CHAPTER II

SUSTAINABLE DEVELOPMENT

2.1 Economic Development

Economic development has long been at the forefront of national agendas throughout Asia and the rest of the developing world. However, the perception of what exactly development is, what benefits it provides, and what the costs are, can change dramatically from person to person and over time. Superficially, the idea of development implies progress, or rather a sense of moving forward towards a desirable, commonly recognized goal. Although development is frequently interpreted and defined differently, nearly all explanations share this common theme. Promoting and advancing the welfare of common people also frequently appears in definitions of development. For example, economist Paul Ekins characterizes development as, "a process which results in the increased welfare of the group under consideration, perhaps with special reference to the least well-off members of the group," acknowledging the unique role of the poor in the course of development but admitting that it is a process in which objectives varies by group (Ekins, 2000: 1). Economic development, likewise, can be interpreted differently depending on who you ask, and can cover a dizzying array of indicators including everything from labor wages or a nation's gross domestic product, to poverty rates, as well as to more peripheral seeming figures like literacy rates or life expectancy. An increase in one factor (or a decrease, depending on the desirability of the indicator) can generally represent progress towards economic development. The world operates under this framework, leaving global organizations like the United Nations (UN) or the World Bank (WB) to track these indicators and scores more, to chart our development as nations and as a species.

Without a doubt, economic growth remains the prime objective of economic policy. However, over the last ten years the concept of environmental sustainability has certainly climbed up the public agenda as well. The anti-growth movement of the early 1970s first challenged the primacy of growth as a development tool, but in the decades since, and in the face

of global ecological crises like climate change and ozone depletion, etc., economists and governments began to look inward and question the wisdom of that path. Growth and sustainability, whether these two public objectives are in fact compatible or not is of critical concern, indeed, for some economists the link between sustainable development and growth is, perhaps, the key economic question (Ekins, 2000).

That link has certainly been scrutinized. The literature on economic growth and the environment is vast, with large and varied disagreements about their relationship. Ekins provides perhaps the most approachable review. He notes a difference of opinion between some economists and some biologists on this issue, however he points out that there are just as significant disagreements between economists (Ekins, 2000). For example, writing in 1990, Herman Daly provides the most colorful denunciation of any link between sustainability and current development trends, proclaiming that sustainable growth is an oxymoron (Daly, 1990). However, five years later, after sustainable development had begun to gain mainstream appeal, notably with the publication of the Brundtland Report in 1992, economists Ian Goldin and L. Alan Winters had grown more optimistic, concluding that 'economic growth and development are perfectly consistent with environmental protection (Goldin & Winters, 1995: 14)." Neither opinion is incorrect. In the face of devastating man-made ecological disasters, like climate change, it appears that growth has ultimately proved to be unsustainable. However, by acknowledging the faults of rampant economic growth, the modern sustainable development movement has provided policy-makers with the tools to harness the positive effects of economic growth, while minimizing or eliminating its harmful and ecologically destructive consequences. This does not imply that there will not be trade-offs, indeed, in order to reduce emissions certain aspects of growth may need to be slowed or halted, at least temporarily. Though, this is not true in all sectors. In fact, the potential for sustainable development to seamlessly integrate with many aspects of development, simply through modification of behavior, and not necessarily at the expense of growth, is high, particularly for infrastructure. However, before sustainable development can be practically applied sectoraly one must adopt or create an operational and functional definition of sustainable development, something few have done satisfactorily, and never in regards to infrastructure.

2.2 Sustainability: A Growing Concern

During the 20 year span, between the UN Conference on the Environment in Stockholm in 1972 and the one on the Environment and Development (UNCED) in Rio de Janeiro in 1992, scientific opinion had gradually shifted towards the conclusion that the damage being inflicted by human activities on the natural environment ultimately renders those activities unsustainable. Furthermore, as Ekins (2000) notes, since UNCED it has become accepted that these activities cannot be projected to continue into the future because they will either destroy the environmental conditions necessary for their continuation, or because their environmental effects will cause unacceptable, massive damage to human health and livelihoods (p. 5).

I will abstain from providing a complete review of the evidence that has led to this growing scientific consensus, because to date the data collected in support of this fact is nearly comprehensive, but the now professed seriousness of the problem can be illustrated by a number of quotations, compiled by Ekins, of the conclusions of the scientific and governmental bodies which have conducted such reviews (Ekins, 2000: 5). First the pioneering Brundtland report, which set off the process which led to UNCED, and of which more will be said later, noted that the strain our environment can be subjected to has limits, and formulated its perception of unsustainability in terms of a threat to the survival of mankind, stating "There are thresholds which cannot be crossed without endangering the basic integrity of the system. Today we are close to many of these thresholds; we must be ever mindful of the risk of endangering the survival of life on earth (WCED, 1987: 32-33)."

In its report to UNCED in 1992, the Business Council for Sustainable Development (BCSD) took the next logical step, beyond the acknowledged limits of our environment, stating, 'We cannot continue in our present methods of using energy, managing forests, farming, protecting plant and animal species, managing urban growth and producing industrial goods (as cited by Schmidheiny, 1992: 5)." While the World Resources Institute (WRI), in collaboration with both the Development and Environment Programs of the United Nations , concluded, on the basis of one of the world's most complete environmental databases and in collusion with the BCSD's findings, that, "The world is not now headed toward a sustainable future, but rather

toward a variety of potential human and environmental disasters (WRI *et al.*, 2000: 2)." Furthermore, according to Ekins, the World Bank also writing in 1992, predicting a 3.5 times increase in world economic output by 2030, recognized that, "If environmental pollution and degradation were to rise in step with such a rise in output, the result would be appalling environmental pollution and damage (as cited by Ekins, 2000: 6)."

