AN ALTERNATIVE APPROACH TO REGIONAL PLANNING:

A CARRYING-CAPACITY FRAMEWORK FOR ACHIEVING A VIABLE REGION

by

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ABSTRACT

The purpose of this thesis is to develop an alternative approach to regional planning based on the concept of carrying capacity.

I assume that the relationship between human society and its ecological resource base has substantially changed because of the unprecedented economic expansion subsidized by fossil fuel and consequently we can no longer behave as if the natural environment had unlimited capability to accommodate human economic activity. In this situation, in order to ensure the long-term welfare of regional residents, it is necessary to improve the viability of a region by restructuring its economy in such a way as to promote regional economic self-reliance and ensure sensible natural resource management. Efforts should be made to achieve a self-reliant economy using regional resources on a sustainable basis. The concept of carrying capacity, which is an explicit representation of limits to growth, can provide a valuable framework for these efforts. I propose a conceptual framework of carrying capacity, where four variables are incorporated. They are [1] natural capability, [2] human intervention, [3] material standard of living, and [4] interregional transfer of commodities.

The exploration of this alternative approach to regional planning involves four steps. First, I examine the present nature-human relationship paying special attention to the prevailing assumption about the natural environment and the role of fossil fuel in industrial society. Second, I consider what the viability of a regional economy is and how it can be improved under the circumstances clarified in the preceding step. Third, I

examine the meaning of carrying capacity criticizing the existing applications, and develop a carrying-capacity framework that can help achieve a viable region. Fourth, I describe how the proposed framework can be applied to the efforts to design a mode of production and consumption that is compatible with a viable region.

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CHAPTER I

INTRODUCTION

(1) Purpose

The purpose of this thesis is to develop a resourse-based approach to regional planning using the concept of carrying capacity. On the assumption that the capability of the natural environment to accommodate humankind is limited, I define a conceptual framework that proposes a mode of production and consumption compatible with ecological imperatives in the long run. I also describe the linkage between ecology and economy from the perspective of regional residents, arguing that establishing an ecologically sustainable economy is the only possible way to achieve a viable region.

A viable region is a key concept in this thesis, and is defined as a region where a standard of living acceptable to the inhabitants is ensured in the long run despite extraregional economic fluctuations such as abrupt changes in the price or quantity of goods traded in international markets. If the mission of regional planning includes ensuring the long-term welfare of community residents, it should be regarded as a major goal of regional planning to achieve a viable region. The concept of carrying capacity is associated with a viable region in that the former can provide a useful framework for the efforts to achieve the latter.

The exploration of this alternative approach to regional planning takes the following steps:

[1] to describe the present relationship between society and its ecological resource base, clarifying major assumptions underpinning

the prevailing mode of human activity;

[2] to consider the meaning of the viability of a regional economy within the context of the present relationship between humankind and the natural environment;

[3] to examine the meaning of carrying capacity reviewing existing applications in planning, and to develop a framework that has a potential to help achieve a viable region; and

[4] to synthesize the argument in the thesis, and show how the proposed carrying-capacity concept can be applied to the efforts to design a mode of economy consistent with the concept of a viable region.

These four steps are the major purposes of Chapters II, III, IV and V, respectively.

(2) Premise, Problem and Argument

The statements of Premise, Problem and Argument are as follows:

Premise:

Because of the unprecedented scale of their impact on the natural environment, human beings can no longer assume that it has unlimited capability to accommodate human activity. In industrial countries, it is often the case that even the present mode of production and consumption, to say nothing of future growth, is ecologically unsustainable.

Problem:

Regional development, in much of the literature, is regarded as synonymous with industrialization, which assumes that the ecological resource base is practically limitless. Industrialization in the name of regional development has been achieved with heavy subsidization by fossil fuel and with little regard to inherent regional ecological properties. This approach, which cannot be sustained in the long run, will fail to achieve a viable region, that is, will not serve the long-term welfare of a region.

Argument:

The policy of constant economic growth, which is based on urban industrialism, results in an unacceptable worsening of environmental pollution and resource depletion both inside and outside a region. This approach usually makes a regional economy dependent for both imports and exports on a larger extraregional economy and thereby makes it vulnerable to economic fluctuations outside the region. For these two reasons, the current dominant approach to regional development is not compatible with the long-term welfare of a region. An alternative approach, which explicitly takes ecological imperatives and regional self-reliance into account, should be explored. The concept of carrying capacity can provide a useful resource-based (supply-based) framework for this exploration.

(3) Structure

The exploration of an alternative approach to regional planning involves four major steps discussed in Chapters II, III, IV and V. The purpose of Chapter II is to justify the above premise by describing my understanding of the present nature-human relationship and presenting my criticism of the traditional assumption that the natural environment has unlimited capability to accommodate human economic activity. I emphasize that the nature-human relationship has entered a new stage where this traditional assumption threatens the long-term welfare of humankind. When the human impact on the biophysical environment was relatively small, this assumption may have provided humankind with useful guidance for their behaviour. However, the unprecedented expansion of human economic activity in this century has fundamentally changed the agelong nature-human relationship and has thereby made the assumption obsolete. Today even large ecosystems on the planet can be severely affected by human activity, and adverse human impact on nature has become apparent in form of environmental pollution and resource depletion unique to the late twentieth century.

I begin Chapter II by briefly reviewing the description of society's "myths" about nature (Holling: 1978), which helps clarify the change that has happened in the nature-human relationship. I then look at evidence supporting the premise of this thesis and attempt to clarify the character of urban industrialism examining the unique role of fossil fuel in industrial society. I conclude Chapter II criticizing the mentality of industrialism to which regional planning has been more or less geared since World War II. The two concepts, economic development and efficiency, are examined because these concepts characteristically incorporate this mentality.

Chapter III considers what is meant by "viability of a regional economy" and how a regional economy should be restructured to achieve the well-being of the region in the long run, when the assumption of an unlimited capability of the natural environment is no longer valid. In this consideration, the perspective of the regional inhabitants is emphasized. This is because in my view the welfare of the regional population should have priority in regional planning.

In this chapter, I attempt to clarify several concepts concerning a viable regional economy such as economic development, self-reliance, sustainable resource utilization and restructure planning. After this, I summarize the report prepared by Slocan Valley Community Forest Management Project in order to look at what kind of economy was considered most desirable by the project staff, who were aware of the change in the nature-human relationship and emphasized the inhabitants' perspective. I then describe the linkage between my concepts and the Slocan case, emphasizing the significance of the viewpoint of a local community. I also consider how the viability of a regional economy is dependent upon economic self-reliance, and how the economy is linked with ecology in the interest of the regional population.

