

論 文

APPLYING THE THEORETICAL CONCEPT OF SUSTAINABILITY TO
THE DEVELOPMENT OF PUBLIC POLICY

*Jae-Shuck Song**

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Abstract

Since the 1980s, no concepts have been paid more attention to in discussions of environmental policy and natural resource management than "sustainability" and "sustainable development." The concepts, however, are still vague and elusive even though they are frequently being used by a wide range of fields including academia, governments, and the private sector. To identify the diversity, range and concepts of sustainability, this paper will conceptualize the theoretical paradigms and social implications of sustainability and will develop general principles in public policy.

* Korea Maritime Institute

I. Introduction

Conventional economics paradigm, based on the laissez-faire economic approach and supported chiefly by classical economics and neo-classical economics, regards economics as a tool for production and growth. This paradigm has a few assumptions: natural resources are so abundant that they are costless or have virtually no marginal value; the increase of GNP (quantitative growth and economic progress) is regarded as national wealth; cheaper natural resources are better for the economy; and any environmental concerns are groundless. Thus natural resources and ecological resources are considered free gifts for economic development. The primary flaw of neo-classical economics, however, is that the goal of continually increasing productivity promulgates natural resource extraction and environmental degradation. Ecological approach recognizes that economic activities can lead to the degradation of natural resources and that this degradation must be taken into account and alleviated.

This study discusses the relationship between environment and development which gives wide insights not only into the connection of economics and ecology, but also in identifying the theoretical boundaries of sustainability. In a sense, the concepts of development and environment have

been recognized as being in conflict because environmental degradation has been resulted by development and growth. At present, the parallel existence of the necessity of development and the environment has created the concept of sustainable development as a logical harmony of the two contradictory concepts. To identify sustainability, this study examines a wide range of perspectives within the theoretical areas of Economics, Ecology and Public Policy. Such a wide range of perspectives provides a more useful explanatory tool for sustainability within the framework of sustainable resources management.

II. Identification of the Sustainability Paradigms

O'Riordan, Pepper, De Vries, Colby and this study categorized four or five paradigms in analyzing the relationship between society and nature (see Table 1). Of the five classifications, O'Riordan and Pepper's four paradigms, based on political economy approach, are "cornucopians," "environmental managers," "self-reliance / soft technologists," and "deep ecology."¹⁾

De Vries' (1989) and Colby's (1990) methods, in contrast, are classified on the basis of a socio-economic model. De Vries' four paradigms are "technocrat-adventurer," "manager-engineer," "steward," and "partners."

1) Pepper (1983: 31) identified the relations of ecological and technological environmentalism in terms of O'Riordan's (1981) description, but latter he (1996: 37) assigned new labels.

Table 1 Paradigms of Sustainable Development

STUDIES	PARADIGMS c)				
	FIRST	SECOND	THIRD	FOURTH	FIFTH
O’Riordan (1981) and Pepper (1984) a)	Cornucopians	Environmental Managers	Self-reliance Soft-Technologists	Deep Ecologists	
De Vries (1989) b)	Technological Perspective: Technocrat- Adventurer	Resource-economic Perspective: Manager-Engineer	Environmental Perspective: Steward	Ecological Perspective: Partners	
STUDIES	FIRST	SECOND	THIRD	FOURTH	FIFTH
Colby (1990) b)	Frontier Economics	Environmental Protection	Eco- Management	Ecological Development	Deep Ecology
This Study b)	Conventional Economics	Environmental Economics	Ecological Managerialism	Ecological Development	Deep Ecology

Note a) Society and nature based on political economy approach.
 b) Society and nature based on the socio-economics and ecology.
 c) It is not easy to define the term of “paradigm.” According to Kuhn (1970), it is a world view or mode of perception, or an accepted models or patterns or models. In this study, it is defined as analytical models or accepted patterns to explain and shape the relationship between nature and society in terms of environment and development.