At about the same time, the Fifth Action Program of the European Community, observing environmental degradation in Europe acknowledged that 'many current forms of activity and development are not environmentally sustainable,[1]'" (defining environmental unsustainability as being one activity which cannot be projected to continue into the future, because of its negative effect either on the environment or on the human condition of which it is a part.) The Fifth Action Program elaborated, describing, "a slow but relentless deterioration of the environment of the Community, notwithstanding the measures taken over the last two decades (Ekins, 2000: 6-7)." In addition, in its annual *State of the World* reports, the Worldwatch Institute presented proud documentation of current environmental damage, concluding in 1993, "The environmentally destructive activities of recent decades are now showing up in reduced productivity of croplands, forests, grasslands and fisheries; in the mounting cleanup costs of toxic waste sites; in rising health care costs for cancer, birth defects, allergies, emphysema, asthma and other respiratory diseases; and in the spread of hunger (as cited by Ekins, 2000: 7)." It warned that 'if we fail to convert our self-destructing economy into one that is environmentally sustainable, future generations will be overwhelmed by environmental degradation and social disintegration (p. 7)." Thus, in the face of such a widespread consensus, it is not shocking, that in 1992 two of the world's most prestigious scientific research institutions issued a joint statement of warning: "Unrestrained resource consumption for energy production and other uses... could lead to catastrophic outcomes for the global environment. Some of the environmental change may produce irreversible damage to the earth's capacity to sustain life... The future of our planet is in the balance" (RSNAS, 1992: 1).

It is against this background of environmental pessimism, of the early 1980s, that sustainable development was first introduced. The International Union for the Conservation of

[1] For a summary of these activities and their consequences please refer to Figure 3.1

Nature (1980) linked environmental conservation with development and first coined the term "sustainable development" in their 1980 World Conservation Strategy, creating a concept that has been popular in the developing world since. The term was not popularly defined, however,

Problem	Principal Agents
Pollution	
Greenhouse Effect/ Climate Change (global)	Emissions of CO^2, N^2O, CH4, CFCs (and HFCs), O^3 (low level), PFCs, SF6
Ozone Depletion (global)	Emissions of CFCs
Acidification (continental)	Emissions of SO^2, NOx, NH^3, O^3 (low level)
Toxic Contamination (continental)	SO^2, NOx, O^3, particulates, heavy metals, hydrocarbons, carbon monoxide, agrochemicals, organo-chlorides, eutrophiers, radiation, noise
Renewable Resource Depletion	
Species Extinction (global)	Land use changes (e.g. development, deforestation), population pressure, unsustainable harvest (e.g. overgrazing, poaching), climate change
Land Degradation/ loss of soil fertility ((bio)regional, national)	Population pressure, unsustainable agriculture, urbanization, development, climate change
Deforestation (global, regional)	Land use changes, population pressure, unsustainable harvest (e.g. hardwoods), climate change
Fishery destruction (regional, national)	Overfishing, destructive technologies, pollution, habitat destruction, migratory disruption (e.g. river damming)
Water Depletion ((bio)regional, national)	Unsustainable use, climate change, deforestation, land degradation
Landscape Loss	Land use changes (e.g. development), changes in agriculture, population pressure
Non-Renewable Resource Depletion	
Depletion of various resources	Extraction and use of fossil fuels, minerals
Other Environmental Problems	
Congestion (national)	Waste-disposal, traffic

Table 2.1: Unsustainability and its symptoms. (UN, 1992: 7).

until 1987 when a report from the now famous United Nations-established Brundtland Commission defined sustainable development as development that "meets the needs of the present generation without compromising the ability of future generations to meet their own needs" (WCED, 1997: 8). The 1992 Rio Declaration attempted operationalize this complex and diverse theory into a practical development path by providing guidelines through which sustainable development can be achieved throughout the world; however its recommendations

were left intentionally vague, and it would be a stretch to call any of them practical (UN, 1992: 7).

Prior to the start of the 21st century sustainable development was simply concerned with environmental sustainability, however in 2001 the United Nations Educational, Scientific and Cultural Organization's (UNESCO) further expanded the definition of sustainable development by incorporating cultural sustainability. It's Universal Declaration on Cultural Diversity (2001) states that "cultural diversity is as necessary for humankind as biodiversity is for nature (p.1)"; it has become "one of the roots of development, understood not simply in terms of economic growth, but also as a means to achieve a more satisfactory intellectual, emotional, moral and spiritual existence (p. 13)". Through this statement UNESCO attempted to expand the pillar of social development by integrating cultural preservation as a key part of sustainable development. The 2005 World Summit Outcome Document attempted to expand the concept further, and refers to the "interdependent and mutually reinforcing pillars (UN, 2005)" of sustainable development as economic development, social development, and environmental preservation. Thus it has come to be that sustainable development policies have expanded to encompass three broad policy themes: economic, environmental and social, with culture in many cases being lumped under social concerns. However, despite this elaboration on the precepts of sustainable development, the concept is still generally based upon measures of ecological sustainability, a foundation that stretches back to the theoretical roots which originally inspired the quest for sustainability.

