both industrial waste and garbage are alien to the earth and its natural cycles. Many of the man-made materials, such as spent nuclear fuel or plastics, are not easily biodegradable. Nuclear waste such as plutonium 239 has a half-life of over 20,000 years. It means, it takes over 20,000 years for only one half of the radioactivity locked in the matter to disintegrate. Therefore, the disposal of nuclear waste represents the kind of complex and urgent problems that must be tackled by sophisticated planning and technology, and by communication, particularly with the future generations who are to inherit the problems from us.

If one views the consumption and production process from a social perspective, the more goods and services people consume, the greater material comfort is achieved, and the more people are being employed to make the goods and provide the services. Accordingly, the continued operation of the production line is very important for sustaining employment, it delivers a significant social welfare function. In addition, when new products are produced in rapid succession, there is more product choice, and more accumulation of stock in the inventory. To maintain a balance in inventory size, and to get rid of the old stock, merchants lower the prices of commodities. Competitive pricing and the rapid turnover of products generally make the materialistic life style more affordable. Nevertheless, the working conditions of laborers, unequal wages for female workers and illegal immigrants, long working hours, poor indoor work environments, and industrial safety hazards are also factors that threaten the quality of social life.

For the economy, the higher the value of goods and services, the higher level of profits that can be made by the industry and business sector. This could lead to greater savings and investment in the economy. Generally, there are three ways to raise profits: an increase in price, an increase in output, and a decrease in manufacturing costs. The increase in output depends on the expansion of the market, and underlying that, the expansion of consumer demand. This is often altered by the change in demands (for example, pocket size calculators in place of the use of logarithm tables as a mathematics tool) and fashion trends (the different dress lengths of the fashion season). Commercial

advertising, a thriving international business, plays a significant role in stimulating and manipulating the preferences of modern consumption.

The most common practices for lowering production costs has been to reduce labor and raw material costs. The former refers to the practice of employing cheap non-unionized laborers, sub-contracting work to cheap labor in the developing countries, or by replacing laborers with automation and the clever use of technologies. The latter is commonly achieved by the suppression of natural resource prices, and by excluding from the balance sheets the value of the life support systems.

The more we consume, the more goods are made, the more natural resources are converted into raw materials, the more items are rendered redundant and are turned into garbage that litters the earth, the more waste is discharged into the life support systems. This is the environmental impact of consumption and production activities. The amount of waste produced in societies like Canada and the United States is simply staggering. The average American consumes twenty tons of raw materials annually. The total annual waste produced in the United States would fill a convoy of garbage trucks long enough to wrap around the earth six times and reach half way to the moon!

In recent years, the dramatic growth in international trade and investment, facilitated by the advancement in telecommunication, transportation, and computerization, has facilitated the creation of a global scale division of labor. Consequently many location-specific natural resources are being harvested to meet the demands of the global market. The extraction of natural resources is often operated at a rate and on a scale dictated by what modern technologies can achieve. Not much attention has been paid to the recharging and regenerating rates of the resource itself. The aggressive and unsustainable practices of forest extraction in Canada, and the cod fishery in the North Atlantic are such examples. As a result, the global transportation of goods has also dramatically increased in volume (see “Globalization, interdependence, and sustainability”).

The great increase in international trade and investment in recent years has been a major promoter of the geographic concentration of economic activities. According to the World Trade Organization, in the year 2000 the total world value for export goods and services was US\$7.6 trillion. In spite of the much slower economic growth compared with the previous year, in 2001 there was still an average of 2 percent growth in the global economy. The value of world merchandise exports reached US\$6.19 trillion in 2000, which is more than a hundred times the value of US\$58 billion in 1948. Meanwhile the *World Investment Report 2001* maintained also that the world foreign direct investment inflows grew twenty-two fold from US\$57 billion in 1982 to US\$1.271 trillion in 2000.

Indeed, trade in the past, in conjunction with the military-political force of colonization, has expanded the supply of materials and the carrying capacity of many nations: Great Britain, the Netherlands, France, Japan, and so on. However, the hardship on the indigenous people and the loss of natural amenities were hardly accounted for in these experiences. Now, we begin to possess the tools and the moral imperative to assess our

performance on a global scale. William Rees in “Carrying capacity and sustainability: waking Malthus’ ghost”, has the following assessment:

Indeed, unfettered trade can lead to a permanent reduction of carrying capacity. Global trade exposes pockets of scarce resources everywhere to the largest possible market. If this bids up the price, it may encourage ever greater harvest rates by exporting nations, to the point of stock depletion or collapse (as has often been the history of open-access fisheries).

(Rees, 2002)

In addition, according to William Rees’s calculation, the aggregate eco-footprint of the present world population of 6 billion is already 20 to 30 percent larger than the size of the earth. It means that the human “load” has already overshoot the long-term carrying capacity of the planet; or the rate of human consumption is greater than what the earth is capable of producing indefinitely, without causing some loss to the earth’s own regeneration capability.

A recent World Trade Organization (WTO) report projected the world population to cross the 7 billion mark in 2013. It has taken only twelve years to add the last billion people. This population trend, combined with the world population’s excessive consumption, is projecting a gloomy picture of resource exhaustion that might happen not too far in the future. Garrett Hardin’s scenario of resource over-exploitation by the overcrowding of people, who do not concern themselves with a need to take care of common or shared resources, strikes a resounding chord (see “The Tragedy of the Commons’ by Garrett Hardin, 1968”).

The debate that Hardin sparked about how to deal with resource depletion problems that arise from the exploitation of “common-pool resources” by an uncaring public, is edifying and pertinent to the challenge of resource management for sustainability. Hardin’s suggestions include government regulatory measures: administrative law that coerces responsible behavior (e.g. environmental protection laws and regulation), and disciplinary market mechanisms (e.g. “green” taxes).

The discussions that have been generated by Hardin’s *Tragedy of the Commons* pertain to the question of the need for, and the roles that are played by, the various levels and types of authority in regulating and coercing compliance in individual and group actions.

The sustainable development perspective fostered by the Earth Summit is one that acknowledges all aspects of the reality that has been highlighted, and that sustainable development cannot be achieved without fundamental changes in the way societies produce and consume. Three major areas for business and industry initiatives have been identified:

- improving production practices
- designing for long-term usage of the product
- reducing negative impacts of transportation of goods and material

The need to reduce both production inefficiency and the quantity of consumption is also being echoed in a recent report entitled, *Assessment of Progress in Sustainable Development since Rio 1992 for Member States of the United Nations Economic Commission for Europe*. It maintained that, although there has been a structural change in the production system in Western Europe and North America in the past twenty years, the change that has occurred shifted the sector's focus, which was once on energy intensive traditional industries (e.g. iron, steel, petroleum refining) to industries that are less energy and material intensive, such as electronic and electrical industries, telecommunications, data processing, and advanced chemicals. The shift in production as well as new energy efficiency practices have achieved a 25 percent improvement in energy efficiency per unit of GDP. However, this gain has also been offset by an increase in consumption of goods and services and the expansion in scale of the waste disposal problem.

In terms of improvement in production practices, the sustainable development challenge involves a more responsible, effective and efficient application/usage of resources, regarding both human and natural resources. There are great advantages to be gained in fostering a sense of reciprocity and mutual interest in the work place. Aside from better labor relationships, better work place conditions are essential for the development of a sense of responsibility; the kind of social norm that will have positive impact on the enforcement of the regulation and the wise use of resources in the production process, involving technologies, energy, raw materials, and local labor. Workers and labor unions are important partners in the reform of the industry and business sectors towards a sustainability ethic.

To decouple economic growth from environmental degradation through "dematerialization" (a reduction in the throughput of material and energy resources per unit of production) has been the main promise of the industry and business sector in response to the challenge of sustainable development. Reducing (ideally eliminating) waste by adopting a "cradle to cradle" approach to production aims to imitate the "closed loop" cycles found in nature. Cleaner production and reduction of pollution, and the more efficient use of natural resources ("eco-efficiency") are the central emphases. In recent years, there has been the introduction of a number of economic instruments, including: a growing range of environmental taxes and charges that are integrated into economic policies of developing and developed countries; the tradable permit system to regulate pollution emissions, water use, fisheries and land development rights; deposit-refund schemes in solid waste management; and noncompliance fees and performance bonds. These are the disciplinary market mechanisms that are presumed to be effective in conjunction with administrative laws imposed by government.

In defending the notion of free trade and confronting the encroachment of the business sector's institutional space, the business and industry sector is strongly resisting the tendency towards increased economic sanctions imposed by government. Businesses and industries support the tradition of free trade. To support this stance while facing a growing public awareness and concern over the deterioration in life support systems, the sector would prefer the use of regulatory mechanisms that are adopted on a voluntary

basis by individual concerns. In the Rio Declaration principle 12 has the following provision:

States should cooperate to promote a supportive and open international economic system that would lead to economic growth and sustainable development in all countries, to better address the problems of environmental degradation. Trade policy measures for environmental purposes should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade.

(Rio Declaration, 1992)

The Earth Summit or the United Nations Conference on Environment and Development (UNCED) in 1992 was not created in a vacuum. There was strong business sector input into the organization of the event, which included the participation in the scoping of the summit's agenda. Prominent industrialist Maurice Strong was the Secretary General of the Summit. Stephan Schmidheiny (of Swatch watches) was appointed a principal adviser for business and industry in the preparatory process. The concept of eco-efficiency was first coined in 1992 by WBCSD in its landmark report "Changing Course." eco-efficiency is defined as the achievement of delivering "competitively priced goods and services that satisfy human needs and bring quality of life while progressively reducing ecological impacts and resource intensity throughout the life cycle to a level at least in line with the earth's estimated carrying capacity."