Colby’s five paradigms are “frontier economics,” “environmental protection,” “resource management,” “ecological development,” and “deep ecology.”²⁾
 O’Riordan (1981) analyzed nature and society by providing the terms “technocentric” and “ecocentric.” In the ecocentric mode of modern environmentalism it is understood that human beings are

part of the global ecosystem, which constrains human economic activities (deep ecology³⁾ and self-reliance). This mode emphasizes decentralized, democratic, and small-scale communities using soft technology and renewable resources. On the other hand, in the technocentric mode of environmentalism, human beings or society solve

2) De Vries’ and Colby’s five classifications are similar, though Colby’s terms are much more explicitly defined.
 3) Deep ecology is more ecocentric than self-reliance.

environmental problems and achieve unlimited growth, or they can cope through economic and environmental management. O'Riordan's ecocentric understanding comes from the philosophies of the romantic transcendentalists of mid-nineteenth-century America.⁴⁾

Pepper (1984) adopted O'Riordan's terms such as ecocentric and technocentric, and developed the paradigms in more details. In his classification, cornucopians assert that humans can always find a way out to any difficulties. As well as scientific and technological expertise provides the basic foundation for advice on matters pertaining to economic growth. This paradigm includes neo-classical economics, environmental economics and ecological economics. This classification encompasses classical economists, neo-classical economists and neo-Marshallians who are concerned with exponential population growth in a global perspective. Environmental managers, as the second paradigm, suggest that economic growth and resource exploitation can be achieved with suitable economic adjustments and sustainable environmental status.

"Self-reliance," or soft technologists, emphasizes small-scale community settlement, work and leisure. Participation in community affairs, which can protect community and minority interests is an important factor in this paradigm.

Deep ecologists emphasize the intrinsic importance of nature for humanity and the rights of endangered species. O'Riordan (1989) and Pepper (1993 and 1996) have developed a new classification which O'Riordan has labeled ecocentrism and technocentrism as "intervention," "accommodation," "communalism," and "gaiannism."⁵⁾ Devall and Sessions (1985) point out "deep ecology attempts to articulate a comprehensive religious and philosophical world view, and not just to handle environmental problems."⁶⁾

De Vries (1989) originally proposed five classifications of sustainable development. The fifth classification of "cultural orientation," however, is not considered in this study because the idea is not suitable for explaining sustainability when compared with the previous four classifications. In fact, it is not associated with a set of paradigm patterns, but with the human psyche and culture such as the psychological aspects of the environmental problem, social inequity in access to resources, and imbalance between material and spiritual values. According to De Vries' classification, technocrat-adventurer is closely related to technological optimism and economic growth discussed in the previous section.

In this cluster, technology is a major indicator for social progress and is based on neo-classical economics.

4) David Pepper, 1984, *The Roots of Modern Environmentalism*. Dover, New Hampshire: Croom Helm, p. 27.

5) O'Riordan (1989) proposed the classification and Pepper (1993 and 1996) developed them with critical views.

6) Bill Devall and George Sessions, 1985, *Deep Ecology: Living as if Nature Mattered*. Layton, UT: Gibbs Smith, p. 65.

In De Vries' second paradigm, accessible resources are depleted in such a way that social benefits are maximized and the cost of material inputs and outputs reflects the costs to maintain or restore the natural environment. The essence of the steward, as the third classification, is anthropocentrism with utmost biological care. The major concerns of this paradigm are air and water quality, soil preservation, and the protection of endangered species. Economic costing techniques and utility concepts are not adopted for the sustainable development of resources and the biosphere. The fourth classification is "partner" as an ecological perspective in which the relation with nature is characterized by interdependence, harmony and partnership, and not by exploitation and the utility of natural resources. As De Vries points out, this perspective is very close to "deep ecology."

Colby's taxonomy (1990) on the relationship between environment and development focuses on sustainable development with explicit definitions and economic, sociological and ecological evolutionary relations. The five paradigms he considers have different evidence, imperatives, strategies, and roles for the economic sector. The five paradigms, "frontier economics," "environmental protection," "resource management," "eco-development," and "deep ecology," have different assumptions about human nature, and the interactions between nature and humans.

They also focus on different dominant problems, threats or risks (problems for development), solutions and management strategies.⁷⁾ In short, the five paradigms are classified by five different academic perspectives with respect to environmental management and development.

Colby's first paradigm, "frontier economics," includes the classical and neo-classical economics schools. In this perspective, nature is seen as existing for the instrumental benefit of humans as it is regarded as an infinite supply of physical resources and free goods. Thus rapid rates of economic growth could be achieved by exploiting natural resources. This perspective has led to resource depletion, environmental commodification and unsustainable development. His second classification, "Environmental Protection," refers to an attempt to cope with the failure of the market in traditional economics. Pollution and ecological degradation in this paradigm are considered as an externality to the economy because they are not priced in the traditional market system. The environmental protection classification can be regarded as a transition to a systemic view of the requirements of sustainability.