2.3 Limits to Growth

Although Sustainable Development may be thought of as a relatively new phenomenon, owing to its 1980s creation and growing popularity, it posses strong theoretical roots, stretching back to the golden age of classical economics. Two of the earliest classical economists, Thomas Malthus and David Ricardo, were deeply intrigued at the prospect of growing human population in a world with a fixed quantity of agricultural land. Malthus' theory of population, for which Ricardo has expressed his esteem (Ekins, 2000: 23-24) contended that: "The power of population

is indefinitely greater than the power in the earth to produce substance for man[;] population, which unchecked, increases in a geometrical ratio. Subsistence increases only in an arithmetical ratio.... This implies a strong and constantly operating check on population from subsistence (Malthus, 1970: 71)." This is perhaps the first recognition of the fact that at some point human consumption and production might outstrip the planets carrying capacity.

However, Malthus and Ricardo, writing in the still relatively unspoiled 18th century, were not able to fully conceptualize the ecological side-effects of economic growth. However, with the increasing scale of industrial activity in the nineteenth century, the appearance of environmental degradation soon became more obvious. Mill was the first economist to recognize that the growth of production might be to the detriment of what he referred to as environmental 'enjoyments (Mill, 1862: 25).' Mill, being a sort of Renaissance man, though naturally more inclined to philosophy then economics (yet gifted in both disciplines), lamented the degradation of the environment. Mill aspired for a 'stationary state,' not the same as described by Malthus, but rather one where continued growth was no longer necessary or even desirable, particularly less so if it's costs have increased. To Mill, growth should clearly not be at the expense of the environment, although he does not quite describe it explicitly in that way. The unintended and uncompensated loss to one person of natural beauty, pleasantness and solitude in nature due to the economic activity of another, the type of loss that he is lamenting in the passage above, is an example of what, following the analysis of A.C. Pigou, has come to be called an 'externality,': A concept too robust to be discussed adequately here (Ekins, 2000: 25).

The two decades between UN Conference in Stockholm in 1972 and Rio de Janeiro's UNCED in 1992, witnessed a major change in how economists, conservationists, and policy-makers alike, approach topics relating to the environment and development. Today the golden phrase is 'sustainable development.' Then it was 'limits to growth,' a concept closely related in spirit and logic to Mishan's anti-growth arguments of the late 1960s (Ekins, 2000: 40). The term 'limits to growth' was coined by Dennis and Donella Meadows (1972) in conjunction with a team from the Massachusetts Institute of Technology through a published work of that same name. To Meadows the limits were strictly ecological, and they applied to economic growth (understood as growth in production as measured by GNP), which they assumed implied a

similar increase in the consumption of resources (Ekins, 2000: 40). They concluded, "The most probable result (of reaching the limits to growth) will be a rather sudden and uncontrollable decline in both population and industrial capacity (Meadows, et al., 1997: 1)." Limits to growth assumes that population and industrial capital grow exponentially, causing parallel growth in demand for food, non-renewable resources and waste. This of course takes place under a context of finite resources, thus leading Meadows, et al., to declare that exponential growth within finite limits will result in economic and ecological breakdown. Furthermore, as Ekins points out, they declared that due to the expansive nature of compound growth, the finite limits of resources could be raised by a factor of four without averting systemic collapse (Ekins, 2000: 40).

The 'limits of growth' thesis resonated within the general public, attracting significant attention, during the 1970s, particularly due to its correlation with that decade's oil and energy crises. However, prominent economists and scientists quickly moved to try and discredit that theory. According to Ekins, two of the most wide-ranging rebuttals came from a team at Sussex University's Science Policy Research Unit led by Cole, and from William Nordhaus (Ekins, 2000: 41). They both focused on three criticisms of 'limits to growth,' including the relationships in Meadows' model, the assumptions on which the model was based, and its emphasis on purely physical parameters. Furthermore, economist Mikhail Bernstam (1991) postulated that industrialization under free market conditions exhibits a characteristic relationship between output and the environment. Particularly, that in the early stages of development, there is a negative trade-off at the expense of the environment. However, this effect diminishes as industrialization proceeds and, at a certain historical moment, a positive relationship can develop between the two. Once this relationship has manifested itself economic growth can reduce pollution by increasing the efficiency of resource consumption faster than both resource output and population growth can contribute to it. In homage to Adam Smith, Bernstam asserts that in industrialized capitalist economies this condition is now being met through the operation of what he calls the 'Invisible Environmental Hand (Bernstram, 1991: 43-44).' Although Ekins roundly dismisses Bernstam's conclusions he does concede that there is some limited evidence on air pollution that supports his hypothesis (Ekins, 2000: 46).

In 1992 Wilfred Beckerman bolstered Bernstam's line of argument, arguing for economic growth in developing countries but with a unique twist. Bernstam's supposition, summarized by Ekins (2000), was that long-term economic growth in industrial countries would reduce their contribution to global pollution, which would go a long way towards balancing out the inevitable rise in pollution from growing less-developed countries (46). Beckerman accepts this notion and adds that it is developing countries that need economic growth to improve their environments, at least in areas vital to human welfare, like access to drinking water, proper sanitation and healthy air quality. He concludes, "In the longer run, the surest way to improve your environment is to become rich (Beckerman, 1992: 495)."