The purpose of Chapter IV is to explore the meaning of carrying capacity and to develop an alternative framework for regional planning on the basis of this concept. The concept of carrying capacity is an explicit representation of the limits to population growth given by the natural environment. It can provide appropriate guidance for human behaviour assuming that the premise of a self-sustaining regional economy is valid. However, the concept of carrying capacity as introduced in bioecology cannot

be readily applied to regional planning, because such variables as technology, level of living and interregional transfer of commodities must be incorporated when it is applied to human society.

I begin Chapter IV by reviewing the carrying-capacity concept in bioecology. I then move on to assessing existing applications to urban and regional development planning. My criticism of these applications is that the meanings of technology and interregional flows of commodities are not appropriately evaluated in relation to the ecological resource base of the study areas. As a result the primary message of carrying capacity, that is, limits given by nature, is left dormant and fails to realize its intrinsic meaning. Based on this criticism, the final section looks at major variables of carrying capacity as applied to humankind, and proposes the concept of "enhanced carrying capacity," where human intervention in the natural environment, material standard of living and interregional flow of commodities are explicitly incorporated.

Chapter V is the final step in exploring the alternative framework for regional planning based on the concept of carrying capacity. In this chapter, I attempt to synthesize the preceding argument. That is, I look at how the framework of carrying capacity (proposed in Chapter IV) works in the effort to design a mode of production and consumption compatible with a viable regional economy (as described in Chapter III) on the premise that we can no longer assume an infinite capability of the natural environment (as discussed in Chapter II).

In Chapter V, I consider the definition of a region which is appropriate for the proposed carrying-capacity studies, and describe how the carrying-capacity framework can be applied to it. I advocate a region which

is determined by its ecological properties, including its human community. I also emphasize the nested structure of a region and suggest applying the carrying-capacity analysis to several levels, between a huge area that can be defined by the broadest distribution of ecological properties and a small area where the inhabitants' identity can be manifest. I then move to describing six major stages of a regional economic study employing the proposed framework of carrying capacity. These stages are expected to result in a normative image of a regional economy, which is consistent with a viable region, where the long-term welfare of regional inhabitants is ensured.

Finally, Chapter VI summarizes the argument in this thesis. Following the summary, I consider the significance of the proposed framework of carrying capacity and emphasize its educational role in present industrial society. The concluding section of this chapter suggests a direction for further study involving the experimental application of the proposed framework to a specific region for the purpose of ascertaining its strengths and weaknesses in practice.

CHAPTER II

ENTERING A NEW DOMAIN

(1) Introduction

The purpose of this chapter is to clarify the relationship between human society and the natural environment in the late twentieth century, and to assess the relevance of the traditional assumption of unlimited environmental capacity to the present nature-human relationship. This examination is necessary in order to identify an appropriate approach to regional planning for the present and the near future.

First, C.S. Holling's description of social "myths" concerning ecological stability is briefly reviewed. Two of these myths provide a valuable framework for understanding why the implicit assumption of unlimited ecological capability is no longer appropriate. Secondly, I look at the character of industrial society. Particular attention is paid to the unique role of fossil fuel in industrialization, because fossil fuel, especially petroleum, makes the current economic mode possible. I conclude that industrial society has passed a particular threshold and has entered a new domain where assumptions different from the currently dominant ones are necessary to cope with the management of the natural environment. Finally, I consider the implications of "entering a new domain" for regional planning. Examining the usual connotations of economic development and efficiency, I argue that planning practice based on a growth-oriented mentality cannot be environmentally sustained, and consequently will fail to serve regional well-being in the long run.

(2) The Myths of Ecological Stability

Holling (1978) describes four models, or "myths," concerning the nature of ecological systems, two of which particularly reveal why the implicit assumption of infinite natural capacity can no longer trusted in. This assumption underlies urban industrialism. Holling states that "[p]olicy analysis in a world constantly threatened by crises resorts to myths [beliefs] concerning the nature of this world," that is, the function of these myths is to "provide guidance for man's actions and protect him from the reality of the frightening unknown." According to Holling, "[m]yths are a way in which mankind captures some essence of experience or wisdom in a simple and elegant form," and "are only a partial representation of reality." Each myth offers "a different guidance for crisis prevention," and the four myths he describes "imply different policy postures."[1] I understand that policy is formulated within the framework of a particular myth, or a set of beliefs, and the gap between reality and the myth appears in the form of surprises and sometimes policy failures. When the gap is too large, the myth can no longer provide appropriate societal guidance. We then have to find an alternative.

According to Holling, the study of ecosystems or renewable resource systems reveals the following four basic myths: [1] Nature Benign, [2] Nature Ephemeral, [3] Nature Perverse/Tolerant and [4] Nature Resilient.[2]

[1] Nature Benign

The first myth is that of stability and "represents a benign and infinitely forgiving Nature. Trials and mistakes of any scale can be made in this world and the system will recover once the disturbance is removed." Holling describes an image of a system of this type as "a surface with a valley

shaped like a bowl, [which is infinitely large,] within which a ball moved partially as a consequence of its own acceleration and direction and partially as a consequence of the forces exerted by the bowl and by gravity."[3] In this analogy, the ball represents a system variable, and the surface of the bowl represents the character of a system to control the movement of the variable. I understand this myth as shown in Figure 1. A variable in the system has only one point of equilibrium. Even though a disturbance deviates the variable from its equilibrium, negative feedback is activated and the variable is pushed back to its equilibrium when the disturbance is removed or comes to an end. This feedback works without exception, regardless of how far the variable is displaced from its equilibrium. Humankind has often operated as if nature behaved this way.

[2] Nature Ephemeral

The second myth, opposing to the first, is that of instability and represents an unstable system that could easily collapse. In this myth, Holling writes, "the imagined surface is now dominated by a smoothly convex hill rather than a bowl" and "[t]he top of the hill represents an unstable equilibrium for if the ball is only slightly displaced from this point, it will roll away."[4] This image may be drawn as shown in Figure 2. When the variable, the ball, deviates from equilibrium, positive feedback is activated and the variable will be pushed away and never return to its original position.