Colby's third classification, "resource management," exemplifies the basic theme running through reports such as *Our Common Future*, *State of the World*, and *World Resources Report*. This paradigm offers considerable change from the first and second paradigms. For example, sustain

7) Michael Colby, 1990, *Ecology, Economics, and Social Systems: the Evolution of the Relationship between Environmental management and Development*. Ph.D. Dissertation. University of Pennsylvania, p. 19.

able development is still essentially anthropocentric in terms of human-nature relations, but the results can be quite different with the anthropocentric form dominant in the first and second paradigms. Thus, it is an attempt to develop a positive integration of ecological and economic needs. His fourth paradigm, "ecological development," is understood as the symbiosis of economics and ecology. It attempts to incorporate many social equity and cultural concerns, instead of economic evaluation or assessment. The basic premise of this paradigm is that all aspects of sustainability should be ecologized.

His final paradigm, "deep ecology," is based on ethics and aesthetics rather than a monetary or material orientation. Advocates of this paradigm are highly resistant to the idea of using economic valuation for environmental damage. All the analysts examined here have a similar scope and meaning for this paradigm. Colby's effort to conceptualize sustainable development is very useful in recognizing its meaning and academic location. The paradigm of sustainable development, however, is too superficial to be fully satisfying.

III. Analysis of Five Paradigms for Sustainability

As the paradigms propose, there are different evidences, imperatives, strategies, roles, perspectives, and assumptions about society and nature in the definition of sustainability. But, there are no sharp bo-

undaries between the paradigms (delineated in Table 1). Further, there is no explicit connection between each scholar's classification (vertically shown in Table 1). The paradigms represent each scholar's subjective observations on meaningful patterns of similarity among analytical units in the sustainability and sustainable development debate. Similarly, this study classifies five paradigms with subjective observations on meaningful environment and development patterns. These are "conventional economics," "environmental economics," "ecological managerialism," "ecological development," and "deep ecology." This classification alludes to the four scholars' classifications, but is primarily based on author's subjective observation and ideas with respect to the issues of environment and development.

As Table 1 shows, the first paradigm, conventional economics, is very similar to the O'Riordan and Pepper's "cornucopians," De Vries' "Technocrat-Adventurer" and Colby's "frontier economics." The second paradigm, "environmental economics," is identical to Colby's "environmental protection," and similar to De Vries' "manager-engineer." The third paradigm of "ecological managerialism" is the same as Colby's "resource management." The fourth paradigm, "ecological development," is the same as O'Riordan and Pepper's "self-reliance," and similar to De Vries' "steward" and Colby's "ecological development." "Deep ecology," the last paradigm, is closely identified with O'Riordan and Pepper and Colby's "deep ecology" and De Vries' "partner."

Table 2 Paradigms on Environment and Development Relations

Criteria for Analysis	P A R A D I G M S				
	Conventional Economics	Environmental Economics	Ecological Managerialism	Ecological Development	Deep Ecology
Advocators	Classical and Neo-classical Economists	Environmental Economists	Ecological Managerialists (Steady-State)	Steward and Political Ecologists	Deep (or Social) Ecologists
Dominant Ideas	Social Progress as Economic Growth	Offset of Economic Development and Environmental Cost	Sustainable Development For Green Growth	Co-development/ Symbiosis of Humans & nature	Ecological Utopia, Clean Nature, Anti-Progress
Analytical Methods	Cost-Benefit Analysis for Development and Environment	Willingness to pay for Compensation of Development and Environment	Integration of Social, Economic, Ecological Criteria for Development and Environment	Integration of Social and Ecological Criteria for Development and Environment	Ecological and Biological Diversity for Development and Environment
Human Nature Relations	Strong Anthropocentric (Technocentric)	Anthropocentric (Technocentric)	Anthropocentric, but With Strong Care of Nature	Moderate Ecocentric	Strong Ecocentric (Biocentric)
Development and Environment Strategies	Quantitative Development & Indifference to Environment	Compensatory Relation between Development and Environment	Co-Development between Environment and Development	Limitation to "Progress" and Comprehensive Nature Protection	Absolute Resistance to "Progress" and The first priority to Environment issues
Perspectives about Nature	Infinite Exploitation "nature is free goods"	Regards Nature as Economic Externality	"Economize Ecology" for Nature Use	"Ecologize Economics" for Nature Protection	Back to Nature Equal Symbiosis
Sustainable Strategies	Efficiency	Effectiveness	Equity	Stability	Justice between All Living Species

Table 2 shows the five paradigms and their differences, and identifies the theoretical foundation of sustainability. The theoretical foundation of sustainability is not just a compromise between economics and ecology, it is mainly located in ecological managerialism which is theoretically

based on The Limits of Growth of Meadows et al. (1972), the Brundtland Report (1987) and Daly's Steady-State Economics (1991). The fourth paradigm of ecological development, however, may partially include the concepts of sustainable development.