Bernstam and Beckerman argued that the economic growth is a precursor to environmental sustainability. Although, many have acknowledged the connections they made as valid, many questioned the ordering of their priorities. In the face of glaring limitations to the continuity of growth should conservation and reduction not take priority? This thought, emphasizing the continuing limits to growth, is echoed in a 1992 article for the United Nations Educational, Scientific and Cultural Organization (UNESCO) that includes contributions by two Nobel laureates in economics; they write, "Saving the environment will certainly check production growth and probably lead to lower levels of national income. This outcome can hardly surprise. Many have known for a long time that population growth and rising production and consumption cannot be sustained forever in a finite world (Tinbergen& Hueting, 1992)."

Although the 'limits to growth' arguments, and its subsequent debates, introduced several valid concerns regarding the sustainability of growth (though they did not use that term) the concept itself is no longer a point of debate. Rather the purpose of Meadow's argument, in hindsight, has been simply to transition to and inspire a more influential movement, coined 'Sustainable Development' by the World Conservation Union, which embraces growth while acknowledging its limits. Thus, although Sustainable Development did not gain widespread appeal until the 1990s, its roots can still be traced to 1972 and the 'limits to growth' model.

2.4 Institutionalizing Sustainable Development

Despite their popularity, the 1970s' 'limits to growth' critiques failed to sway the social consensus in favor of economic growth, so that by the time the Brundtland Commission produced its report *Our Common Future* in 1987 on the environment and development, emphasis was placed on a perceived symbiosis between growth and environment(Tinbergen& Hueting, 1992: 45). In her introduction to the report, the chairman of the commission, Gro Harlem Brundtland calls for "a new era of economic growth- growth that is forceful and at the same time socially and environmentally sustainable (WCED, 1987: xii)." *Our Common* Future signified a bold turn away from 'limits of growth' by realizing that if real change is to be made in regards to the environment then the best hope is to embrace the global economic system and accept growth as a permanent and desirable fact. However, despite moving to accommodate growth, *Our Common Future* did not minimize the environmental challenges facing our planet. This can be seen through the broad conclusion of the mainstream optimists (those who moved to embrace *Our Common Future*), be they Brundtland, the World Resources Institute or the Business Council for Sustainable Development, the reports of whom have already been quoted. They expressed a common theme that environmental problems are real and threatening and that to be reconciled with continuing economic expansion active policy will be required (Ekins, 2000: 48).

Ekins (2000) points to the World Bank's 1992 World Development Report as the most sophisticated reiteration of this new direction (p. 48). The report accepts the severity of the environmental situation while acknowledging that some environmental problems are "exacerbated by the growth of economic activity (WB, 1992: 7)." The World Bank's strategy to achieve both environmental conservation and economic growth seeks to find a common denominator between the two issues; poverty. They elaborate, "Some problems are associated with the lack of economic development; inadequate sanitation and clean water, indoor air pollution from biomass burning, and many types of land degradation in developing countries have poverty as their root cause. Here the challenge is to accelerate equitable income growth (WB, 1992: 7)."

The Report confirms that the necessary steps towards conservation may not be 'win-win,' there possibly will be trade-offs between economic growth and environmental protection (WB, 1992: 1). Despite encountering trade-offs, however, "the evidence indicates that the gains from protecting the environment are often high, and that the costs in forgone income are modest if appropriate policies are adopted (WB, 1992: 1)." Furthermore, according to Ekins (2000) analysis of the report, the World Bank determined that gains from 'win-win' opportunities while only accruing modest costs on the other, could result in both a 3.5-times rise in world output (p. 48) and "better environmental protection, cleaner air and water, and the virtual elimination of acute poverty (WB, 1992: 1)."

The 1992 World Development Report was significant in that it outlined a different approach towards development, a considerable landmark since the environment first became a major policy concern in the 1970s. Through an institutionalized focus on responsible policy that favored environmental conservation while seeking to minimize trade-offs at the expense of growth, the World Bank pioneered the way towards applying sustainable development on a global scale. In fact, the modern perception and application of sustainable development has not significantly changed from that outlined in 1992. Since then, the World Bank has not significantly revised their approach towards sustainability. The United Nations Development Program adopted similar standards of sustainable development while one of the major contributors towards infrastructure in Asia, the ADB, committed to environmentally sustainable growth through the application of its projects. In fact, the only significant departure from the 1992 WDR's perception of sustainable development began in 2005 when the United Nation's World Summit Outcome Document referred to social development, economic development and environmental protection as 'interdependent and mutually reinforcing pillars' of sustainable development (UN, 2005: 12). By intertwining social issues and sustainability the Document made the assertion that other negative effects attributed to development (like resettlement, migration, etc., or a lack of social development in fields like education or health care) were just as serious threats to the sustainability of growth and development as the environmental risks. Although it is difficult, and morally irresponsible, to argue that these issues are not as important as the environment, (how does one quantify social issues to even make such a comparison?) it is possible to argue that the expansion of the concept of sustainability dilutes its original purpose,

which is to address the grave threats that growth-based development has unleashed on our planet. However, the lasting effect that this change will have on the future viability of sustainable development remains to be seen, and further research on the shared links between environmental degradation and social injustice is essential.