[3] Nature Perverse/Tolerant

The third myth represents a multi-equilibria structure. While in some ranges the system may behave as Nature Benign suggests, elsewhere it may behave in a totally different fashion. Holling describes the dominant feature of this myth as follows:

Figure 1 Myth #1 Nature Benign

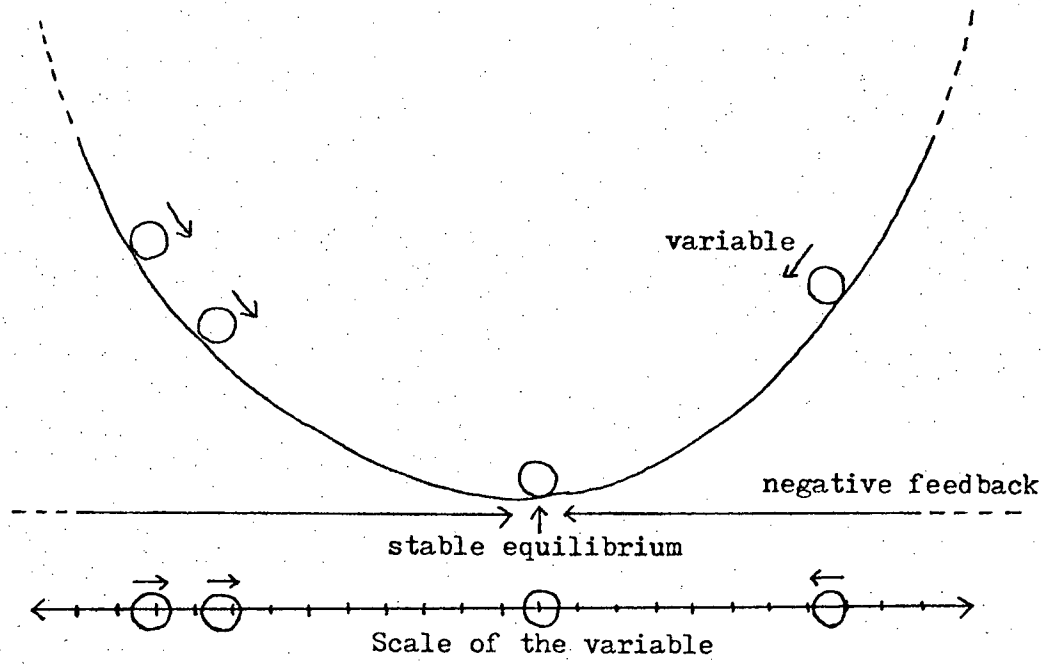
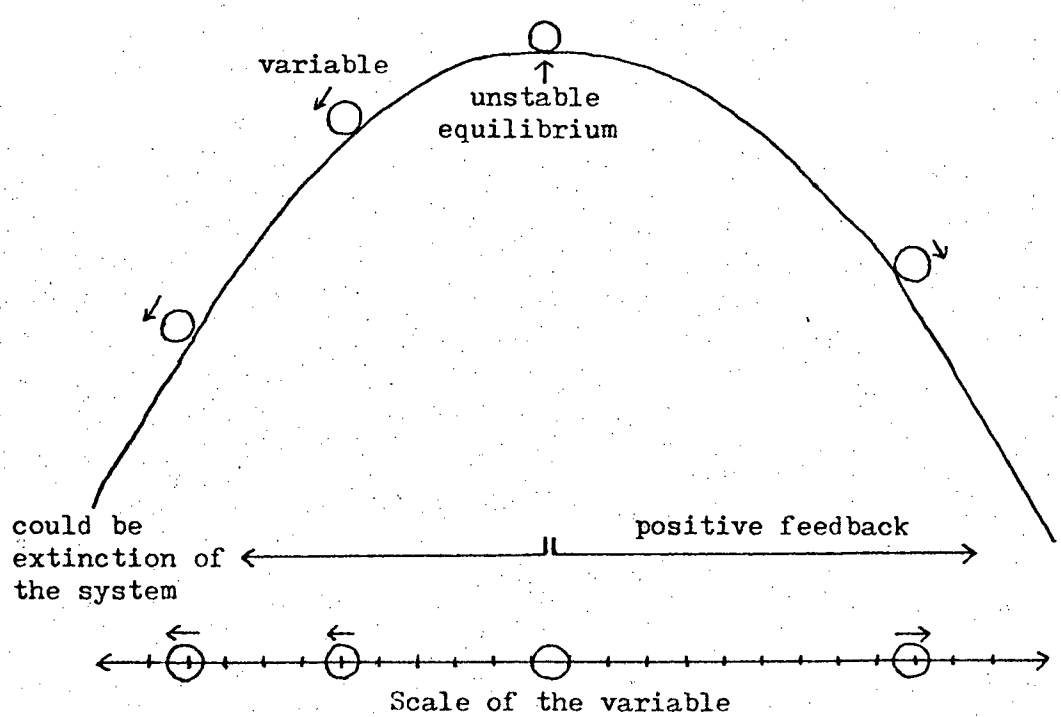


Figure 2 Myth #2 Nature Ephemeral



> Each equilibrium state or attractor [which is represented by the bottom of the basin in the myth of Nature Benign] is separated from its neighbours so that two or more basins of attraction or domains of stability are formed. As long as variables remain within one basin of attraction they will tend to the same attractor. If, however, variables happen to be close to the boundaries of these basins, then an incremental disturbance could shift the variables into another basin, thereby causing radically altered behaviour [of the system].[5]

An analogy for this myth would be "a mesa with a depression at its top."[6] The ball again represents a variable in the system, and the surface of the mesa represents the system's character which determines the movement of the ball.