1. First Paradigm

The first paradigm considered in Table 2, "conventional economics," is based on a laissez-faire economic approach supported primarily by classical economics and neo-classical economics. This approach considers economics as a tool for economic production and growth. Conventional economists look at natural resources (e.g., water, air, etc.) as "free goods," because when the schools were established between 1850 and 1950 enormous quantities of new natural resources were discovered and easily obtained. The paradigm runs as follows: first, natural resources are so abundant that they are costless or have virtually no marginal value; second, the increase of GNP (quantitative growth and economic progress) is regarded as national wealth; third, cheaper energy is better for the economy; and fourth, any environmental concerns are groundless.

This paradigm, like the "cornucopians" that O'Riordan (1981) and Pepper (1984) proposed, accepts that scientific and technological expertise provides the basic foundation for economic growth and progress. This paradigm, as De Vries suggested in the "technocrat-adventurer," is often referred to as technological optimism, technocratic management and growth myth. In short, economic growth can be achieved by exploiting natural resources. Resource depletion, natural commodification and unsustainable development are irrelevant.

2. Second Paradigm

The basic premise of the second paradigm, "environmental economics," is that tra-

de-offs between environmental degradation and economic growth can be measured through "willingness to pay" and compensation principles. Since the 1960s, the industrialized countries, including Western Europe and the U.S., have begun to change the laissez-faire economic system into a new economic paradigm. Conventional economists started to regard pollution and ecological degradation as externalities to the economy because they are not included in the prices of the market system. Meanwhile the negative externalities (e.g., pollution and ecological degradation) began to increasingly destroy nature and the ecosystem. Thus, environmental problems required some social and economic institutions to regulate and control the pollution and ecological degradation accompanying industrialization. Environmental concerns played considerable roles in the passage of the U.S. National Environmental Policy Act (NEPA) and the creation of the Environmental Protection Agency (EPA).

At the same time, these concerns have led to changes in economics itself, to incorporate environmental costs in economic analysis. Environmental economics attempts to apply new economic measures to the problems of environmental protection (e.g., pollution levels and human health impacts, etc.), and argues that pollution and ecological degradation should be priced in the economic market system. An example of the activity of this paradigm is expressed as formation of the superfund program.⁸⁾ According to Portney, the Superfund law is one of the few environmental statutes that attempt to address past

environmental degradation rather than focusing on prevention. This approach is identical to Colby's "environmental protection" in which Colby points out that Rachel Carsons Silent Spring (1962) was a significant turning points to the emergence of the dominant paradigm of environmental management.

3. Third Paradigm

"Ecological managerialism," the third paradigm considered here, is expressed as the integration of economic, social and ecological criteria for development and environment. This paradigm provides the theoretical fundamentals of sustainability. Sustainable development is the reaction of societies to the questions of limited natural resources and environmental issues. "Ecological managerialism" is the same as Colby's "resource management," and also similar to an integrated concept of both De Vries' "manager-engineer" and "steward," and both O'Riordan and Pepper's "environmental managers" and "self-reliance." This paradigm is supported by the basic ideas presented by the Brundtland Commissions (WCED) Our Common Future (1987), State of the World and World Resources Report, Daly's Steady-State Economics, and the Club of Rome's The Limits to Growth (Meadows et al., 1972).

The discussion of sustainability started with the 1972 Stockholm U.N. Conference on the Human Environment and with The Club of Romes study, The Limits to Grow

velopment became a major issue for debate through the 1987 report of the Brundtland Commission on the Environment and Development and the 1992 UNCED Rio Conference. The Club of Rome study (Meadows et al., 1972), The Limits to Growth, not only challenged conventional economic wisdom that is based on the social phenomenon of technological development, economic growth and ecological degradation, but also showed that an immediate transition to the steady-state economy was necessary. The Club of Rome study also attempted to cope with the conventional economic paradigm that is based on economic growth and ecological degradation.