Despite its growing acceptance and near-idolization by development institutions, sustainable development has not escaped debate. One popular criticism of sustainable development rests in the perception that the concept is being forced upon the developing world by nations whose development has long since passed the point of sustainability. One scholar notes that key figures driving the sustainability movement in the developed world, particularly in the United States, have no connection to the environmental movement at all, in fact many represent industries commonly seen as barriers to environmental sustainability, such as oil and chemical and other energy interests (Willers, 1994). This top down approach to sustainable development neglects local and grassroots participation while allowing the developed nations to pursue unrestricted growth at the expense of developing nations (Willers, 1994: 1147).

Another criticism points to the fact that the term 'sustainable development' in itself can be vague and misleading. Canadian Bob Jickling (1994) argues that the language surrounding sustainable development has become a, "vague slogan... susceptible to manipulation and deception (p. 231).' He also argues that the concept is for some "logically inconsistent," and that concerned efforts to implement sustainable development can frequently obscure understanding of the economic, social, and environmental issues and interfere with adequate investigation of social alternatives (p. 232). Others, like Stanley Temple (1992), are skeptical of the phrase, noting that the word sustainable has been used in too many situations today, for the most part in-effectively and in a confusing manner. Sustainable development, sustainable growth, sustainable economies, sustainable societies, sustainable agriculture, and sustainable ecology are all examples of such. Everything is sustainable. As a result of its overuse, sustainability, has come to mean too much and nothing at the same time. Therefore sustainable development as a concept is too broad and ill defined to have much relevance (Temple, 1992: 1).

Furthermore, the highly acclaimed economist Robert Solow (1991), in his paper "Sustainability: An Economist's Perspective" elaborates, criticizing the term sustainable development, saying "sustainability is an essentially vague concept, and it would be wrong to think of it as being precise, or even capable of being precise (p. 131)." Skeptic, Beckerman (1992) is bluntly dismissive of the whole debate around sustainability, "The aggregative concept of global sustainability... seems to be either morally indefensible or devoid of operational value (p. 491)," while the question "How do we achieve sustainable development?" is "unanswerable and meaningless (p. 492)." Indeed, the multi-dimensionality and multiplicity of purposes embraced by sustainable development, and expanded upon by the World Summit Outcome Document, has resulted in it coming to mean different things to different people. As early as 1989 economist David Pearce (1989) was able to cite a 'gallery of definitions' which following 2005 has been significantly expanded. As Ekins (2000) eloquently puts it, "such diversity of meaning clearly militates against clarity of discourse (p. 49)."

However, although several of the concerns regarding sustainable development are justified, it remains the planets best hope for containing environmental degradation without a radical change in society or global economic systems.

2.5 Defining Sustainability

How do you determine if an action is sustainable or unsustainable? The environmental sustainability of human livelihoods predicates on the ability of the environment to sustain those ways of life (Ekins, 2000). The environmental sustainability of economic activity refers to the ongoing ability of the environment to provide the necessary inputs to the economy to facilitate its preservation of economic welfare. Ekins (2000) identifies that both these sustainabilities in turn depend on the maintenance of some essential environmental functions. Although which functions are vital for which ways of life, which economies, and at which level they should be sustained, will vary to some degree by culture and society, there are clearly fundamental biophysical criteria for human production, consumption and survival (Ekins, 2000). Accordingly Ekins (2000) defines environmental sustainability as the maintenance of important

environmental functions (p. 80). Thus the goal of sustainable development should be to maintain these functions more or less intact. Or in other words, sustainable development should be development which does not control or inhibit natural environmental functions to such a degree that they could possibly cease to function sometime into the future (Ekins, 2000). Though there certainly should be provision for exceptions, like a positive trade off in one environmental function for another or a deterioration of one function for the considerable benefit of mankind, the previously stated point is generally the rule (Ekins, 2000).

This concept, that the key contribution of the environment to the human economy and to human life through the operation of a wide range of 'environmental functions,' was first employed in economic analysis by Dutch economist Roefie Hueting in 1980 and has since been extensively developed by Rudolph S. de Groot (Ekins, 2000). De Groot (1992) defined environmental functions as "the capacity of natural processes and components to provide goods and services that satisfy human needs (p. 15)." De Groot (1992), in his seminal paper, "*Functions of nature: Evaluation of nature in environmental planning, management and decision making*," identifies thirty-seven environmental functions, which he classifies under four groupings: regulation, carrier, production and information (p. 15)." Fortunately for the reader and researcher alike, Paul Ekins (2000) simplifies these in to three major categories (p. 79):

1. The provision of resources for human activity
2. The absorption of wastes from human activity, and
3. The provision of environmental services independently of or independently with human activity

As Ekins notes, these 'natural processes and components' can in turn be recognized as the stocks of and flows from natural capital (though de Groot does not use the term), a factor known as ecological capital in various definitions of sustainability and sustainable development.

Ecological capital, or natural capital as it's also commonly called, is the driving force of environmental functions, and should be at the heart of any operational definition of sustainable development as its preservation is essential for the sustainability of human development. Natural capital is a metaphor for the mineral, plant, and animal resources of the Earth's biosphere when analyzed as a means or input of production of oxygen, atmosphere, water, etc., or a provider of

other ecosystem services. Within a traditional account of the factors of production, like that provided in The Wealth of Nations for example, natural capital would usually be classified as "land" distinct from "capital" in its classical sense. The historical distinction, made by Smith and others, between "land" and "capital" was that land is naturally occurring and its quantity is assumed to be fixed, whereas capital as originally defined referred only to man-made tools of production (like machines, etc.). However through the intellectual process previously described natural systems slowly have become valued as capital because due to the acceptance of the fact that they can be improved or degraded by the actions of man over time (the Tragedy of the Commons is a great example of this interaction), so that to view them as if their productive capacity is fixed by nature alone is incorrect.