In 1995, the WBCSD joined with the United Nations Environmental Programme (UNEP), and consolidated the definitions of Eco-efficiency (adopted earlier by BCSD), and cleaner production (which is a pollution prevention strategy promoted by UNEP, focusing on production processes, products, and services into the broader sustainable production and consumption vision). The purpose of this collaboration according to UNEP is:

- To catalyze industry/government partnerships to promote eco-efficiency and cleaner production: two related concepts for sustainable development.
- To demonstrate the common efforts of UNEP and the WBCSD to promote these concepts at the international level.
- To exemplify the voluntary actions undertaken by industry to implement these concepts "from the laboratory into the market," and demonstrate the economic value they bring to corporations and shareholders.

The Sustainable Production and Consumption Vision is presented as a concept by WBCSD which:

- Forms an integral part of the broader sustainable development agenda, where the focus is on the sustainable production and use of goods and services.
- Encourages continuous improvement in efficiency of the use of energy and resources (i.e. in the patterns of consumption).
- Involves changes in the supply and the demand for goods and services.
- Promotes the idea that both consumer durables and non-durables can be compatible with sustainable production and consumption.

- Emphasizes a lifecycle perspective in the manufacture, use, reuse, recycling, and disposal of goods and services, rather than the traditional focus on discrete activities.

The cleaner production, eco-efficiency approach promotes the dual goals of business excellence and environmental excellence. This concept encompasses the goals of value creation, efficient use of raw materials, pollution prevention, source reduction, waste minimization, and internal recycling and re-use. Some companies took initiatives in monitoring the environmental impact of activities by designing and conducting their own in-house environmental assessment. The voluntary environmental protection efforts, asserting a sense of corporate responsibility towards the public and the environment as a new company value, have developed into a sophisticated international network. These are corporate sector initiatives, to create partnerships in environmentally friendly industrial practices with international agencies, government, university, and research institutes; partnerships that indirectly promote the corporate sector as a major stakeholder in environmental protection matters.

In a parallel development, there is the process of earning the “Certificate of Environmental Management Systems” under the ISO 14000 criteria of the International Organization for Standardization or the European Eco-Management and Audit Scheme (EMAS) as a demonstration of a company’s acceptable environmental performance. And there is the development in environmental management accounting that works towards achieving a self-regulating system in delivering efficiency in material consumption, and reducing pollution and waste. Also, the “Global Reporting Initiative” was introduced as an international multi-stakeholder effort, with the intention of creating a common framework for voluntary reporting on the economic, environmental and social dimensions of organization-level activities, products and services.

The banking and financial sector in recent years is also paying attention to eco-efficiency, as one aspect of company performance. A company that has a bad record in environmental protection is more vulnerable to lawsuits and damage claims, and therefore poses a high financial risk and the dim prospect of a poor share value. Integrating environmental criteria into customer rating systems is one area that the banking and financial sector is moving into.

The Dow Jones Sustainability Group Index (DJSI) was launched in 1999 as the first index to track the share performance of leading sustainability companies from around the world. There are regional indices for America, Europe, and the Asia-Pacific region, as well as the global index and a United States index. Included in the world index are 236 companies in 61 industries from 27 countries, with total market capitalization of US\$5.5 trillion as of August 2000.

The objective of the DJSI is to address “increasing investor interest in companies committed to corporate sustainability principles. These principles – innovative technology, corporate governance, shareholder relations, industrial leadership and social well-being – are a catalyst for enlightened and disciplined management, a crucial factor in making investment decisions.” On the basis of these principles and the recognition that sustainability-oriented companies will pursue these opportunities in a proactive, cost effective and responsible manner, such companies are expected to outpace their

competitors and provide increased, long-term shareholder value. Indeed, according to the *Annual Review of DJSGI Components*, over the past five years, the average DJSGI World index's return on equity was 14.73 percent against 9.8 percent for the DJGI [Dow Jones Group Index] World index. During the same period the average return on investment (DJSGI: 8.86 percent versus DJGI: 6.9 percent) and the average return on assets (DJSGI: 5.49 percent versus DJGI: 4.77 percent) were also superior for sustainability-driven companies.

There has also been significant growth in the area of ethical or green investing. In Canada, for example, there is more than US\$3 billion invested in green and ethical funds so far, while in the United States the assets in such funds doubled from US\$1.1 trillion in 1997 to US\$2.2 trillion in 1999. While this trend is driven in part by investors who are concerned with avoiding polluters or unethical firms, such as tobacco, nuclear and weapons companies, the most significant driver is in fact investment performance.

As pointed out by Blair Feltmate and Brian Schofield, corporate commitment to sustainability is an effective predictor of share price appreciation because it serves as an indicator of proactive management that is “ahead of the curve.” Moreover, commitment to sustainability can translate into increased sales to green consumers, ease of establishing new facilities (particularly for natural resource companies), enhanced eco-efficiency/cost effectiveness, enhanced access to financing from banks that are wary of lending to poor sustainability performers, and similar cost savings from reduced insurance premiums and diminished legal liability.

Nevertheless, the voluntary eco-efficiency approach to environmental protection, which relies on the market mechanism to translate the aggregate of public spirited value into investment power and company policies, has been largely criticized for its lack of a direct commitment to the reduction of the ecological footprint. According to this view, specific targets ought to be devised to help guide the production performance. In response to this, some more target-specific approaches have been created, for example, “factor four,” which is about getting four times as much usage or gain out of each unit of raw material; and “factor ten,” which proposed that we should not increase the volume we produce until we can demonstrate that we can reduce the throughput of energy and material resources by a factor of ten. The “factor ten” concept has been endorsed by the United Nations Commission for Sustainable Development.

Authors Hawken and Lovins argue that as we evolve towards sustainability, industrial capitalism will give way to a new form of capitalism that accepts the significance of the life support systems. Under a regime of “natural capitalism,” radical increases in resource productivity will be accompanied by redressing global inequities of income and material well-being. This new system will fully value all forms of capital, including human, producers' goods, financial, and natural (see “Beyond Brundtland: the evolution of sustainable development in 1990s”).

Another innovative concept is called “ecosystem services.” This is an assumption that the new economy will put an emphasis on services and their flow, rather than the traditional economic focus on goods and purchases. In this industrial model of a service economy, customers obtain services by leasing goods rather than buying them.

Manufacturers shift from being sellers of products to being deliverers of services, such that what is being sold are “results” rather than physical products. In the process, companies are given incentives to innovate and to develop more durable “products” from which services and value can be derived. Examples of this model in practice include:

- DuPont Canada made a deal with the Ford Motor Company to get paid for the number of vehicles painted (the result), rather than for the number of gallons of paint used (the product). Ford achieved cost savings of 35 to 40 percent, emissions of VOCs were reduced by 50 percent, and DuPont achieved improved efficiencies.
- Interface Inc. has attempted to shift the bulk of its activity from selling carpets, primarily for large commercial facilities, to selling the services of carpets through “green lease” arrangements. Rather than dispose of large volumes of carpets, which sit in landfills for several millennia, Interface developed a system of replaceable and recyclable carpet “tiles” and is continuously engaged in research and development to find better alternatives to traditional carpet materials.
- Swedish company Electrolux established a pilot project for energy efficient, digital pay-per-use washing machines that provide the function of clothes washing without actual appliance ownership. Customers are billed per wash using a central database that digitally tracks usage of each machine. While customers have an incentive to reduce their number of washes and have their washer replaced after 1,000 washes, Electrolux has an incentive to maintain the machine well, to develop more durable machines, and to develop machines that are recyclable.

A shift in thinking from a focus on products to a focus on results or services, can foster unprecedented levels of industrial innovation of a form that is consistent with the goals of sustainability. The Electrolux example also points to the strong linkages between such a business model and the emerging communications technology and knowledge-based economy. The opportunities for developing win-win-win strategies, which benefit businesses and consumers while advancing environmental sustainability, are considerable.

In a recent article in *The Futurist* magazine, Lester Brown has called for an “eco-economic revolution” that will result in “getting the market in sync with Nature.” The new “eco-economy” will operate on natural principles and will rest on renewable energy. Our dependence on fossil fuel will come to an end, as non-polluting forms of energy such as hydrogen (manufactured from water using wind-generated electricity) will transform transportation systems, manufacturing processes, and living conditions all over the globe. In this context it’s worth noting Amory Lovins’s sage prediction that “Just as the Stone Age did not end because we ran out of stones, so the oil age won’t end because we run out of oil.” New technologies and new awareness will be the prime drivers of this transformation.

5. What are its Implications For Farming and Agriculture?

According to *The State of Food Insecurity in the World 2001*, an estimated 815 million people in the world are undernourished. Of this total, an estimated 777 million live in developing regions, 27 million in transition countries, and 11 million in industrialized countries. Meanwhile the Worldwatch Institute reported that there are as many

overweight as underfed people in the world. Eighty percent of the world's hungry children are living in countries that enjoy a food surplus. So while malnourishment is strongly linked to the condition of poverty, in many instances the problem is not an absolute deficiency in food but social inequity. As Gandhi once said, "There is enough for everyone's need, but not for everyone's greed."