The World Commission on Environment and Development (WCED) defines "sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs." World Commission on Environment and Development. 1987. Our Common Future. The WCED's concept of sustainable development implies "a general change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are all in harmony and enhance both current and future potentials to meet human needs and aspirations."⁹ The WCED intends to include both the essential needs of the worlds poor and the idea of limitations imposed by the state of technology and social organization on the environments ability to meet present and future needs.

8) Portney, Paul R, 1990, Introduction in Paul Portney, (eds.) *Public Policies for Environmental Protection*. DC: Resorces for The Future, p. 2.

th (Meadows et al., 1972). Sustainable d

Herman Daly (1991 and 1996) stresses the importance of "the optimum scale of total resource use relative to the ecosystem" by comparing the economy with the ecosystem. In his view standard economics promotes an ever-expanding scale of resource use. The central aspect of this paradigm can be found in Daly's (1991) "Steady-State Economics," where he states "the steady-state economy seeks to change institutions in such a way that people become autonomous and technology is not abandoned, but is demoted to its proper accommodating role."¹⁰

4. Fourth Paradigm

Although the fourth paradigm label of this study, "ecological development," is the same as Colby's fourth paradigm, the two paradigms differ in components, characteristics and scope. Particularly, it is sometimes hard to differentiate the fourth paradigm from the third. This paradigm attempts to move from economizing environmental problems for resource management to ecologizing economics, and to integrate natural resources, social systems, economic systems, and ecosystems. This paradigm

starts from questions about the most serious long-term environmental problems such as deforestation, soil erosion, global climate change, endangered species, extinction of poverty, wealth distribution, population growth, and sustainability.¹¹ "Development" deals not only with the pollution clean-up, the prevention of excessive resource depletion, and the economic efficiency of resource, but also addresses to the coexistence of humans and nature. This view does not assume that all economic principles should be thrown out, but rather that economics should be able to provide an understanding of what is necessary for sustainability. Thus, this paradigm identifies developmental activities as a form of the relationship between society and nature.

The "Ecological Development" paradigm is similar to "Ecosocialism" proposed by Pepper (1984: 196-201), De Vries' "Steward," and the "steady state society" proposed by Ophuls and Boyan (1992). Redclift (1987) also used the concept in the early 1970s. Redclift insists that "the term of sustainable development suggests that the lessons of ecology can, and should, be applied to economic processes."¹² In his vi

9) World Commission on Environment and Development, 1987, *Our Common Future*, Oxford: Oxford University Press. p. 46.

10) Daly, Herman. 1991. *Steady-State Economics*. 2nd (eds.) D.C.: Island Press. pp. 6-7 and 180.

11) All paradigms dealing with deals with environmental issues use the sustainability concept. The body of theory regarding sustainable development (beginning with the Brundtland report) is rooted in three paradigms: ecological economics, political economy, and social ecology. The differences among the three are found in the perception of the relationship between environment and development.

12) Redclift, Michael. 1987. *Sustainable Development: the Concept Sustainable Development: Exploring the Contradictions*, pp. 15-36.

ew, sustainable development encompasses the ideas in the World Conservation Strategy, providing an environmental rationale to improve the quality of all life through development. He also proposes that ecological development be represented by basic needs, self-reliance, and ecological sustainability.

5. Fifth Paradigm

The fifth paradigm, "Deep Ecology," largely regarded as the polar opposite of conventional economics in the context of environment and development, embraces a totally divergent value system, based on ethics and philosophy rather than economics. This paradigm should be distinguished from pure ecology because, unlike ecology, it is a philosophy about how humans should live. This paradigm, linked with the natural view of Buddhism and Taoism, is highly resistant to the idea of using economic cost measures to assess environmental damage, and tends to be quite skeptical of the dominant western idea of "progress." De Vries identifies that his last paradigm, "partner," "has its most explicit expression in Deep Ecology with its emphasis on existential unity and on religious and vernacular values."¹³⁾ According to Pepper, "deep ecology" fundamentally does not have the dualistic view of humans and nature as being separate, but the unitary view that humans and nature are one.¹⁴⁾

IV. Development of the Sustainability Principles in Public Policy

The theoretical foundation of sustainability is not just a compromise between economics and ecology. The theoretical basis of sustainability is founded in "ecological managerialism" which is theoretically based on *The Limits of Growth* of Meadows et al. (1972), the Brundtland Report (1987) and Daly's steady-state economics (1991). The fourth paradigm, "ecological development," also partially includes the concepts sustainable development. In short, the scope of this study of sustainable resources management is primarily based on "ecological managerialism," and partially on the ecological development.