The preservation of natural capital is essential because in many cases it is irreplaceable. Under some circumstances, manufactured capital can be a substitute for natural capital, but only if it performs the same environmental functions (Ekins, 2000). However, this is less likely to be possible when the natural capital is multifunctional in diverse ways (e.g. a rainforest), rather than when it performs a single resource function (e.g. as an energy source) (Ekins, 2000). Similarly technological innovation can only be said to balance for natural resource loss when, through new technology, a reduced quantity of natural resources can perform the same environmental functions (Ekins, 2000). Of course there will be cases when such a trade-off appears justified; environmental sustainability is generally perceived to *not* require the safeguarding of *all* environmental functions and capital, a concept that has become a key dimension of environmental valuation and cost/benefit analyses (Ekins, 2000). Human knowledge and understanding of the environment is never complete, however, thus the limits of natural capital continue to grow or shrink as the requisite knowledge is acquired or lost. But as Ekins (2000) points out, "the loss of natural capital to date, combined with ignorance about the importance of what remains, together with threshold effects and irreversibility that make unwelcome changes impossible both to predict and undo, argue for caution (p. 80)."

Sustainable development has had its problems. Its weaknesses in conceptualization, in particular, have added to the confusion concerning the growth/sustainability relationship. Although the 'limits to growth' has been eclipsed by sustainable development, the debate has

been left hanging in the air, "with the resource optimists either dismissing it as passé or regarding it as somehow resolved by the mere incantation of [sustainability], and the resource pessimists sticking doggedly to their line of 'indefinite growth is not possible in a finite world,' without adequate differentiation between different kinds of growth, or specification of what kinds of growth they have in mind," to quote Ekins (Ekins, 2000: 50). Furthermore, the definitional imprecision of sustainable development has further muddied the waters, what is clearly needed is a more practical approach to sustainability (Ekins, 2000).

In order to clarify and operationalize the sustainable development discussion, I have established a clear definition of sustainable development as development which does not control or inhibit natural environmental functions to such a degree that they could possibly cease to function sometime into the future. Moreover, I have shown the importance of natural capital to the preservation of these functions. Yet, without clear standards and measures this definition is not yet practical. What is now required are clear specifications and clarification of the goals of sustainable development with a practical interpretation of its capabilities and limits. Furthermore, an operationalization of the relationship between sustainability and natural capital/functions is also necessary before sustainable development can be practically applied to development projects.

2.6 Measuring Sustainability

As previously discussed, despite a vast amount of research and debate following *Our Common Future* through to the present, little headway appears to have been made in terms of establishing a rigorous definition of the concept, let alone one that could be universally accepted by the development community. Therefore, not surprisingly, efforts to 'operationalize' sustainable development and to "show how it can be integrated into practical decision-making have been few and generally unpersuasive (Pearce, 1989: 1)." As Ekins (2000) points out, governments of the world have made commitments, at UNCED and elsewhere, to environmental sustainability which generally indicates at least a passive public preference for the sustainable use of environmental functions. Yet, environmental degradation is not occurring in the meeting

halls of international conferences and meetings. In order to be effective public policy will have to be formulated at a level appropriate to the impact concerned. Because of the primacy of national governments in the developmental decision-making process, it is realistic to think of the boundaries of sustainability, initially at least, in terms of the nation-state (Ekins, 2000: 87).

Unsustainability in regard to human development has been earlier defined as a situation in which, because of its consequences towards the planet or the human way itself, cannot with any certainty be projected to persist indefinitely into the future. Furthermore, environmental unsustainability occurs when environmental functions, which are vital for human ways of life and welfare, are not maintained or protected. Given the uncertainties involved in issues of sustainability, the matter of risk is crucial. The possibility of irreversibility and of the incurrence of substantial future costs, once environmental functions have been lost, incurs very real present costs, not to mention those that could hypothetically accrue in the future (Ekins, 2000).

To steer development towards sustainability, policies under consideration should be those that regulate the day to day perpetuation of growth in ways that enhance the natural capital endowments of future generations, but with an eye towards the economic implications of specific steps to implement such policies (Bishop, 1993). Sustainable development, if implemented intelligently, should not necessarily come at the expense of growth.

The belief that sustainability is intrinsically linked to the non-depreciation of the natural capital stock is explicit in the Brundtland Report (Bishop, 1993). It states that, "if needs are to be met on a sustainable basis the Earth's natural resource base must be conserved and enhanced (WCED, 1987: 57)." IUCN's (1980) World Conservation Strategy also embraces this concept, although in more implicit terms, when describing the necessity of maintaining 'essential ecological processes and life support systems,' 'preserving genetic diversity' and ensuring 'sustainable utilization of species and ecosystems (p. I).' Furthermore, a similar definition of sustainable development is also advanced by economist Robert Repetto (1986) that stresses the dual importance of both natural and man-made capital (p. 15):

> Sustainable development [is] a development strategy that manages all assets, natural resources, and human resources, as well as financial and physical assets,

> for increasing long-term wealth and well-being. Sustainable development, as a goal rejects policies and practices that support current living standards by depleting the productive base, including natural resources, and that leaves future generation with poorer prospects and greater risks than our own.