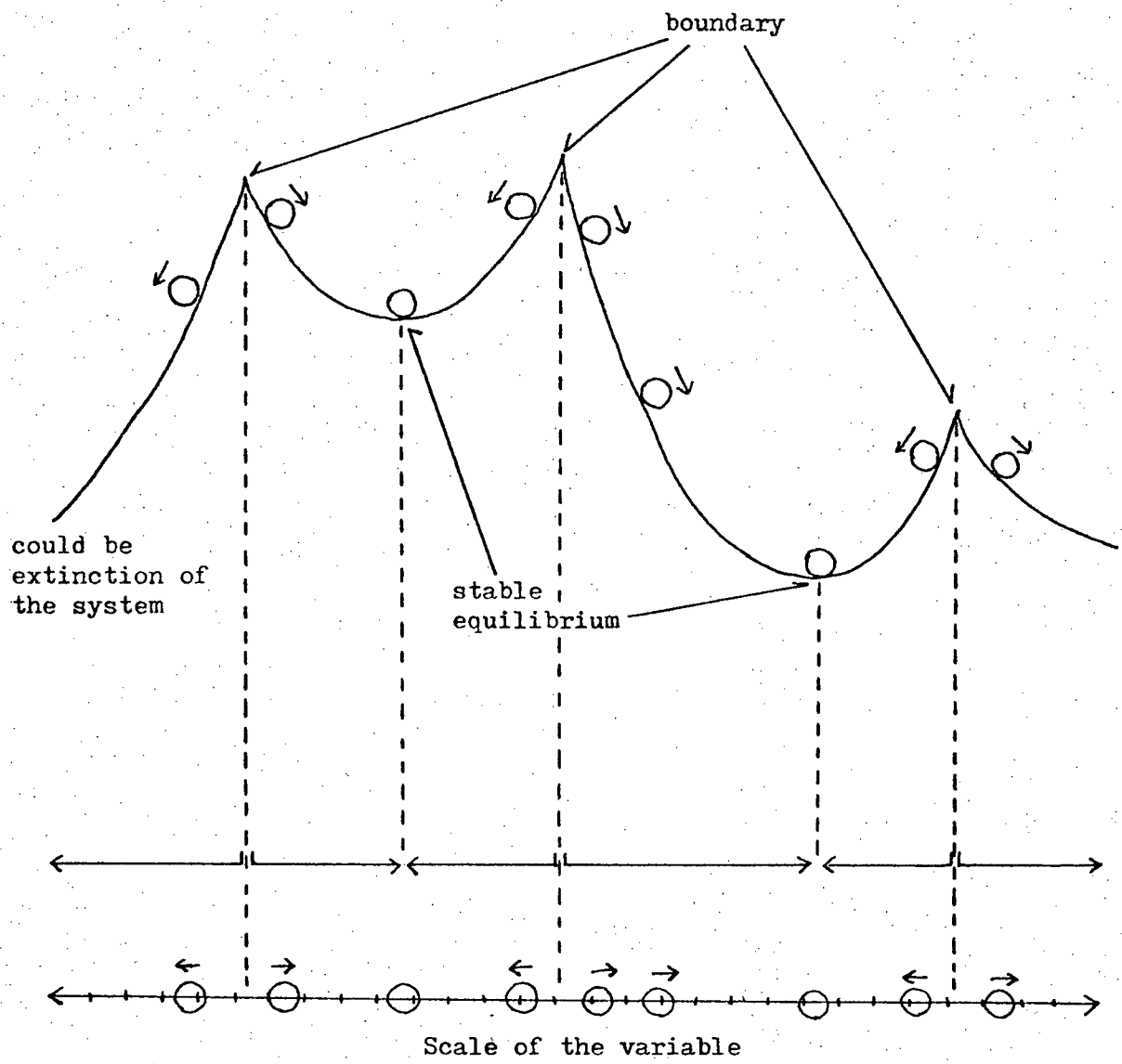
> As long as the ball is in the depression, the system appears qualitatively stable. If the ball is tipped over the edge of the mesa it will move to a different position, one of which could well represent extinction [of the system].[7]

I understand the character of the world of Nature Perverse/Tolerant as shown in Figure 3. In this type of the world, the meaning of "boundary" is most important because it may be where the system changes its behaviour drastically. The threshold effect, the phenomenon that a discontinuous change is triggered when a variable has passed a certain boundary, is well explained by the myth of Nature Perverse/Tolerant. This myth suggests that a sudden breakdown is possible even to a system that has appeared qualitatively stable. One example may be a system of a fish stock. Even though a particular stock has traditionally behaved as the myth of Nature Benign suggests, that is, the stock quickly recovers to its original size no matter how much of the population is harvested, it is possible that the stock suddenly becomes extinct when the harvest exceeds a particular amount, or some unexpected environmental shock occurs.

[4] Nature Resilient

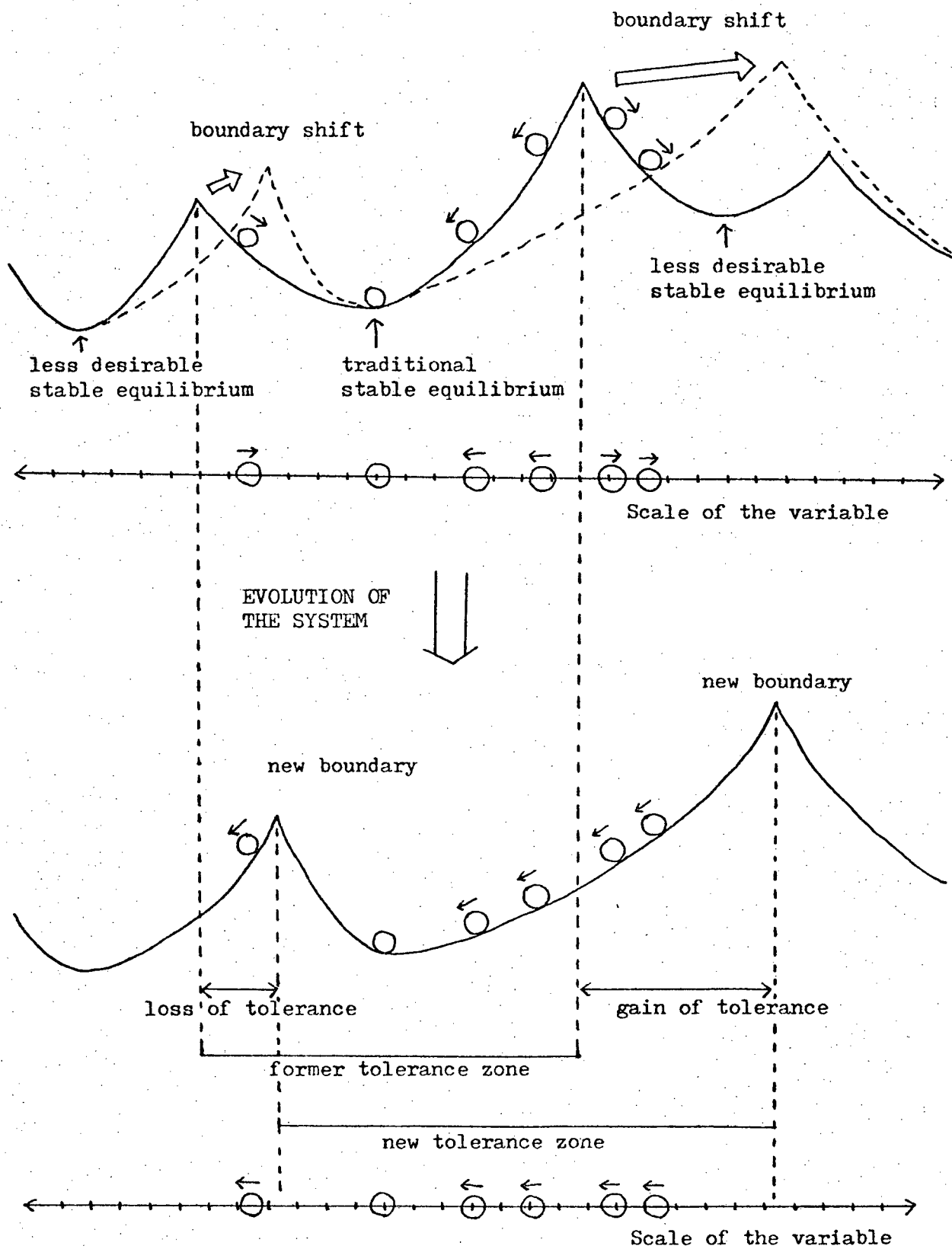
The final myth represents a system characterized by "resilience", which is