Based on the theoretical concept of sustainability, this study does not intend to add another definition of sustainability, but rather abstract the fundamental ideas of sustainability for resource management. The intention of such an approach is to abstract the concept of sustainability and to find common characteristics of sustainability, and to include central and peripheral ideas based on the rationale of resource management. The central ideas proposed here are: *Limits to Growth* discussion on the growth and development of society; "equity," a description of participation

13) De Vries, Hubertus, 1989, *Sustainable Resource Use: An Inquiry into Modelling and Planning*. Ph. D Dissertation, University of Groningen, p. 14.

14) Pepper, David, 1996, *Modern Environmentalism: An Introduction*. New York, NY: Routledge, p. 17.

and intergeneration; integration of resource use, an argument on the necessity of the integration of multiple resource use; balanced conservation, a discussion about the balance between growth and conservation; and environmental stewardship, an illustration of the environmental ethics included in the process of resource planning. These are now looked at in turn.

1. Limits to Growth

The central component in discussing the distinction between growth and non-growth depends on how we can accept the concept of social progress as was suggested mainly by neo-classical economists. Neo-classical economists argue that change in production modes were an important aspect of the spectacular long-term economic growth experienced in the post-industrial era. This growth was accompanied with social progress. Technological change was a very important factor to achieve economic growth. In this context, as Bryne, Hoffman and Martinez point out (1992), social progress can be characterized by three issues: the commodification of nature in resource management, a larger-scale economic system, and economic efficiency. The size of industries in fact has been getting bigger and the structure of the industries has become more centralized.

Meanwhile, the Club of Rome (Meadows, et al.) investigated five major trends of global concerns such as accelerating indus-

trialization, rapid population growth, widespread malnutrition, depletion of nonrenewable resources, and a deteriorating environment. Their central inquiry is "if the development is fully successful and removes some natural limit to growth, what limit will the growing system meet next?"¹⁵⁾

As a result, to address sustainability, it is necessary to include the environmental issues that neo-classical economics has not considered in its economic model. As Pezzey (1992) points out, if we use the conventional 1960's model of economic growth, in which output is produced from just capital and labor inputs, we have little reason to find that sustainability should ever be a problem. Such critiques of conventional neo-classical economics provide more understanding of the first fundamental of sustainability presented by the Club of Rome. The primary flaw of neo-classical economics in this regard, is that the goal of continual growth leads to the degradation of natural environment and that this degradation must be taken into account. As mentioned above, however, a steady-state economy is a central feature of sustainability. A steady-state economy is not characterized by growth, which is the conventional economic goal. Thus, growth is not consistent with the framework of sustainability.

15) Meadows, Donella H., Dennis L. Meadows, Jorgen Randers and William W. Behrens III., 1972, *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind*. New York: Universe Books, p. 155.

2. Equity and Participation

The most frequently cited definition of sustainable development can be found in the report of the World Commission on Environment and Development (WCED). According to the report, sustainable development is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Even the narrow notion of physical sustainability implies a concern for social equity between generations, a concern that must logically be extended to equity within each generation.¹⁶⁾ The report provided two concepts of intragenerational and intergenerational equities in defining sustainable development. These are most important for resource management. Meanwhile, Banuri et al. added two equity concepts that involve procedural and consequential issues. Procedural equity relates to how decisions are made whereas consequential equity relates to their outcomes.¹⁷⁾

In other words, the former relates to participation (intrageneration) and the latter relates to social equity (intergeneration) in the analysis of natural resources management.

Participation in sustainable development means that those who are affected by decisions should participate in the decision-

making process through either direct participation and or indirect representation. Participation itself is viewed as an educational process, that is, people learn when they participate in the policy process. Currently participation, although not as popular as in the 1960s and 1970s, is a key element in the process of resource management decision-making. There are many forms of participation ranging from the traditional public hearing to citizen committees, drop-in centers, workshops, meetings, conferences, and surveys.