Thus, although the central focus of sustainable development on natural capital stock maintenance is not universally accepted as the sole criteria for the environmental sustainability of human development, it has been embraced, at the least, as an extremely vital component of that equation.

As previously alluded to, conserving the natural capital stock serves a broad array of goals which would receive wide, though not universal, acquiescence. In regards to intragenerational fairness, defined by Pearce (1989) as "justice to the socially disadvantaged both within any one country and between countries at a given point in time," he argues that a constant or rising natural capital stock is likely to serve that end (p. 12). The clearest evidence for this exists within poor, un-dynamic developing economies in which an absolute reliance on natural resources is dominant (Pearce, 1989). Because public goods posses the attributes of both 'jointness of supply' and 'non-excludability, natural environments, often considered public goods, when supplied to one group of individuals are also supplied to all because of the inability to exclude others from the benefits (Pearce, 1989: 12). The classic example of this relationship relates to air quality, thus, if one country, state, or state mounts a campaign to improve air quality because one group of people advocates for a better environment, even those who may be indifferent to better air quality will also experience the improvement, introducing a 'free-rider' element to environmental protection. Another controversial dimension of this relationship, as Baumol and Oates (1988) point out, is that if the rich wield more political power they will 'force' more environmental quality on the poor than the poor wish to buy. In fact many environmental advocacy groups in the developed world have embraced this path as a way to 'clean up' developing countries despite the effects that it may have on their economic growth.

In its environment 1990 White Paper, the Government of the United Kingdom (1990) also emphasized the moral basis of environmental concern, 'The ethical imperative of stewardship... must underlie all environmental policies... We have a moral duty to look after our

planet and hand it on in good order to future generations,' introducing the issue of intergenerational fairness to the sustainability debate (p. 10). Philosopher John Rawls's (1972) popular theory of justice also contends that we have a moral basis for preserving natural capital stocks, arguing that the next generation should have access to at least the same resource base as the previous generation. Yet there would appear to be no particular reason for focusing on natural capital as the prime mechanism for achieving intergenerational equity, Rawl's theory might equally apply to man-made capital or to some blend of both types of capital. Yet, as Pearce (1989) points out, there are some valid reasons for believing that natural capital is more important. First, Rawl defines a 'primary good' as a good with the characteristic that any rational being would always prefer more of it to less (Pearce, 1989: 12). Natural capital would certainly qualify as a Rawlsian 'primary good.' Pearce (1989) elaborates, "The life support functions of the natural environment would seem to fit this category since less of them would remove the very capability of choosing and having preferences (p. 12)." Furthermore, natural capital varies from man-made capital in other crucial aspects as well. Man-made capital is nearly always capable of what is known as symmetric variation, which means that its value and quantity can be increased or decreased at will (Pearce, 1989). Yet the natural capital stock is much more difficult to manipulate. It is subject to irreversibilities, in that it can be decreased but often not increased if past diminutions lead to extinction or depletion. These two features of natural capital, its role as a 'primary good,' as well as its irreversibility, strongly suggest that man-made capital can only serve as a substitute for natural capital to a very limited and specific extent (Pearce, 1989).

Another justification for preserving the natural capital stock is the role that natural capital, in addition to man-made capital, contributes to the resilience of an economy by shielding it to some degree from external shocks and stresses. Pearce (1989) elaborates on that relationship, "at the starkest level, the larger the stock of natural capital, including working capital such as seed stocks and food security, the more likely it is that a poor agricultural country can withstand external shocks such as climatic variation and stresses such as international indebtedness (p. 14)." Man-made capital in many accounts has the ability to fill-in for natural functions, serving many of the same purpose, yet it tends to lack an essential attribute of natural capital, diversity (Pearce, 1989). The rationale for natural capital conservation appears to be the

strongest in the developing world. Developed countries benefit from greater flexibility margins than poorer countries where rapid population growth and a history of poor economic performance in general often result in very narrow margins for risk in the face of external turbulence (Pearce, 1989). This economic fact is partly accountable for developing countries' enhanced vulnerability to global economic downturns and instability.

As seen above, and as demonstrated by Pearce (1989) in his work, the resilience justification for preserving the natural capital stock is accordingly based on the idea that diverse ecological and economic systems are more resilient to shocks and turbulence. Thus, in order to maintain diversity, avoiding irreversible decisions is essential. Because knowledge and technological capacity, once developed, are infrequently lost forever, economic irreversibility is likely to be rare occurrence, as Pearce (1989) states, "a discontinued machine can be re-created, towns can be rebuilt, and so on (p. 16)." Yet ecological irreversibility occurs all too frequently. Ever year unknown numbers of natural species are lost while unique ecosystems are destroyed and environmental functions are damaged beyond repair. This unfortunate fact strongly suggests that we as a species should only destroy natural capital if the benefits of doing so are exceptionally large. Thus, under the precepts of sustainable development, the destruction of irreversible natural capital stock should be avoided unless the social costs of conservation are unacceptably large or the social benefits of destruction are immense (Pearce, 1989).