Figure 3 · Myth # 3 Nature Perverse/Tolerant



defined as "a property that allows a system to absorb and utilize (or even benefit from) change." The myth "explicitly recognizes the unknown and the ability to survive and benefit from 'failures.'"[8] The myth of Nature Resilient suggests that a system itself evolves and stability boundaries, which have been introduced in the myth of Nature Perverse/Tolerant, fluctuate in response to the changes the system experiences. This myth may be interpreted as shown in Figure 4. It describes an evolution of the system, which results in shifts of stability boundaries. These shifts are caused by experience of the system, that is, they are in a sense a result of the system's "learning." When a variable is frequently flipped over one of the boundaries and consequently the system is forced to repeatedly undergo an unpleasant experience, the system may evolve to shift the boundary in order to meet the same kind of accident in future. On the other hand, the system can "forget" the existence of another boundary if the variable is successfully kept away from it for a long time. This may result in losing part of the traditional tolerance zone, and causing an unexpected surprise which contradicts the historical behaviour of the system. The myth of Nature Resilient can be dangerous because it implies the possibility for human beings to control an ecosystem so that the system will evolve to become beneficial to human purposes, as for example a human body becomes able to manage an extra load by training. Some people may want to try to determine how the boundaries of a given ecosystem fluctuate for the purpose of human manipulation of renewable resource systems. If their experiment is conducted in an existing ecosystem (for example, a fish stock) by controlling the impact on the ecosystem, their trial can result in an expensive error (for example, the depletion of the fish stock), which a local or regional community cannot afford. I therefore believe it dangerous

Figure 4 Myth #4 Nature Resilient



to interpret this myth as encouraging human manipulation of stability boundaries of ecosystems. Instead, I understand the myth of Nature Resilient to underscore the difficulty for humans to determine the location of stability boundaries of ecosystems for management purposes. When applied to human systems such as economic and political systems, the myth of Nature Resilient can inform the argument about the ability of a system to survive disturbances including unexpected ones. Using this myth as a framework, we may develop an image of systems with "resilience," or of systems "viable" in the world of the unknown. We can study what property allows a human system to survive unhappy surprises and further improve its ability to persist by learning a lesson from them.

According to Holling, the myth of Nature Benign, underlying much of the presumption of economics, has been pervasive in human thought,[9] but "[t]he burden of evidence suggests that the multi-equilibria world of Nature Perverse/Tolerant is common--and not only for ecological systems."[10] The comparison of these two myths helps clarify my argument about change in the nature-human relationship. It should be noted that the world of Nature Benign can be interpreted as part of the world of Nature Perverse/Tolerant, as shown in Figure 5. When it is impossible for the variable, the ball in the figure, to go beyond any stability boundaries in the world of Nature Perverse/Tolerant, the world can be safely regarded as identical with that of Nature Benign. My argument is that the unprecedented expansion of human economic activity has extensively undermined the validity of the myth of Nature Benign by expanding the range of possible fluctuation of variables in ecological systems, as shown in Figure 6. Consequently, if Nature Perverse/Tolerant is a more realistic myth, the currently prevailing assumption of infinite natural capacity (Nature Benign) becomes a positive

Figure 5

Nature Benign (#1) and Nature Perverse/Tolerant (#3)