Grigg (1996) argues that decision-making bodies such as federal, state, or local governments should fulfill the special trust relationship with the public. His describing feature is, "decision making to include all affected interest groups: decision-making bodies to provide the public with clear information; respect for existing equities when reallocation of water is necessary."¹⁸⁾

Through the various forms of participation, governmental behavior is changed so that governmental units better respond to citizens' needs and citizens are able to understand the public policy that directly relates to their lives.

Intergenerational equity for sustainable resources management, as the WCED explicitly provides, means that the present generations meet their needs without compromising the ability of future generation

16) World Commission on Environment and Development, 1987, *Our Common Future*, Oxford: Oxford University Press, p. 43.

17) Banuri, T., K. Goran-Maler, M. Grubb, H.K. Jacobson, F. Yamin, 1996, "Equity and Social Consideration," In James P. Bruce, Hoesung Lee, Erick F. Haites, (eds.) *Climate Change 1995*. New York, NY: The Press Syndicate of the University of Cambridge. p.85-86.

18) Grigg, Neil S., 1996, *Water Resources Management: Principles, Regulations, and Cases*, New York, N.Y.: The McGraw Hill, p. 11.

s. Intergenerational equity considerations also deal with the distributional aspects of costs and benefits. In other words, it is important to consider questions of "who benefits?" and "who pays?" For example, long-term public project capital investments is often financed by future generations through the taxation structure. Similarly, the construction of a water storage facility may turn out to be the destruction of the natural eco-system of future generations. As a result, equity questions in resources management remain among the primary points of contention and debate and will remain so into the future. Such questions emphasize the complicated interaction of resources management.

3. Integration of Resource Use

Sustainable development, defined in terms of ecology, is particularly important in the field of natural resources management, where economic development and environmental protection are crucially dependent on the efficient management of natural resources. Ecological sustainable development is most likely to be achieved through integrated natural resources management. Integrated resources management is a specific application of the more general notion of integrated environmental management. Integrated resources management seeks the linkage of multiple resources uses, as well as connection of both the supply- and demand-side. In fact, a growing number of areas have recognized problems

in current approaches to resources management and have taken significant steps to modify the regulatory, institutional, economic and social framework in which resources policy takes shape.

Integrated resources management has multiple objectives. For example, they include the minimization of waste water, maximization of water use efficiency, the maximization of water availability by limiting the degradation of water supplies and thorough reuse, the optimization of water allocation to competing users, and the consideration of environmental sustainability as a key concept. Dzurik (1996) illustrates that integrated water resources management has a number of dimensions. These dimensions suggest that integrated resources management is not only a comprehensive approach for resource management, but also a management of the resources system for broad scope and long term objectives.¹⁹⁾ Human judgement and values becomes a determining variable in defining what constitutes an acceptable level of ecosystem integrity. With respect to the problem of designing or planning for sustainability, the question how this judgement is made, who takes it, and for what purpose, is critical to the overall assessment of whether ecosystem integrity, and hence sustainability, has been achieved.

4. Balanced Conservation

The notion of balanced conservation, in

19) Dzurik, Andrew A., 1996, *Water Resources Planning*. Lanham, MD: Rowman & Littlefield Publishers, Inc., p. 106.

response to a perceived need to find a balance between growth and conservation, is also a very important principle in the framework of sustainable resources management. The typical examples of balanced conservation may come from the sustained yield in the areas of forest and fishery management. A sustained yield in forest management "implies continuous production, with the aim of achieving an approximate balance between net growth and harvest, either by annual or somewhat longer periods" (Drengson and Taylor, 1997: 310).

The optimum-sustained yield in fishery management means not only the amount of fish that provides the greatest overall benefit to the national economy, but also the basis of sustainable yield from the fishery modified by any relevant economic, social, or ecological factors.²⁰⁾ In short, the logic underlying the concept of optimum sustained yield is a balance between growth and conservation, which means using no more than the annual increase without reducing the physical stock. The concept of sustained yield, however, is criticized in the fields of fishery and forest management. Criticism points out that optimal sustained yield is a vague concept so that nobody can measure the optimal level of sustained yield in fishery management, while the concept works well only when there is some excess forest resource potential in forest management.