The major objective for sustainable farming and agriculture is to increase food production in a sustainable way and to enhance food security. In the 1990s, with the expansion of agricultural land, improvement in irrigation, intensive farming technologies, use of new seed types, and alternative farming practices, the rate of global food production grew faster than population. Unfortunately, this trend has been interrupted in recent years by unfavorable weather conditions, such as drought in West and Central Asia, and East Africa, floods in East Asia, a series of natural disasters in Central America, and wars.

At the World Food Summit in 1996, world leaders expressed a commitment to achieving food security for all and eradicating hunger in all countries, with an intermediate target of reducing the number of undernourished people in the world to half the current level by 2015. Since two-thirds of the world's poor population live in rural areas, and engage in agricultural activities for food and income, helping these people to achieve improvements in agricultural productivity will be an effective way to help eradicate hunger and poverty. Sustainable agriculture and farming, therefore, must consider how to bring food and development to the poor rural communities of the world, as well as how to improve the overall food production in an environmentally sound way.

Many problems in the farming and agriculture sector are linked to other concerns with social, economic, ecological, and technological implications including, poverty and food security; gender equity; management of land and water resources; climate change; market access and trade liberalization effects; investment; biotechnology; organic agriculture; traditional community knowledge; knowledge transfer and information access; consumers' choice; and improved farming system. Moreover, agricultural practice and conditions differ drastically between developed countries and developing countries. At the Commission on Sustainable Development forum on sustainable agriculture, a representative from South Africa commented, "Developed countries speak of agriculture as a lifestyle, whereas for developing countries it is a form of livelihood."

It is true that *Agenda 21* has different strategic implications for different communities, depending on the social, economic, and ecological conditions of the community. Yet the sustainable development challenge of how to produce food for everyone in the world, now and in the future, without causing irreversible harm to the ecological system, is the same everywhere. A United Nations projection maintains that a nutritionally adequate diet for the world's growing population implies a tripling of food production over the next fifty years.

Agricultural productivity is related to the size and suitability of land for crop cultivation. The global land mass is limited, and land that enjoys suitable conditions for agriculture is geographically specific. As a matter of convenience often markets and human

settlement are established within commuting distance to these prime farmlands, but increasingly urban sprawl is crowding out the farmlands.

With more people moving to urban areas, the majority of the world's population became urban in 1999. Urban encroachment into the adjacent rural land often leads to loss of farm land to other competing and conflicting land use, and destruction of soil productivity for the remaining farmland. One of the ways for the farming community to maintain productivity is to utilize more natural forests, converting nature to farms. The rate of deforestation globally in the 1990s was estimated at 14.6 million ha per year, mostly in tropical countries. The loss in forests, grasslands, wetlands, etc. also reduces the natural habitat, biodiversity, as well as the functioning of other environmental goods and services.

Other ways for improving farm productivity have met with mixed responses. The expansion of irrigation helps to extend growing seasons and allow more land, which is otherwise considered too dry for farming, to be used for agricultural production. Irrigation schemes become more and more in demand as degradation of dryland continues to increase.

Globally, desertification, a result of human activities and climate variability, has affected about one quarter of the total land area of the world, or about 70 percent of all drylands. With the increase of built areas, changes in water catchment for underground water, and the artificial channeling of irrigation schemes, drylands do not recover as fast as they used to from climate variability, such as a long drought. Thus dryland becomes desert.

Global water reserve remains about the same over time, but the expansion in irrigated agriculture and industrial and municipal consumption of water has created water stress. Presently about 70 percent of the world's freshwater resources are used by agriculture but, even with improved irrigation schemes, only 30 percent of this amount is taken up by crops and plants. Estimates indicate that in the next two decades, about 17 percent more water will be needed to grow food for people living in developing countries, and total water use will increase by 40 percent.

Intensive farming technologies are not without negative impact. Irrigation wastes water to evaporation, and exacerbates the problem of salinization, the accumulation of salt in the upper layer of soil due to poor drainage. The practice of applying chemical fertilizers, in place of more traditional methods involving the use of manure and compost, is starving the soil of humus (which is much needed for maintaining the soil structure), and polluting underground water. Soil degradation has affected at least 2 billion hectares or as much as two-thirds of the world's agricultural lands. Pesticide applied to crops has been found accumulated in the environment, and also emerged in breast milk. Pesticide exposure is linked to a growing list of health disorders: cancer, birth defects, reproductive harm, neurological and developmental toxicity, disruption of the endocrine system, and so on. The use of heavy machinery in place of farm laborers has led to changes in farm size, relative decrease in the hiring of farm laborers, and generally a much more cash intensive operation that relies on various forms of

subsidies. Also, 70 to 80 percent of deforestation worldwide was due to large, mechanized agriculture.

Presently there are animated debates over the use of genetically modified organisms (GMOs) in agriculture. According to the Worldwatch Institute, since 1996, the cultivation of genetically engineered crops has grown twenty-three fold, and now the world has 39.9 million hectares of farmland devoted to this type of crop. These new seeds that are sown have been genetically altered so that the crops are resistant to herbicide, or are designed to be able to use the insecticide produced by the soil bacterium (bt-crops), or to do both. These crops are designed to streamline pest control by amplifying the effects of herbicide spraying and reducing the need for weeding.

According to the Worldwatch Institute report, in 1999, 71 percent of the global transgenic area (area that is designated for growing genetically modified crops) was planted with herbicide resistant varieties of soy, corn, cotton and canola, and 22 percent was planted with bt-corn and bt-cotton. The genetically modified soy and corn were for feeding livestock, canola was for oil and processed food use, and the cotton produced was for fiber and oil.

Criticisms of agricultural biotechnology focus on two main concerns:

First, the direction of biotechnology research can exacerbate inequality; the new GMO seeds are not particularly useful for small-scale farms, or subsistence farming, where weeding is done by hand. For large farming operations the elimination of weed is done customarily by hired hands. When weeding becomes unnecessary, many laborers will be out of work. (On the contrary, one would not want to bring laborers to work in fields where chemical toxins are active.) The GMO crops mentioned were designed to be fully dependent on biocide, targeting on the farming industry, and not particularly with the poor third world farmers in mind. Unless GMO seeds are designed for helping poor farmers in overcoming their agricultural problems, such as the problems of high salt content, dryness, and low nutrient content in the soil, biotechnology research will not help third world farmers. Moreover, the latest biotechnology development is generating a system of patented germplasm. The spreading of GMO seeds from the transgenic area to the adjacent wilderness and farms has been of concern to some scientists. Those who do not wish to subscribe to the new seeds might inadvertently find them taking root in their farms. Therefore, the matter of patented seeds and their access can be a source of legal wrangling. And it might even impact on the traditional way of farming and jeopardize poor farmers' livelihood.

Second, while the long-term health risk for human consumption of genetically modified crops remains an unknown, there are two sides to the debate on whether genetically modified food brings greater health risks. Some scientists have argued that genetic modification of crops has been done for centuries by farmers, who employed traditional methods of hybridization and selection. The new genetic tools of biotechnology, according to the scientists, may create outcomes that are more predictable and safer. On the other hand, opponents of biotechnology have been demanding more longitudinal tests, clear communication of test results, and generally more public input in decisions concerning the commercial growing of GMO crops.

There is also an organic farming movement in the agricultural community. Currently in the US about 1.1 million ha of farmlands employ organic farming management techniques. Organic farming implies a rejection of the use of chemicals, such as chemical fertilizers and herbicides and pesticides, which might end up in the produce and contaminate the ecosystem. Instead, organic farming uses compost and manure, and “green manure” crops (such as clovers and rye grass) as natural fertilizers, and earthworms and beneficial insects to create a suitable growing condition for the crops. There are presently over 10,000 certified organic farmers in the US. And standardized labeling of organic food to provide better consumer information is now on the horizon.

Sustainable agricultural practices must be developed with an appreciation of the rising trend in global consumption, and a potential downward trend for arable land availability and soil productivity. In recent years the farming community is further stressed by the changing weather pattern of long droughts, flooding, and too warm or too cold temperatures in many parts of the world, that are affecting the growing conditions for many crops. For sustainable food production, agricultural development will depend on the improvement of farming techniques to conserve soil and water, to consume less fuel and less toxic substances. Conservation and eco-efficiency must also be practiced along with better land management to reduce the loss of land parcels to urban settlement, and to damages by flooding or landslides.

Farming in the world is conducted in a very dispersed fashion. There are many actors and decision makers (men, women, children who engage in subsistence farming, commercial farmers, investors, scientists, academics, politicians), who operate quite independently but together they determine the food security of our future. There are some very knowledgeable farmers who use state of the art scientific technologies, and there are some who use traditional knowledge and also gain very good results. However, two-thirds of the world’s agricultural lands are affected by soil degradation.

There is a sense of urgency for building a more foolproof system to deliver food security. A good information network that facilitates the sharing of farming knowledge is necessary to help bring everyone up to date on how to maximize farm productivity, without causing further harm to the fragile farmlands and the surroundings. The adoption of the precautionary principle is important for making wise decisions that preempt damage before it occurs. However, the awareness of exercising caution has to be derived from a good knowledge base and experience. There has been some discussion about the documentation of indigenous knowledge to sell as a commodity for supporting rural development in the developing countries. Private sector biotechnology research is also churning out GMOs as commercial commodities. A regulatory framework will perhaps be necessary to help facilitate the exchange of knowledge and wisdom for sustainable agricultural development, in the event of rapid privatization of knowledge.