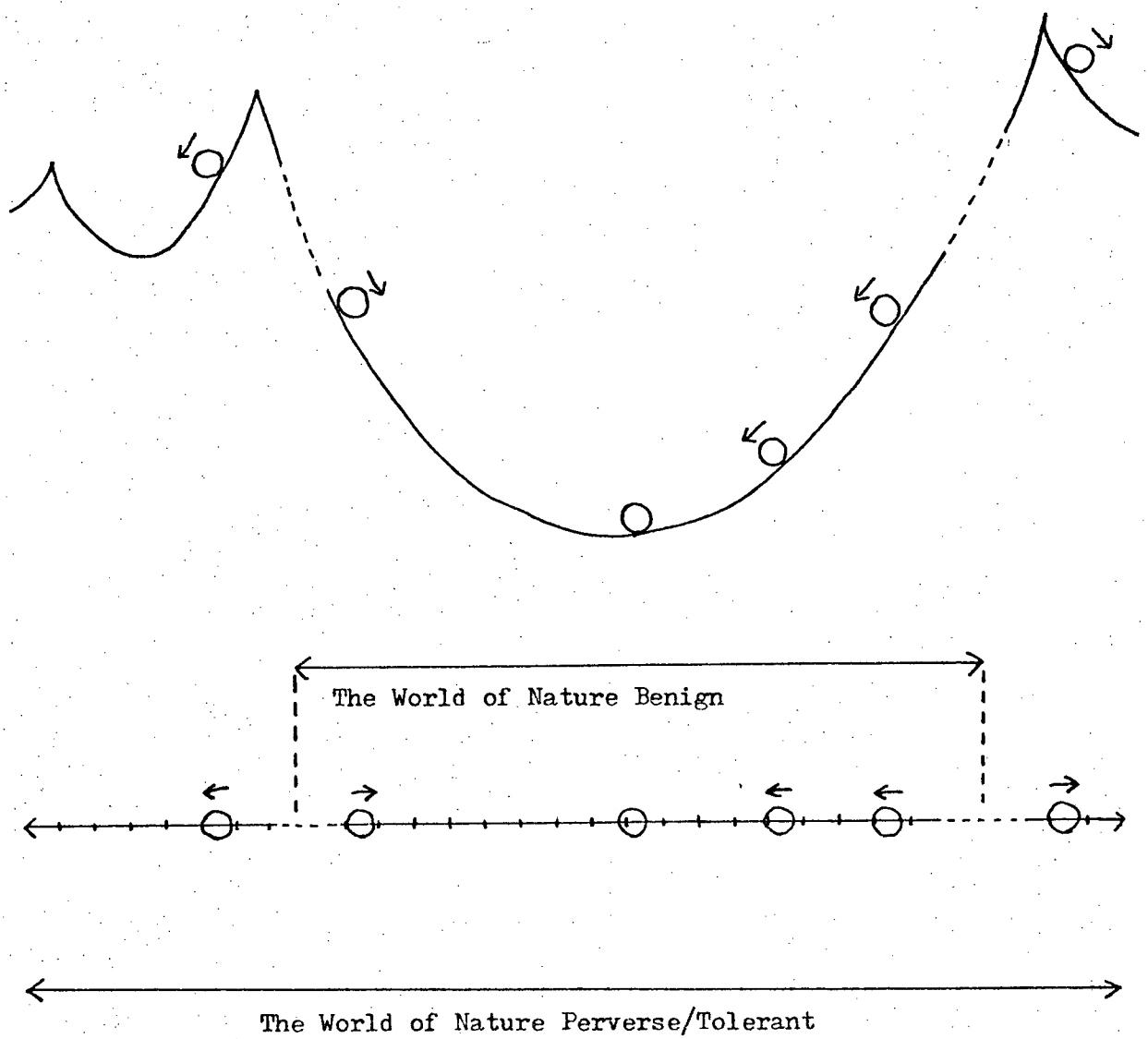
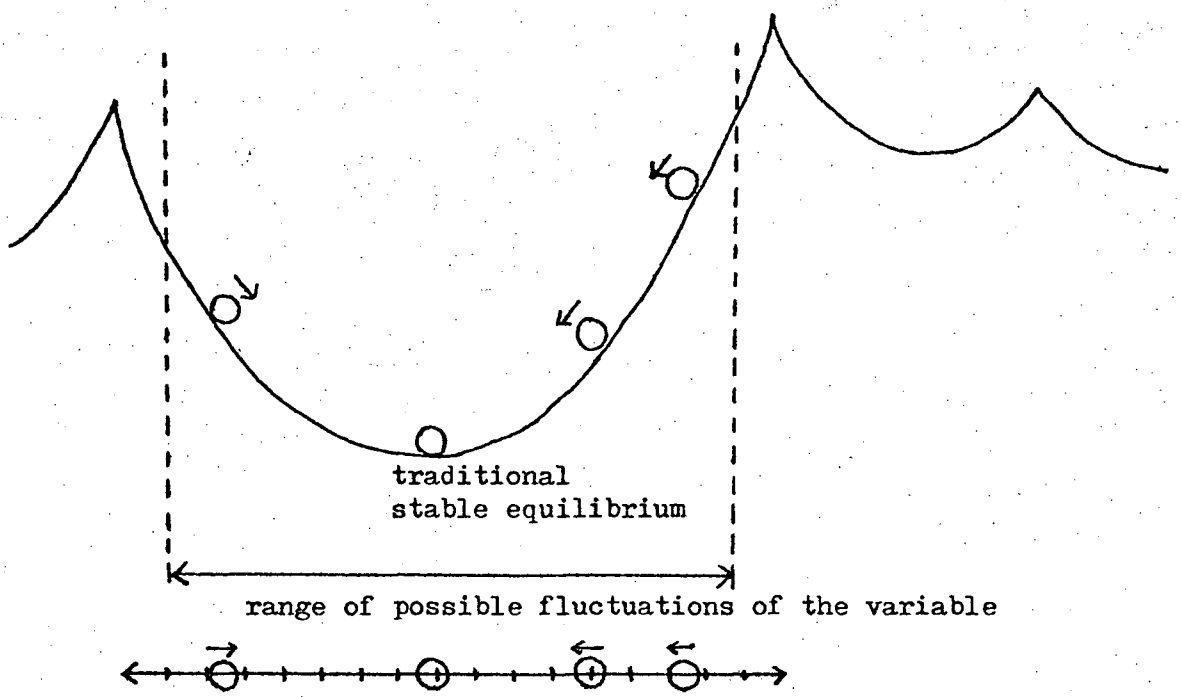