With respect to forest management, there is a growing evidence of decreasing productivity over large areas of intensively-managed forests in the United States. According to Maser (1994), the United States is already starting to experience some of the same consequences seen in the forests of central Europe and China. For example, growth of southeastern pine plantations is declining after decades of increase. In other words, sustainable yield becomes vulnerable to criticism when the demand is in excess of the supply. In this context, the National Research Council suggest that new paradigms rooted in principles of sustainability, include concepts of "forest health," "ecosystem management," and "sustainable forest management."²¹⁾

Forest health is an effort to make a healthy forest ecosystem, suppressing forest fires and insect infestations. Ecosystem management, a process-oriented approach to resources management, is a landscape management for federal-land management, related to forest fire, alien plants, or insects and disease. Sustainable forest management is interested in the effects on the sustainability of the multiple resources of forests. The new paradigms have identified broader sets of forest management and multiple use against the old concept of sustained yield.

20) Cicin-sain, Biliiana and Michael K. Orbach, November 1986, "Mutual Mysteries: Washington/Regional Interactions in the Implementation of Fisheries Management Policy." *Policy Studies Review*, Vol. 6, no. 2, p. 355.

21) National Research Council, 1998, *Forested Landscapes in Perspective*, Washington, D.C.: National Academy Press, pp. 205-209.

5. Environmental Stewardship

Environmental stewardship, as the last major principle of sustainability, is an inclusive and synthetic concept of sustainability which is not only supported by the concepts of justice, equity, integration, but also based on some components from the Limits to Growth of the Club of Rome, Daly's Steady-State Economics and the Brundtland Commission's Our Common Future. The concept of stewardship can be shown throughout many literatures. The dictionary defines a steward as a keeper, one in charge of the affairs of a large estate or the supervisor or administrator of the property of another. According to Howell, "the Christian steward is entrusted with certain divine gifts demanding faithful and wise stewardship, arguably including stewardship of the earth."²²⁾ Stewardship is the responsible and accountable management of resources.²³⁾ Stewardship is also defined as an intuitive and essentially moral commitment to preserving the beauty and productivity of the earth for future generations.²⁴⁾

These conceptions implicate that environmental stewardship is a guide to human behavior and an intuitive and essentially moral commitment to searching for an environmental aesthetic and/or the responsible and accountable management of resou

rces. In this context, society needs to develop an ethic of stewardship that strongly encourages all of us to take full responsibility for the economic, environmental, and social consequences of our actions. The concept of stewardship calls for everyone in society to assume responsibility for protecting the integrity of natural resources and their underlying ecosystems for the interests of present and future generations. Furthermore, we need to strive for the practical efforts to integrate personal and collective commitments, and to accept the responsibility for successful environmental stewardship.

In conjunction with the concept of stewardship, Sitarz (1998) suggests we pay attention to four interacting moral concerns. The first is a commitment to sustainability or a belief that current practices resulting in deforestation, groundwater depletion, mining, pollution, and other impacts on the health of the natural world must be corrected. The second is a commitment to make connections between social injustice and environmental justice. The third is a commitment to a satisfying life. Finally, stewardship requires the ability to participate in the decisions that affect our life. In reality, however, stewardship will become more challenging as human population continues to expand, so too will demands for fertile soil, clean and abundant water, healthy air, diverse wildlife, food, fuel, and fiber.

22) Howell, Dorothy J., 1997, *Environmental Stewardship: Image from Popular Culture*, Westport, Conn: Bergin & Garvey, p. xv.

23) Drengson, Alan and Duncan Taylor, 1997, "Glossary" in Alan Drengson and Duncan Taylor (eds.) *Ecoforest*. Stony Creek, CT: New Society Publisher, p. 310.

24) Soderstrom, Elizabeth Ann., 1996, *Sustainability and Water Management: Case Studies on School Trust Lands in the Western United States*, Ph. D. Dissertation: University of California at Berkley, p. 310.

V. Conclusion

This study examined theoretical discussions about sustainability, and reviewed a wide range of different perspectives within economics, ecology and public policy. Upon reviewing the works of O'Riordan, Pepper, De Vries, and Colby, this paper identified five broad paradigms in regard to sustainability and sustainable development in analyzing the relationship between society and nature. The theoretical basis of sustainability is founded in Ecological Managerialism which is theoretically based on *The Limits of Growth* of Meadows et al. (1972), the Bruntland Report (1987) and Daly's *Steady-State Economics* (1991). The fourth paradigm, Ecological Development, also partially includes the concepts sustainable development. Based on the discussion of sustainability, this study consolidates the fundamental ideas of these paradigms into an operational idea of sustainability for public policy: limits to growth, equity, integration of resource use, balanced conservation, and environmental stewardship.

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