Sustainable agriculture and farming must begin with a better understanding of the overall global land resources, and will depend on strategic planning that is sympathetic to a bioregional perspective. It is also about trying to optimize the productivity of farmland using sustainable and regenerative agricultural practices. The world’s environmental resources are unevenly distributed and location specific. In certain

circumstances, trying to achieve food security for a locality where the preconditions for successful farming do not exist, is frivolous, and might not be desirable from an ecological point of view. Similarly, if the promise of biotechnology is so remote from delivering the goods that give the poor and hungry a better livelihood, and give everyone of us a better nutritional status and good health, the objectives of biotechnology must be revisited. Furthermore, the rules for biotechnology research and application, either too stringent or too loose, can hurt the prospect of food security in the future. Biotechnology offers new opportunities but one must proceed with caution.

Agricultural crops are a commodity of the agribusinesses. Commercial crops are also part of the biological system. Centuries of cultivation of land and, specifically, the last forty years of intensive farming, have had an enormous impact on the range, distribution and density of wild plants and animals. Some arable weeds, which adapted well to agricultural practice in the past, are now considered endangered, due to the use of pesticides and fertilizers on farms. Any new agricultural innovation, or genetic modification of organisms, must pay attention to this and contribute to solving the problem. By the same token, agri-business must therefore be cautious of any environmental impact that its activities may generate.

Sustainable business principles are also useful for guiding the agri-business operation. As mentioned in Section 4, there has been a revolution in business thinking, shifting from one that sells products to one that sells services. This approach is also applicable to commercial sustainable agriculture. It implies that commercial growers should pay attention to the health and nutritional needs of consumers, and produce crops that would satisfy the need for good health and good nutritional diet of those who buy the produce. In other words, a sustainable agri-business sells more than just food, it is contributing to a safe and healthy diet.

Agriculture is not only a commodity, it is also a livelihood for many who live in the rural communities of the developing countries, where poverty and hunger are rampant. However, it must be noted that improving agricultural productivity is not the only lever to get the disadvantaged rural population out of hunger and poverty. Also needed are an increased amount of food being produced and traded, the rise in income level of the poor, and a greater proportion of investment going to agriculture and rural development. There are 150 million underweight children in the developing world.

Women who expend a great deal of energy on farming received the least proportional amount of calories in diet. The existing weaknesses in rural institutions and society that impede development and progress must be addressed. In particular, women's role in rural development and agricultural productivity ought to be emphasized. A great number of women in developing countries are farmers as well as meal providers for children. Acknowledging women's equal status, allowing them to have equal access to education and information, to land rights, and to financial assistance are very important for helping them to become better farmers, and better gatekeepers of nutrition. Any planning strategy that fails to address the significance of women as partners in development and agricultural reform will be neither effective nor ethical.

The 1992 *UN Convention on Biological Diversity* signed by over 178 governments at the Earth Summit provided a commitment among all the signatory countries to develop an international legal regime or protocol on the transfer, handling and use of genetically modified organisms (GMOs). In 2000, this process finally culminated in the adoption of the *Cartagena Protocol of Biosafety*, which endeavors to regulate the international transport and release of genetically modified organisms to protect natural biological diversity. This protocol is the first legally binding international instrument to explicitly include a precautionary approach as a fundamental element of decision-making. The protocol also provides for the eventuality should conflict arise between the protocol and the provisions of international trade rules: if such a situation occurs the parties agreed that the *Biosafety Protocol* would take precedence. The *Biosafety Protocol* can also be considered an important companion for sustainable agricultural development.

Achieving food security in any locality requires the devising of a strategic approach to development by the local community. This development plan must take into account how to best capture the domestic food security potential, with a view to not compromising in any way the global inventory of farmlands and long-term prospect for food production. The decision as to whether to produce food domestically or to depend on food imports, would also be determined on the comparative pricing of food crops against other commodities. The design of international trading regimes ought to reflect the goal of global food security, so investment regimes and politicians must also join hands with research scientists, farmers and consumers to pursue this goal.

6. What are its Implications for Civil Society, NGOs, and Individuals: Education and Awareness?

Civil society is a term applied to the political space in which the public interest of individuals and groups, apart from governments and businesses, can be expressed and help influence matters that affect the public. Under the provision of UN Resolution 13 (1), Non-Government Organizations (NGOs) are formally associated with the United Nations through the Department of Public Information. Thus NGOs become the UN's means for reaching and mobilizing support from the grass roots. Further to this, in 1968, the UN General Assembly Resolution 1296, provides individual UN agencies and programs autonomy in devising procedures to ensure NGOs' access. Recently the UN has adopted the term "Civil Society Organization" (CSO) in preference to the term NGO, thereby giving greater prominence and definition to the concept of civil society.

The 1992 Earth Summit in Rio de Janeiro and the emergence of the concept of sustainable development have given the United Nations and other international bodies a new way of viewing international relationships. Sustainable development seeks to avert global environmental disasters that could potentially affect all nations, rich or poor. For example, trans-boundary environmental problems are one of the emerging issues of concern confronting global governance. This new focus necessitates the forming of a global alliance to champion common objectives of humanity. Sustainable development calls for cooperation and sharing of responsibility and resources in achieving the global common goal. In addressing issues of governance that lie outside national jurisdictions (e.g. fisheries in the high seas and global warming), the application of the concept of civil society is relevant (see "Sustainability in international law"). Under the auspices of

a global civil society, nation states as well as international agencies could find the legitimacy to exercise influence and authority in the interests of safeguarding our common future.

Sustainable development provides a point of departure for a constructive critique of existing government structures and systems, locally, nationally and internationally in order to make fundamental but peaceful changes in global society. According to *Agenda 21*, the key prerequisite of successful implementation of the concept of sustainable development, is broad public participation in decision-making. Sustainability imposes a common challenge to everyone, and our knowledge of how to solve the problems is still very limited. A multi-stakeholder approach is necessary to create a more integrated framework for understanding the implications of our actions, and to begin building the knowledge foundation for advancing our decision-making power. Decisions that have failed to take into consideration the realities of any sector of society will not likely be able to take care of the needs of those people, and will create imbalances as a result.

Education and public awareness can “lead” people (the literal meaning of education is “to lead out”) to change attitudes, reconsider their lifestyle, adopt a public spirit, and ultimately make wiser decisions in the home, in the economy, and in the public sphere. The availability of good information about the environment and society is an essential complement for informed citizenry. As we improve the effectiveness of our governance systems at all levels from the local to the global, civil society groups will have to assume a more significant role in shaping our society.

Agenda 21 and, subsequently, the Commission on Sustainable Development (CSD) have also employed the term “major groups” which includes business and industry, women, children, non-government organizations, indigenous peoples, local authorities, workers and trade unions, scientists and technologists, and farmers. This has further extended the network and the reach for engaging in a dialogue on sustainable development. *Agenda 21*'s approach of forming partnerships with groups and individual citizens (in parallel to those with governments), can potentially motivate and accelerate government and business reforms. This partnership will perform well in a civil society, where pluralism of thought and opinion must be encouraged by public institutions. Businesses respond to consumer preferences and trends in consumption. Therefore, when individuals indicate their consumer preferences, for example in buying green products, organic fruits and vegetables, these individual-level decisions to prefer green products or purchase organic food, taken together, will modify business behaviour and provide encouragement and support for various kinds of sustainable enterprise.

Beyond the advocacy role of helping to galvanize government support, there is a special need for involving NGOs in the building of knowledge. NGOs articulate the interests of the grassroots, or those who are “on the ground,” close to the source of the controversy or problem. Researchers and practitioners need to learn about the grassroots' experience, their observations, and the local or traditional ways of dealing with problems. The benefits go both ways. The applied aspect of this new knowledge, which is commonly called public information, can then be returned to the grassroots and become a useful resource for helping the affected and the local decision makers. This

kind of informal education is a key instrument for promoting sustainable development. The media and NGOs play a significant role in disseminating public information.

To the United Nations, CSOs have proved to be much more than a conduit for dissemination of information for the Department of Public Information. They have become a very creative force in designing and implementing research, outreach, and monitoring and evaluation programs, and have contributed to the shaping of the Earth Summit, *Agenda 21* as well as the various Rio agreements. The broad sectoral and geographic coverage of these non-governmental organizations makes them very significant partners in effecting changes everywhere. NGOs have access to communities, and they can help to ensure that local communities and governments at all levels strengthen their commitment to sustainable development.

Since Rio, the International Council for Local Environmental Initiatives (ICLEI), an international environmental agency focusing on issues of local government, has promoted sustainable development programs and projects in various formats, at all levels of decision-making, all over the world. In 1995 ICLEI recruited 113 municipalities worldwide to help implement the *Framework Convention on Climate Change*, which is one of the Rio agreements. This marks an important first step for these cities to form partnerships with ICLEI, to begin searching for ways to become responsible for their greenhouse gas emissions.