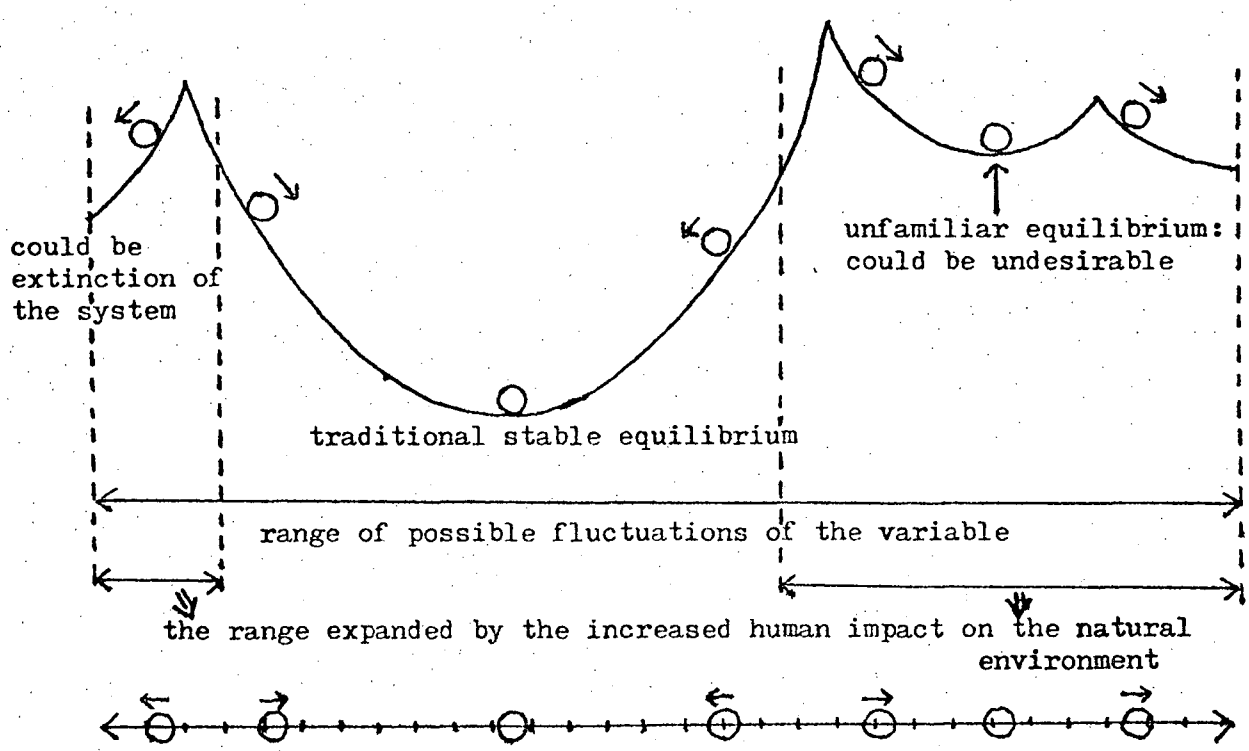
Figure 6

The Validity of the Myth of Nature Benign

The pre-industrial world, where Nature Benign was valid



The present world, where Nature Benign is no longer valid



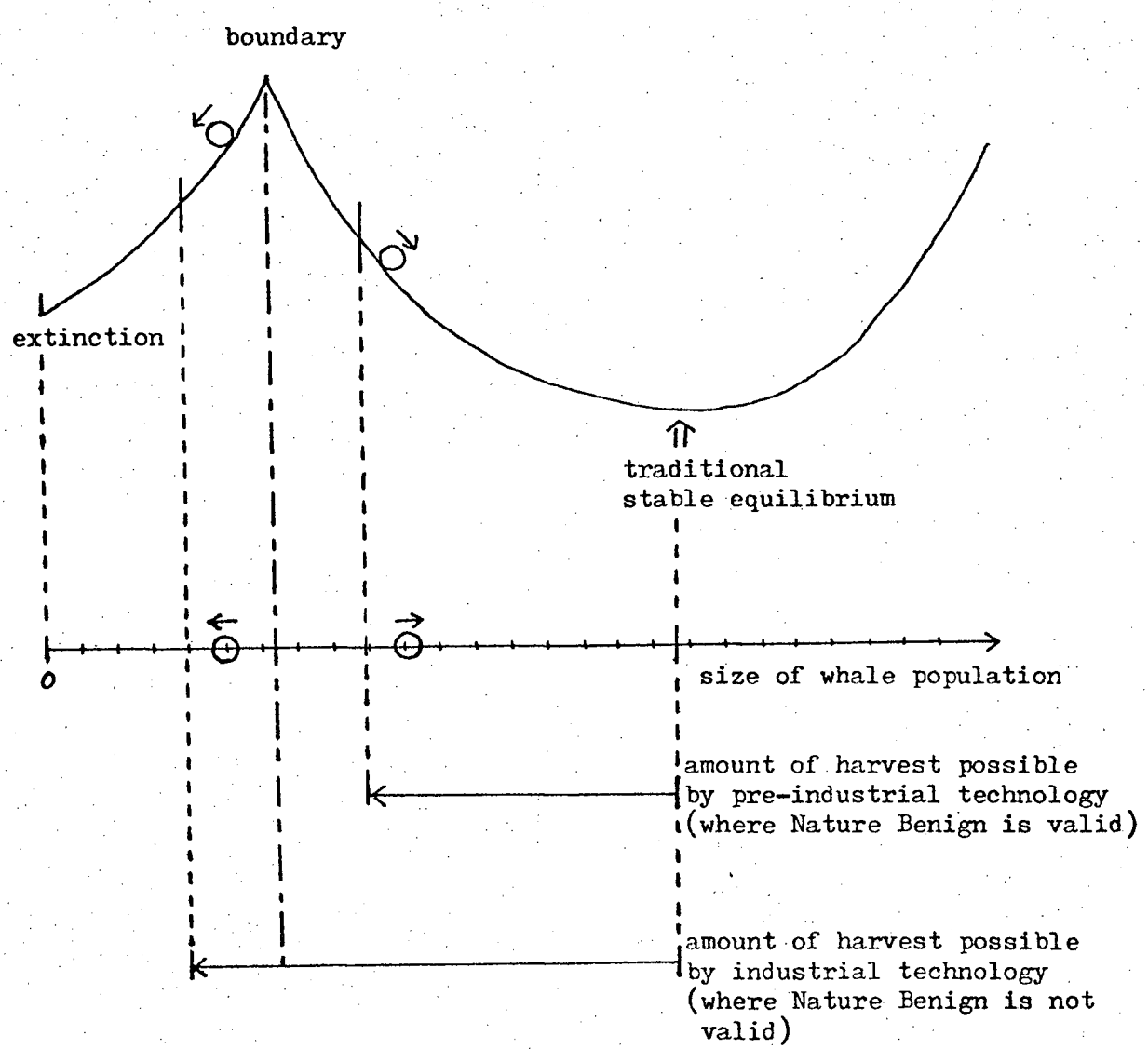
hazard to our continued existence.

For example, coastal towns in Japan such as Taiji, Tsuro and Kubotsu have a long whaling history. It was recorded in literature that a whalers' cooperative composed of five squads was organized at Taiji in 1606, and this system lasted until the late nineteenth century.[11] Until the early twentieth century, people caught gray, right and other smaller whales with such pre-industrial technology as small open boats, whaling nets and hand-held harpoons. When people found spouts, they put out boats and attacked whales that happened to be near the village.[12] If a certain whale stock behaves as the model of Nature Perverse/Tolerant suggests as shown in Figure 7 and if the best possible human effort to harvest whales with this pre-industrial technology cannot reduce the size of population (the variable) below a certain level (a boundary),[13] then the myth of Nature Benign is valid and provides appropriate guidance for human behaviour. The size of the whale population is prone to recover to the traditional stable equilibrium no matter how much of the population is removed, and people can do their best in whaling without worrying about the collapse of the whale stock. The advent of mechanized whaling, however, totally changes this story. With modern whaling technology, it is possible to harvest whales to the extent that the population is below the critical boundary, which results in the extinction of the whale stock. Under this circumstance, if people continue operating according to Nature Benign and do their best in whaling, their effort will likely result in the total breakdown of this whale stock. Thus, the myth of Nature Benign, once reliable, becomes dangerous. It no longer provides appropriate guidance for society.