Returning to man-made capital, Pearce's (1989) study on the subject demonstrates that, "the superficial view of the comparative rates of return to augmenting man-made and natural capital suggests favoring the former (p. 15). Thus, if the two forms of capital are viewed as substitutes, then an argument based on this data would imply expansion of the man-made capital stock at the expense of the environment is a positive trend, something that has clearly been demonstrated as harmful. This view, of favoring man-made capital, typifies the traditional approach to economics and the environment, of which has been discussed here extensively, in which economic change usually is at the expense of our planet's ecological condition (Pearce, 1989: 18). Thus, while acknowledging the wisdom of Adam Smith and his fellow classicists, we can no longer accept the promotion of man-made capital as dominant goods relative to natural

capital. In order to achieve sustainability an equal balance between the two must be struck. Because as Pearce's study shows natural capital is more valuable than we treat it.

Our societies' increased emphasis on sustainability implies a greater concern for the future and future generations than what has been implicit in past development models. The assumption that the 'future will look after itself,' characterized by previous 'growth for the sake of growth' development models, is simply not acceptable today. Sustainable development acknowledges that future economic growth, not to mention human welfare, can be seriously damaged by actions taken now (Pearce, 1989). Thus as Pearce (1989) notes, "sustainable development does not give greater weight to the future than other development approaches: it simply points out that the factual assumption that future generations would be able to choose as freely as a current generation is not likely to be correct (p. 19)."

Defining sustainability around natural capital s helps to guarantee the sustainable use of important environmental functions while also creating a practical methodology with which to address such environmental problems where uncertainty, irreversibility or large potential costs make the use of benefit-cost analysis challenging. Now that clear standards for sustainability have been set it is possible, and necessary, to redefine sustainable development as a concept. The largest problem with sustainable development as a tool for development has been its imprecision and lack of practical value. However, by incorporating these established sustainability principles we can form an operational interpretation of sustainable development that reflects a common, unifying characteristic, the preservation of natural capital stock.

2.7 Operationalizing Sustainable Development

The goal of this analysis of sustainable development has been to create an operation definition, which can easily be applied to future development projects in order to enhance the long-term sustainability of said development. Although the presented principles are useful for guiding sustainable development in general, they are not simple or practical enough to apply to

individual development projects. Fortunately they all share a common theme, the reliance on the non-depletion of the natural capital stock.

Through an evaluation of the literature, we have determined that it implies a set of minimum conditions, the conditions being predicated on the provision that the natural capital stock should not decrease over time. Natural capital stock, as has been defined, incorporates all environmental and natural resource assets including those crucial to the continuation of essential environmental functions, including: petroleum and gas in the ground, the quality of soil and groundwater, the stock of fish in the oceans and lakes, as well as the capacity of our planet to recycle and absorb carbon, among others (Pearce, 1989: 1). The definition of natural capital stock has been deliberately left vague in order to promote the flexibility needed to account for new sources of natural capital which will inevitably be found (and those that could be lost) in the future.

Since development is essentially a value judgment, meaning a variety of different things to different people (yet still implying change that is desirable), no consensus of its meaning is possible. What comprises development depends on what socio-economic goals are being promoted by the policy-makers driving development in any given area. David Pearce (1989), the preeminent expert on natural capital stock flows, logically interprets development to be a vector of desirable social objectives; in other words, it is a list of attributes which society seeks to achieve or maximize (p.2). The measurements of this vector might include such factors as," an increase in real income per capita, improvements in health and nutritional status, educational achievement, access to resources, a fairer distribution of income, and increases in basic freedoms (Pearce, 1989: 2)." Thus, sustainable development could then be technically defined as a situation in which the development vector D does not decrease over time. Yet, such a simple definition is not without complications. For example, as Pearce (1989) points out, the use of that definition implies the adoption of an infinite time-frame, "i.e. that the aim is to achieve everlasting development- whereas practical decision-making requires adoption of some finite horizon (p. 4)." Thus, the key necessary condition for sustainable development to be achieved can be summarized as the constancy of the natural capital stock, a notion first hinted at when discussing the conclusions of de Groot in previous sections. Pearce (1989) advances this notion,

setting the requirement as a non-negative change in the stock of natural capital and environmental quality. Thus, in simplistic terms, the environment should not be degraded further by development but improvements, as always, would be welcome.

2.8 Conclusion

Sustainable development was created in the early 1980s, a product of the anti-growth and 'limits to growth' movements of the 1970s, as a new development path intending to reconcile economic growth with the seemingly devastating ecological harm that it has wrought on our planet. Unfortunately, sustainable development, despite its popularity, has not lived up to the ambitious goals of its creators. In fact the concept is plagued by criticisms and inactivity. Due to its inherently vague nature sustainable development has adopted a plethora of meanings, all interpreted differently by different individuals and development organizations. This lack of clarity has not proved conducive to the practical application of sustainable development on the individual project level, and it has been largely relegated to mission statements and strategic visions. What was needed was a redefinition of the concept which focuses on its practical aspects, while allowing it to serve the function it was intended: Protecting the environment from human development.

Through an analysis of sustainable development literature I have identified the preservation of environmental functions to be the single most important component of sustainability. Yet this definition poses problems. The value of environmental functions is difficult to quantify and does not lend itself to an operationalization of the concept. Furthermore, some environmental functions can be effectively replaced through man-made substitutes. Rather, through further analysis, a unifying dimension emerges between my more or less environmental function-centric sustainability principles- natural capital. Development that does not negatively affect the natural capital stock is a definition of sustainable development that can be easily applied to development projects, a capability sorely lacking in previous conceptualizations of sustainability. This principle will be illustrated throughout the rest of this study, through the

context of infrastructure development, first generally, and later against the backdrop of road construction in the Greater Mekong Sub-region.