ICLEI also submitted a *Local Agenda 21* proposal, which was endorsed at the Earth Summit. The proposal was to help local municipalities build capacity for sustainable development planning. ICLEI designed the first general approach to local sustainable development planning, which was further developed and refined with input from fourteen municipalities from around the world. Subsequently, a much larger *Local Agenda 21* Communities Network was formed. This network is made up of local governments and associations of local governments, which have adopted the *Local Agenda 21* planning processes. ICLEI is continuing to expand this network, fostering exchange among the network members, and providing members with technical assistance. In collaboration with other European networks, ICLEI also presented the European Sustainable Cities and Towns Campaign, and as a result of it, the *Aalborg Charter* was adopted by 300 representatives, 80 European communities committed to the establishment of the *Local Agenda 21* processes and long-term environmental action Plans.

The *Local Agenda 21* process has generated innovative approaches to sustainable development. The multi-stakeholder participatory methodology has enabled women to gain access to the local political system and achieve various forms of results, thereby to advance the cause of sustainable development. In Heidelberg, Germany, the gender department of the city council initiated an attempt to plan the city with gender specific considerations. In Amstelveen, Netherlands, women seek to improve their environment through changes in policy. In Hamilton, New Zealand, the city seeks to maintain meaningful women's representation in environmental decision making roles. In Kurdzhali and Stara Zagora, Bulgaria, women draw attention to the conflicts of interest arising from employment opportunities offered by polluting industries, and the industries' impact on public health. In Cajamarca, Peru, even in the absence of a legal

framework to support their involvement, women fight against urban encroachment, and raise concern over water access and usage. In Rio de Janeiro, Brazil, women created a model for mobilizing women's participation in sustainable development. In Santos, Brazil, women advocated the wise use of resources, reduction of waste and environmental education.

To date, there are over 3,000 communities in the world participating in the *Local Agenda 21* initiatives. The multi-stakeholder approach to decision-making, identification of priorities, finding solutions and implementation encompasses the ideal of civil society, and is found to be adaptable by different forms and sizes of communities, from rural villages to large metropolitan centers.

In addition to the work done by formally structured NGOs, there are many other local level sustainable development projects, including numerous women's initiatives. Many women, including some living in traditional societies are making important contributions to sustainable development. Examples include: women activists of countries bordering the Mediterranean Sea working together to devise strategies for mobilizing international and local support to look into the military and industrial pollution problems in the Mediterranean. Russian women revealed the disposal of radioactive waste from the nuclear armament industry into the River Techa, the drinking water source for the rural community in the Chelyabinsk region. Rural women in Bangladesh helped to discover naturally occurring arsenic contamination in the underground water. This has led to national and international NGOs' involvement in survey and monitoring of health effects, as well as negotiation with government and international agencies to assist in the crisis.

Many kinds of health damage are caused by environmental contaminants that do not manifest themselves immediately as visible symptoms in the affected person. In the case of contamination by endocrine disruptors, the evidence of health effects may take as long as a generation or two from the time of exposure. The effects may emerge in the offspring of those who have been exposed to the chemicals. In addition, toxin may be cumulative, and may also compromise the immune system, and/or nervous, reproductive and endocrine functions. Obviously there is no advantage in waiting for the symptoms to appear, to start looking for a solution, as the damage by then may be irreversible. The impact on the future population may be massive and long term. Avoiding this kind of environment problem requires environmental stewardship of very well informed citizenry, businesses that are environmentally responsible, a system to facilitate the detection of pollutants and communicate the findings, a government, which is committed to the principle of precaution in development, and a civil society arrangement to empower the vigilant public. This example illustrates the joint responsibility for sustainability that must be acknowledged and acted upon by all sectors of society, and by all individuals.

An impressive number of NGOs have developed into reputable international organizations, aided in their global activities by the powerful communication capabilities provided through the internet and other forms of high speed communication. Many have acquired considerable capacity in research, in consultancy, in lobbying, and have established authority in some specialized fields. The World Wide Fund for Nature

(WWF) has been involved in the activities of the Intergovernmental Forum on Chemical Safety (IFCS) and the Pollutant Release and Transfer Registers (PRTR) since their inception. In effect, NGOs have become partners in international policy-making. WWF is working with government, and international agencies, under the auspices of IFCS, in promoting innovative policy responses to chemical contamination issues, such as the PRTR toxic tracking tool and systematic programs to reduce pesticides. And IFCS is coordinating and guiding the reduction and elimination of persistent organic pollutants (POPs).

Education at all levels is an important instrument for sustainable development. This imperative is well recognized in *Agenda 21*, where the term education appears more than 600 times. It is mentioned in every one of the forty chapters, and is the focus of Chapter 36 on “Education, Awareness and Training.” In this chapter, three modes of education are identified: formal, informal, and non-formal. “Formal” education is what happens in the classroom. “Non-formal” education comprises educational work done outside the school system by governments, NGO’s, and businesses. “Informal” education comprises the multitude of cultural influences that affect what people think, believe, and value. In modern industrial societies the mass media are important agents of informal education, but religion, theatre, literature and community discussion are also important modes of informal education.

For each of *Agenda 21*’s forty chapters, a UN agency was assigned the job of serving as “task manager.” Chapter 36 was assigned to UNESCO, the United Nations Educational, Social and Cultural Organization. Furthermore, when the 1992 Earth Summit concluded, the UN took seriously the words of Secretary-General Maurice Strong, who warned that follow-up was absolutely essential if the countries of the world were to be able to move “from agenda to action.” Accordingly, the UN established a new agency, the Commission for Sustainable Development (CSD); and put in place a provision that all countries and all UN agencies would be required to report “progress” on implementing *Agenda 21* at a “Special Session” of the UN General Assembly to be held five years later in June 1997.

Education helps to heighten the level of awareness, the ability to understand, synthesize information and make better judgments. Education for sustainability must embrace the principle of equity emphasizing equal access, for males and females, rich and poor. The curriculum of education must be interdisciplinary, introducing a balance in economic, social and ecological perspectives, local and global understanding. It must include the sciences that help us to think logically, and discover more about the physical world around us, and the arts, that bring back the human spirit of hope, culture and creativity. The development of skills or ability to integrate the science and the arts, the economic, social and ecological knowledge into an analytical framework for different disciplines has to be an important focus. This will greatly facilitate any form, at any level, of management of human affairs. Moreover, education for sustainable development must also foster a love for learning, making learning a lifelong pursuit; and should aim to instill a basic understanding of how complex systems function and interrelate.

Recognizing the importance of Education for Sustainable Development (ESD) is an obvious first step. Developing effective strategies to reorient the education system to deliver it is far more challenging. There are nearly 60 million teachers in the world.

Most of them know very little about the concept of sustainability or the commitment all nations made in signing *Agenda 21* to promote ESD. As the UN “Task Manager” for Chapter 36, UNESCO has developed a focus on ESD and has held numerous conferences and meetings to discuss how to implement it. One strategy is to concentrate on teacher education, and an ambitious project is in place to work with dozens of countries to help them “reorient” teacher education on the basis of a “strengths model” which recognizes the contribution every teacher can make to sustainability education instead of focusing on the “deficit” of specific knowledge and training in sustainability concepts. In discussing the opportunities for promoting formal sustainability education, it is essential to recognize that the benefits of formal education are very limited in many countries of the South. For Latin America as a whole, the average number of years spent in school is six; the average completion level is Grade 4. In some countries of Africa, the average time in school drops to a few months. So adult education, and informal education, are arguably at least as important as formal education when it comes to promoting understanding and public awareness of sustainability.

On the other hand, a recent UN study revealed that the global problem of illiteracy and lack of access to basic formal education could be rectified with the expenditure of funds equivalent to the amount of money Europeans spend annually on ice cream, or North Americans spend each year on cosmetics. Despite this, it is unlikely that the requisite funds will come available in the near future.

Public awareness (achieved through informal and non-formal education) is also a precondition for citizens to better exercise their freedom of choice. This includes consumer choice, and choices that one makes in a professional capacity. Public awareness, along with education, can help streamline efforts in facing the sustainability challenge at all levels. Public awareness can be fostered by better access to, and the availability of, information about the goods that one consumes, the environmental and social performance of businesses, government conduct, etc. In recent years, there has been a growing range of examples of this type of information. For example, “fair trade” products have been in the market since the 1980s. Now there is the development of certification for eco-labels; labeling of genetically modified crops (GMOs), organically grown farm products. Also, the certification of environmental management systems ISO 14000 in business operations, the publishing of state of the environment reports by businesses, governments, and international agencies, the establishing of information data base, such as the “Pollutant Release and Transfer Registers” are such examples. Some Civil Society Organizations has taken this kind of information and made it available on the internet in powerful ways that serve well the public’s “right to know” about environmental conditions that affect their health and the well-being of ecosystems.

The concept of a multi-stakeholder participation in decision-making, has made some progress in recent years. The private sector, which is producing most of the wealth of today, is a key stakeholder that must, therefore, be included alongside civil society organizations and governments. But multi-stakeholder processes face many barriers. Women’s participation in sustainable development is still considered relatively low priority, and is not geographically balanced. Insufficient funding prevents many people and organizations from taking part in meetings and gaining access to processes. The

concern over representativeness of some CSOs sometimes limits their legitimacy and always raises issues of accountability. The multi-stakeholder processes are still often ad hoc and are not a part of institutionalized mechanisms. Public information is slow in coming. Governments, NGOs and international agencies, due to the lack of funding, have also had to cut back on plans for effective participation.

Nevertheless, the multi-stakeholder approach is useful in creating new fora and new processes to engage all the key members, in particular the business community, trade unions, local authorities, the scientific community, NGOs, in a civil dialogue about the future.

7. What Progress Has Been Made?

Viewing the earth from space gave us a tangible picture of the whole global system. It has heightened our awareness about the earth's fragility, and the systemic linkages that form our life support system. Technology has given us the tool to observe, monitor, and assess the physical, chemical, and biological aspects of change in the natural environment, and has helped us to learn about the various levels of impact that human activities have on the environment. Satellite technologies, amongst others things, have enabled us to observe the earth's changing processes from the outside and, thus, have extended our research capacity both in scale and in scope. Time-series data generated from remote-sensing and in situ observations have told us a great deal about nearly every aspect of earth's ecosystems, including the oceans, the ozone layer, the upper air, global forest coverage, ocean biology, and so on. In 2001, the Intergovernmental Panel on Climate Change (IPCC) gave the following report:

- An increasing body of observations gives a collective picture of a warming world and other changes in the climate system.
 - The global average surface temperature has increased over the twentieth century by about 0.6 °C.
 - Temperatures have risen during the past four decades in the lowest 8 km of the atmosphere.
 - Snow cover and ice extent have decreased.
 - Global average sea level has risen and ocean heat content has increased.
 - Changes have also occurred in other important aspects of climate, for example: redistribution of precipitation, more frequent and intense droughts in parts of Asia and Africa.
 - Some important aspects of climate appear not to have changed, for example: a few areas of the globe, mainly over some parts of the southern Hemisphere oceans, and parts of Antarctica, have not become warmer; no systemic changes in the frequency of tornadoes, thunder days or hail events.
- Emission of greenhouse gases and aerosols due to human activities continue to alter the atmosphere in ways that are expected to affect the climate system.
- Confidence in the ability of models to project future climate has increased.
- There is new and stronger evidence that most of the warming observed over the last fifty years is attributable to human activities.
- Human influences will continue to change atmospheric composition throughout

the twenty-first century.

- Global average temperature and sea level are projected to rise under all scenarios employed (the IPCC *Special Report on Emission Scenarios*).
- Anthropogenic climate change will persist for many centuries.

Our new knowledge of the global system is a product of advances in geomatics, global observation technologies, and integrated research design. The “Integrated Global Observing Strategy,” bringing together major satellite and surface-based systems for global environmental observations of the atmosphere, oceans and land, has made possible the generation of very useful global data on a regular basis. This has assisted in formulating forest management strategies, in launching initiatives for the protection of coral reefs, in raising awareness about the possible social, economic, and political impacts that could be caused by, for example, the rise of global surface temperature; changes in precipitation magnitude, intensity and geographical distribution; and the disappearance of coastal areas. New technologies have enhanced transnational discourse such as that encompassed by the *United Nations Framework Convention on Climate Change*.

New methodologies of assessment and evaluation of progress toward sustainability have also been adopted by the social sciences and applied to measure societal development. In recent years, significant progress has been made in the development of performance indicators in the social, natural resource, economic, and institutional domains. These indicators articulate the conditions of a dynamic society, comprise essential background information for planning, and contribute to the statement of management goals and standards and to the formulation of legal arguments. They facilitate systematic comparison of progress over time and across communities. Potentially, they can be essential measurements of policy performance, providing evidence of progress or failure. As well, they are communication tools, applicable for use in broad-based consultation, and for decision making.

In recent years, the Commission on Sustainable Development has been active in developing “Indicators of Sustainable Development,” with the aim of using them as measures of progress in communities around the world. A major obstacle, however, has been that not every country has the resources necessary for comprehensive data collection. Other concerns are: the reliability of data, the accessibility of data to others, the applicability of some indicators to certain communities, and whether the indicator design is holistic, and capable of exposing the undercurrents of societal functions. These are some of the intricate problems that still need resolving through greater international coordination and cooperation. Because the design of indicators is based on value assumptions, indicators developed to measure sustainable development are preferably a multi-stake-holder initiative; accordingly, a pluralistic perspective of what constitutes sustainability will be represented in the design.

A long term monitoring program to collect data on key aspects of the global ecology and the human community will provide multidisciplinary insight about the world. The measurements of societal progress and global ecology will contribute to the creation of a global database, and this will serve as an invaluable intellectual reservoir for managers, planners and decision-makers at all levels. The *Global Environmental Outlook* (GEO), a

relatively new UNEP publication, which provides an up to date assessment of the state of the global environment and policy responses, and other such publications are derivatives of this kind of monitoring and data collection process. Thirty-five GEO centers have been established around the world to collect and synthesize data of regional and global value. Many nations have also begun to publish state of the environment reports as a form of public information. Large corporations have also been issuing sustainability performance reviews of their operations not simply for their share-holders, but more importantly for their stakeholders. Stakeholder engagement is considered an essential component of a sustainable enterprise business approach. Similarly many NGOs publish their data and perspectives for their membership and for the general public. Underpinning the many pages of words and figures describing and analyzing environmental conditions, and the progress that has been made in advancing the sustainable development cause, there are numerous research processes at work churning out information at every level and in every sector of society.

Reporting is often used as a monitoring and communication tool required by multilateral treaties. Under the *Framework Convention on Climate Change*, all parties must report at regular intervals to the conference of the parties. The initial report must include the national inventory of anthropogenic greenhouse gas emissions data, accompanied by an implementation plan and relevant supporting information.

New information technologies (IT) have created unprecedented opportunities for sharing and exchanging information. The World Wide Web, for example, has opened new avenues for public participation in all kinds of global affairs. In some ways, the information technologies have greatly facilitated accessibility of information for the public. They enable instantaneous sharing of information by different users and, because of this, many new kinds of international cooperation can be possible. The World Wide Web can deliver satellite-based information service to any Internet user (see “Sustainability, knowledge management, and the Internet”).

Unfortunately, there are many emerging problems in information technologies such as the accuracy or inaccuracy of some web information. And information technologies, like many other technologies, are still beyond the reach of a major portion of the global population, thus, limiting any claim as a universal forum for global civil society. Called the “digital divide,” the problem of unequal access to IT and the wealth of knowledge and information it makes available has introduced another important fissure between the “haves” and “have-nots.” This division will grow in importance as digital information and knowledge becomes increasingly critical to the functioning of the economy, politics, and society generally.

There has been a great deal of emphasis on scientific solutions to support sustainable development. In the *Convention on the Conservation of Biological Diversity* (1992), the *United Nations Framework Convention on Climate Change* (1992) and later the *Agreement on Desertification* (1994) the scientific and technological ability to evaluate environmental performance, identify problems and find solutions have been emphasized. Many legal treaties also make provision for the creation of scientific and technological bodies. As a recent United Nations report pointed out, however, there are wide gaps between identifying needs for solutions and the actual attainment of effective

solutions for our environmental problems. There is a need for greater collaboration among the scientific disciplines in developing measures for achieving sustainable development.

Furthermore, *Agenda 21* prescribed the principle of “common but differentiated responsibilities” as the strategy to engage every nation in the sustainable development process. This principle reflects the reality that certain nations may have limited domestic capacity to commit and take part in environmental clean up and related reforms, yet their participation is important to the overall effort. *Agenda 21*, instead, has placed great expectations on the developed nations’ technologies to solve the problems for the third world, and the world as a whole.

Unfortunately, in addition to the problem of inadequate development in science and technology research, technology transfer to the third world is further hampered by a lack of assistance in funding. This is related to the global phenomenon of public sector offloading. In recent years, the private sector and the market mechanism, much assisted by a series of changes towards greater liberalization of international trade and investment, are presumed to have taken on a bigger role in delivering the welfare function domestically and internationally. A recent report of the Commission on Sustainable Development pointed out that since the Earth Summit, the volume of overseas development aid (ODA) has been on a general downward trend, from US\$58.3 billion in 1992, to US\$53.1 billion in 2000. The distribution of aid, during this period, has also been restructured by the donor countries according to their cost-effectiveness assessments. As a result, most of the least developed countries suffered a decline in aid of at least 25 percent. This reduction in ODA, however, has been accompanied by an increase in foreign direct investment in this period. The increase in foreign direct investment has been uneven; only ten countries received about 80 percent of the total amount. At the same time, expenditure on arms and the military have been increasing, particularly after September 11 2001, and President George Bush announced in his 2002 State of the Union address that there would be a further increase to the US\$1 billion a month military spending on the current war. Shortly afterwards Bush’s security advisor mentioned the additional request was US\$48 billion. This increase alone would have gone a long way towards satisfying a wide range of global needs related to sustainable development.

The reduction in availability of financial aid and the reassessment of funding criteria have not been helpful for some developing countries, which were ill-equipped in the first place to cope with meeting traditional basic needs. The lack of financial support to back the commitments made at the Earth Summit has been blamed for the slow development in *Agenda 21* initiatives in third world countries and elsewhere.

In 1992, the Global Environment Facility reoriented its operation to render the much needed financial support required for *Agenda 21* initiatives. Among other things, it has provided assistance to national capacity building programs as well as to NGOs and community groups engaging in sustainable development efforts. In addition, a great deal of effort has been spent by stakeholders at all levels to raise funds for sustainable development.

It is clear that the private sector, which generates most of the world's wealth, has a key role in sustainable development in both the North and the South. The WBCSD paper outlining "The Business Case for Sustainable Development" presents compelling arguments for the adoption of sustainability as a strategic imperative for the twenty-first century. The United Nations has introduced the "Global Compact" to engage the private sector in multi-stakeholder meetings, to adopt global citizenship norms and to participate in the sustainable development process. Despite the fact that bold steps have been taken in building new institutions, framing new decision-making processes, creating new legal frameworks, fostering research networks, etc., no one can yet claim possession of a grand plan for sustainability. Without this definitive blueprint, all organizations embarking on the path toward sustainability must use the principles of "adaptive management" based on continuous learning and response to feedback of various kinds.

The greatest challenge to the implementation of sustainable development lies in the formulation of a joint learning, co-evolving process, as discussed in "Culture and sustainability". Apparently, the difficulty originates in the ill adaptation of human culture to nature. Sustainable development is about finding solutions to problems that are intrinsic in the human system. Humanity's power to detect, diagnose, and prescribe solutions to those problems is limited by our own level of awareness, the capacity of our institutions to transform our society, and the ability of our society to attain consensus, and to seek solutions. Sciences offer one aspect of human creativity. Research design for sustainable development requires the integration of both the sciences, and the arts. To date the one most important ingredient missing from the recipe for achieving sustainability is political will. Developing sustainability champions and leaders at all levels from the local to the international and across all sectors of society has become an urgent imperative.

Empathy that extends one's own reality and concerns, intuition that is grounded in knowledge, aspiration that leads to triumph—these messages, embedded in literature, in the holy books, in stories of human struggle, are the motivation behind all human progress, the underpinning of humanity's spirit of survival, and our inspiration for advancement. Ultimately sustainability offers society the challenge and the opportunity of making wise choices that will lead to a brighter future for humankind and the planet.

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Glossary

Carrying capacity: The maximum population that can be supported by a given area, without causing any reduction in the ability of the area to support future population.

Climate change: Change in climate over time due to natural variability or human activities.

Desertification:	The destruction of topsoil due to lack of water, followed by loss of the land's ability to sustain crops, livestock, or human activities.
Ecological footprint:	The land and water area that is required to support indefinitely the material standard of living of a given human population, using prevailing technology.
Half-life of nuclear waste:	The time it takes for a given radioactive isotope to lose half of its radioactivity.
Intensive farming:	A farming method, which employs a large amount of energy and resources to make each unit of land as productive as possible.
Natural capital:	The stock of natural assets that yields goods and services on a continuous basis.
NGO (Non-governmental organization) :	Any non-profit, voluntary citizens' group that is organized on a local, national, or international level (also known as CSOs : civil society organizations).
Overshoot:	When activities of a population lead to exceeding available carrying capacity, potentially causing long-term loss in productive potential of the habitat.
Photosynthesis:	The biological process in chlorophyll-containing cells that converts sunlight, CO ₂ , water, and nutrients into plant matter (biomass). All food chains, which support animal life including our own, are based on this plant matter.
Salinization:	The rising level of salt in soil. The origins of salt may be from mineral weathering, inorganic fertilizers, soil amendments (e.g. gypsum, compost and manure) irrigation water, as well as salt in ice melters used on roads and sidewalks, or seawater flooding of coastal areas.
Social capital:	The capacity to establish and operate formalized institutions necessary for governance in the public sector, private sector and civil sector; also physical facilities and services, like schools and hospitals, serving community needs.
Strong sustainability:	A perspective on sustainability which insists that the overall stock of capital be "constant" or increasing, with an emphasis on maintaining or enhancing the stock of natural capital.
Systems thinking:	Discovering, mastering and applying an understanding of the principles and functioning of complex systems to decisions about ecological or social problems.
Transgenic area:	Area that is designated for growing genetically modified crops.
Weak sustainability:	A perspective on sustainability, which insists that the overall stock of capital be "constant," but which allows for depletion of natural capital to be offset by increases in manufactured capital.

Bibliography

Bell, D.; Halucha, P.; Hopkins, M. 2001. *Sustainable Development Concept Paper*,

<http://www.yorku.ca/ycas/publications/index.html>. 19 pp. [This paper discusses the concept of sustainable development, its implications and the role of government in meeting the challenge.]

Bell, D. V. J.; Myers, J. 2001. *Seizing the Opportunities, Seizing the Future: A Discussion Paper for Natural Resources Canada*, <http://www.yorku.ca/ycas/publications/index.html>. 55 pp. [This paper highlights the importance of sustainability as a priority issue for business in the new economy and for public policy in Canada, and suggests strategic initiatives to be undertaken in the next few years.]

Bell, D. V. J.; Schwartzberg, P. 2001. *Advancing Community Sustainable Development in the Ontario Region: The Role of the Government of Canada*, <http://www.yorku.ca/ycas/publications/index.html>. 27 pp. [This paper outlines the importance and meaning of sustainable development, and pursues its application to community development in Canada.]

Cheung, Y.-K. A. 1997. *Chapter Two: The Concept of Sustainable Development. An Environmental Assessment Approach for Hong Kong and the Pearl River Delta: Principles and Practices*. Ph.D. Thesis, The University of Hong Kong. 48 pp. [This thesis covers the emergence of the concept of sustainable development, its various definitions and interpretations, its implications at the global and local levels, barriers to sustainability, and its policy implications.]

Dolzer, R.; Thesing, J. (eds.) 2000. *Protecting Our Environment: German Perspectives on a Global Challenge*. Germany: Konrad-Adenauer-Stiftung. 580 pp. [An exposition of sustainable development in terms of concept, and how it has been translated into international policies and regimes. It also has a section on environmental protection in German domestic law.]

Foster, J. 2001. *Knowing Ourselves: A Brief History of Emerging Global Civil Society: Prepared for the 4th CIVICUS World Assembly August 2001*, Vancouver, B.C., Canada. 10 pp. [This paper considers the evolving concept and practices of global civil society, and the opportunities and challenges that the civil society organizations are confronting in the present world.]

Intergovernmental Panel on Climate Change. 2001. *Summary for Policymaker, A Report of Working Group I of the Intergovernmental Panel on Climate Change*. <http://www.ipcc.ch>. 20 pp. [This paper summarizes the findings on climate change.]

International Council for Local Environmental Initiatives (ICLEI), CAG Consultants and the Division For Sustainable Development of UNDESA. 1999. *Study on National Obstacles to Local Agenda 21*. <http://www.un.org/esa/sustdev/iclei.htm>. 26 pp. [A review of *Local Agenda 21* initiatives as an attempt to identify obstacles and barriers experienced at the local level, and the use of this information to create a framework of policy analysis for governments at all levels.]

Lerner, S. (ed.) 1992. *Environmental Stewardship: Studies in Active Earthkeeping*. Department of Geography Publication Series, No.39, University of Waterloo, Canada. 453 pp. [This book focuses on earth stewardship at the grassroots level, and includes experiences of various environmental groups.]

Mashishi, M. 15 October 2001. *Time for a New Global Compact*, *Daily Mail* and *The Guardian*, UK, <http://www.mg.co.za/mg/archive/2001oct/features/15octcompact.html>. 4 pp. [The role of the business sector in the sustainable development movement is discussed, with an emphasis on the September 2002 Johannesburg World Summit on Sustainable Development and its themes of “poverty, environment and development.”]

North American Commission For Environmental Co-operation 7 January 2002. *The North American Mosaic: The State of the Environment Report*, <http://www.cec.org/pubdocs/documents/index.cfm?varlan=english&ID=629>. 100 pp. [This paper presents information about environmental conditions in North America, and the implications of human activities for policymakers and private citizens.]

ORR, D. W. 1991. *Ecological literacy: Education and the transition to a postmodern world*. Albany, State University of New York Press. 210 pp. [This book underlines the need to reorient our education system for sustainable development: to include new discoveries and analysis of our finite natural system in the education curriculum and agenda.]

PRAKASH, C. S. 2000. *Scientists Release Declaration Defending Biotechnology: Genetically Modified Foods Called Beneficial and Safe*. January 22. <http://www.plant.uoguelph.ca/riskcomm/archives/agnet/2000/1-2000/1g-01-23-00-01.txt>. 1 p. [This paper outlines the benefits of biotechnology in crop production in satisfying food demands and environmental protection.]

Stave, J. W.; Durandetta, D. 2000. GM Crop Testing Grows Amid Controversy. *Today's Chemist At Work*, Vol. 9, Nos. 6, 32, 33, 37. <http://pubs.acs.org/hotartcl/tcaw/00/jun/stave.html>. 5 pp. [Without some fundamental reforms in the distribution system, the labeling of agbiotech crops cannot be an effective way for differentiating agbiotech crops from conventional crops, although the detection technology is available for most agbiotech crops.]

UNCTAD. 2000a. *Management of Biotechnology Seen as Crucial to Developing World*. July 19. <http://srch1.un.org:80/plwebcgi/fastweb...and&TemplateName=predoc.tpl&setCookie=1>. 3 pp. [The risks and opportunities of biotechnology, and the issue of its ownership and transfer to developing countries are discussed.]

UNCTAD. 2000b. “*We can't turn back the clock on globalization,*” *World Bank President Tells UN Trade and Development Conference*.” February 16. <http://srch1.un.org:80/plwebcgi/fastweb...and&TemplateName=predoc.tpl&setCookie=1>. 11 pp. [The World Bank President talked about poverty in the world, and the Bank's new approach, called “Comprehensive Development Framework,” to address the interdependent – social, structural, human, institutional, environmental, economic and financial – aspects of development.]

WBCSD AND UNDEP. 1999 *Eco-Efficiency and Cleaner Production: Charting the Course to Sustainability*. May 1999. <http://www.iisd.ca/linkages/consume/unep.html>. 13 pp. [This paper describes a series of collaborations between UNEP and the business sector in promoting ecoefficiency and cleaner production, within the business sector and with government partnerships.]

United Nations Press Release. 2000. *Commission on Sustainable Development Concludes Two-Day Dialogue on Sustainable Agriculture*. April 25. <http://srch1.un.org:80/plwebcgi/fastweb...and&TemplateName=predoc.tpl&setCookie=1>. 10 pp. [Opinions expressed by representatives of government, industry, farming, trade unions, and non-government organizations, on the impact of globalization, trade liberalization and investment patterns, including economic incentives and framework conditions, on sustainable agriculture.]

United Nations Press Release 25 April 2000. *Commission on Sustainable Development Holds Dialogue on “Knowledge for a Sustainable Food System”*. <http://srch1.un.org:80/plwebcgi/fastweb...and&TemplateName=predoc.tpl&setCookie=1>. 10 pp. [Opinions expressed by representatives of government, industry, farming, trade unions and non-government organizations, on “knowledge for a sustainable food system,” an attempt to identify problems in providing education, training, knowledge-sharing, and information related to sustainable agriculture.]

United Nations Economic and Social Council. 2001. *Implementing Agenda 21: Report of the Secretary-General*. December 20. 63 pp. [It provides a comprehensive assessment of the state of the world, and broad discussion on the progress and achieving of *Agenda 21* activities.]

United Nations General Assembly. 2000. *Report of the United Nations Conference on Environment and Development (Rio de Janeiro, June 2–14 1992)*. <http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm>. 5 pp. [Chapter 1 of the Report of the United Nations Conference on the Human Environment, which include the twenty-seven principles endorsed at the Conference.]

United Nations Population Fund. 2001. Chapter 2: Environmental trends, *The State of World Population 2001*. <http://www.unfpa.org/swp/2001/english/ch02html>. 21 pp. [This paper discusses the linkages between depletion of environmental resources and the human conditions. It includes issues such as water access, food security, loss of biodiversity, and climate change.]

US Office OF The Press Secretary. 2002a. President Delivers State of the Union Address. January 29. <http://www.whitehouse.gov/news/releases/2002/01/20020129-11.html>. 9 pp. [The increase in military budget for fighting the current war was mentioned.]

US OFFICE of the Press Secretary. 2002b. “National Security Advisor Speaks at Conference, remarks by the National Security Advisor Condoleezza Rice to the Conservative Political Action Conference. February 1. 6 pp. [An additional amount of \$48 billion for the armed force budget was noted.]

WCED. 1987. *Our Common Future: World Commission on Environment and Development*. New York, Oxford University Press. 400 pp. [A seminal document, which popularizes the term sustainable development, and has paved the way for more dialogue at all levels, local and international, on the subject, culminating in the organization of the Rio Summit to focus on the discussion.]

Wackernagel, M.; Rees, W. 1996. *Our Ecological Foot-print: Reducing Human Impact on the Earth*. Gabriola Island, B.C. and Philadelphia, PA.; New Society Publishers. 160 pp. [This book attempts to give more concrete meaning to the concept of sustainable development by introducing a measurement tool.]

World Trade Organization. 2001. *Statistics on Globalization*. <http://www.wto.org>. 44 pp. [This paper provides current indicators of economic and social development of the world.]

Biographical Sketches

David Bell is interested in the Politics of Sustainability; the transformation in political practices, policies, institutions, and culture that will be necessary to support sustainability in the twenty-first century. He has served as consultant and advisor to private sector companies and to governments at all 3 levels in Canada and internationally to the G8, the Government of China, and the Government of Jamaica.

A political scientist by training, David was an undergraduate at York University in its earliest years, graduating with his B. A. in 1965. He received his PhD from Harvard University in 1969, and taught at Michigan State University for 2 years before returning to York in 1971. He served as Dean of the Faculty of Graduate Studies (1981-87) and Dean of the Faculty of Environmental Studies from 1992-1996 at York University.

David is Professor Emeritus and Senior Scholar in Environmental Studies and was until July 2003 the Director of the York Centre for Applied Sustainability (YCAS). This Centre, which he founded in 1996, has now evolved into the York University Institute for Research and Innovation in Sustainability (IRIS).

David is currently the Chair of Learning for a Sustainable Future (www.lsf-ist.ca) and co-chair of the Education Alliance for a Sustainable Ontario (EASO), and of the National Education for Sustainable Development Expert Council (NESDEC). He served as a member of the National Round Table on Environment and Economy (www.nrtee-trnee.ca) from June 2003 to February 2007. From December 2002 until November 2006, David served as Chair Of the Board of Directors of Parc-Downsview-Park Inc. (www.pdp.ca), a federal Crown Corporation whose mandate is to create for the people of Canada an “urban greenspace for the enjoyment of future generations” at former CFB Downsview.

David was a member of the Environmental Task Force of the City of Toronto (1998 – 2000) and the Toronto Sustainability Round Table (2000 – 2003). David chaired the SRT Governance Working Group. He was a founding member of the International Sustainability Indicators Network (ISIN) and was also Chair of the Technical Advisory Committee of the Voluntary Challenge and Registry (VCR Inc) from 1997 until 2004. He served for the Minister of Environment (Ontario) as Chair/facilitator of the Expert Panel on the Taro East Landfill which released its Final Report in October, 2000. In July 2005 he was appointed Chair/facilitator of the Toward Sustainability in York Region Advisory Group which presented its Report to the York Region Council in June 2006.

David’s recent papers and chapters include “Education for Sustainable Development: Cure or Placebo?” presented at the IISD/Carleton University Conference *Charting the Future – Learning From the Past: The Path to a Sustainable Canada 1987-2027* October 2007; “Governance Implications of Sustainable Transportation Policy”, presented to the International Forum On Strategy and Policy for Sustainable Transportation Development in China (June 2005, Beijing); “Voluntary Codes and the New Sustainability Paradigm” in Wes Cragg (ed.) *Ethics Codes, Corporations and the Challenge of Globalization* (Edward Elgar, 2005); “The Role of Government in Advancing Corporate Sustainability” (background paper for the G8 Environmental Futures Forum, 2002); “Towards a National Sustainable Development Framework for Jamaica: National Sustainable Development Framework Scan and Approaches for Process Management” (for the ENACT Project/Government of Jamaica, 2003); “Advancing Community Sustainable Development in the Ontario Region: The Role of the Government of Canada” (for Environment Canada, 2001); “Sustainable Urban Communities in Canada: From Rio to Johannesburg” (for the Canadian Earth Summit Secretariat, 2001). He is the co-author (with Glen Toner) of 2 chapters in the UBC Press book, *Sustainable Production* (Glen Toner ed.) published in the Spring of 2006. His chapter on “Canadian Political Culture” will appear in the forthcoming edition of *Canadian Politics in the 21st Century*, co-edited by Glen Williams and Michael Whittington.

David was the writer and host of a series of 12 one hour radio broadcasts for the Open College (91.1FM Toronto) entitled "Sustainability: Canadian and Global Perspectives" that has been broadcast six times in

Canada and once internationally by shortwave from Radio Peace International in Costa Rica. (Available in RealAudio at www.lsf-1st.ca.)

David was Honorary Theme Editor of the Sustainable Development Theme of the *Encyclopedia of the Life Support Systems (EOLSS)*, published in collaboration with UNESCO; and is an editor of the *International Journal of Sustainable Development*. He was a founding core faculty member of the Sustainable Enterprise Academy, developed by the Erivan K. Haub Program in Business and Sustainability in York University's Schulich School of Business.

In May 2007, the City of Toronto honoured David with a Green Toronto Award for Leadership in Sustainability.

Yuk-kuen Annie Cheung's research interest covers a wide range of community, governance and policy issues, using sustainable development as the overarching theme. Her work thus far has addressed concerns over the urban rural divide, environmental protection and management, social justice, human security, multiculturalism, human rights, public participation, peacebuilding, civil society's role in governance, micro-credits and poverty alleviation, and climate change adaptation. Her international work includes Canada, China, and the Democratic People's Republic of Korea.

Dr. Cheung was educated both in Hong Kong and Canada. She received her undergraduate degree with Honours from the School of Urban and Regional Planning, the University of Waterloo, Canada. She was the recipient of the Philip E. Uren Fellowship in 1982. In 1998, she received her Doctoral degree from the University of Hong Kong, specializing in environmental management. In 2007, she attained the Masters Level of training from the United Nations Institute for Training and Research – through the UNITAR-CANADEM Programme of Correspondence Instruction in Peacekeeping Operations.

Dr. Cheung is a designated Consultant with the Asian Development Bank, a Research Fellow of the Asian Institute at the Munk Centre for International Studies, University of Toronto and a Research Associate of the York Centre for Asian Research (YCAR), York University, Toronto.

Dr. Cheung has also served at the Canadian Institute of Planners as Manager, Policy and Outreach (Domestic and International), and taught "Environmental Impact Assessment" and "the Environment and International Relations" at Glendon College, York University. Earlier in her career, she worked in the NGO sector in Hong Kong. She has served as the Vice Chair of PLAYRIGHT, a NGO promoting play opportunities for children in Hong Kong.