Today human activity has expanded so that its impact on the natural environment can substantially affect global ecosystems. In other words, it

Figure 7

Human Impact on the Persistence of an Ecological System



is likely that ecosystem variables are so highly disturbed that they can pass the boundaries of the basins in the world of Nature Perverse/Tolerant much more readily than before. In order to avoid unpleasant surprises, some of which may be extremely dangerous to society, it is necessary to recognize the existence of stability boundaries. In short, since human impact on the natural environment can now be far more severe because of the advancement of technology, we have to give up the myth of Nature Benign, which assumes an infinite capability of the natural environment to accommodate human activity.

(3) Industrial Society and Fossil Fuel

The second half of the twentieth century is characterized by an unprecedented expansion of industrialization. We have entered a domain where industrial operations can irretrievably affect the natural environment. Adverse effects resulting from the expansion of industrial operations have today become apparent in the forms of environmental pollution and resource depletion unique to the late twentieth century. Acid precipitation is one of the most striking examples of environmental pollution. It is destroying ecosystems of forests and lakes in North America and Europe, and tells us that we are excessively emitting such pollutants as sulphur dioxide and nitrogen oxides, in excess of what the natural environment can cope with. For example, in 1978 an Ontario government study showed that out of 200 lakes surveyed in and near the Killarney region "40 were dead and 100 more were on the critical list."[14] In the same year, about 24 million tons of nitrogen oxides and 28 millions of sulphur dioxides were emitted into the air in the United States, and about 2.1 million tons and 5.5 million tons were emitted in Canada.[15] As

for resource depletion, Brown presents various examples of the loss of cropland by soil erosion, desertification, waterlogging, salinization and urban expansion; the deterioration of the biological systems that sustain civilization, especially forests, grasslands and oceanic fisheries, by deforestation, overgrazing and overfishing; and the rapid depletion of petroleum.[16] He believes that these three threats have today become serious enough to undermine the contemporary global civilization.[17]

It is true that human impact on the natural environment was not negligible even before the industrial age. Locally, resource depletion occasionally seems to have threatened people, who then developed intended and unintended devices, including taboos and rituals, in order to avoid over-exploitation.[18] The beginning of agriculture changed the human-nature relationship. Many plants and animals were domesticated all over the world, and interregional trade and communication developed. Still it seems that people lived largely self-sufficiently those days. That is to say, they lived within the ecological capability of the local or regional environment.

The advent of technology subsidized by fossil fuel fundamentally changed the relationship between human society and nature described above. In every situation where such technology has been introduced, the human-nature relationship becomes something qualitatively different from what it used to be. Pre-industrial society may be capable of depleting harvested resources locally, as mentioned above. However, industrial society can deplete natural resources on a completely different scale. Without the twentieth-century technology, for example, the tropical rain forest in Southeast Asia would not have been deforested so quickly and extensively, and the blue whale, which was too big and fast for the early whalers, could have been left virtually intact. Furthermore, in terms of the natural

capability to decompose wastes resulting from human activity, it is in this century that the myth of Nature Benign has for the first time ceased to be valid extensively. Industrial society has produced various chemicals that are only slowly decomposed, if at all, in the natural environment. Plastics are an example familiar to our daily life. DDT is a well-known classic example of the chemicals that have been used as pesticides/herbicides and have unexpectedly resulted in harsh negative effects on the natural environment. Industrial society has also been producing more wastes than what the natural environment can cope with. Air pollution and water contamination, which have caused various human disorders at such places as Yokkaichi and Minamata in Japan, are often a result of industrial operations and citizens' daily life that produces a vast amount of wastes, including sulphides, nitrides, phosphides and heavy metals. The myth of Nature Benign seems to have prevailed in society in terms of the capability to receive wastes, even if not always in terms of the natural capability to supply natural resources. Without subsidization of fossil fuel, the present society would not have produced vast amounts of various chemicals as wastes that are now undermining the validity of the myth of Nature Benign. I therefore regard fossil fuel as the agent that has induced the significant change in the nature-human relationship, which is qualitatively different from those caused by, for example, the advent of bows, animal domestication and agrarian transformation in the past.

The status of fossil fuel, such as coal, petroleum and natural gas, is unique in human history.[19] Fossil fuel, not only as fuel but also as material, has a rich beneficial potential for industrialization. It has liberated human beings from many of the temporal and spatial restraints of the natural environment. Murota argues that coal and petroleum ensure the

temporal and spatial continuity of industrial operations. That is, because of the high potential of fossil fuel as a power source and material, industrial operations are possible day and night, in any season, almost at any speed and virtually at any place.[20] According to Murota, this continuity is not shared by agricultural production, where the harvest of a particular crop is only possible in a given season and each crop requires a certain set of ecological conditions. He describes modern mechanized agriculture as the result of the effort to incorporate the advantage of industrial operations given by fossil fuel into agriculture under the pressure of the market system.[21]

Fossil fuel, especially petroleum, is the secret of industrialization. It has achieved many miracles since the Industrial Revolution, especially in the last fifty years. Coal and petroleum have made it possible for human beings to obtain remarkable mobility and unprecedented production. Today it is even possible to send astronauts to the moon and to build a large city in the middle of an arid land. In the economic sphere, largely encouraged by the principles of market economies, we have continuously tried to improve economic efficiency by employing innovative technology and expanding the scale of production. Both means are usually made possible by fossil fuel.

People often worry about the depletion of fossil fuel, as they do about the exhaustion of other nonrenewable resources. In a sense, however, fossil fuel is unfortunately too abundant. Since a large amount of fossil fuel has been available, industrial society has utilized this resource to advance industrialization to the extent that our ability to exploit natural resources and produce commodities exceeds the ability of local/regional environment to accommodate such activity. In other words, industrialization has advanced so far that resource depletion and environmental pollution have

become serious problems. One of the main reasons is that so much fossil fuel is available. For example, heat pollution is today serious in metropolitan areas in Japan. Tsuchiya argues that heat pollution has become so serious as to affect original patterns of wind and precipitation and thereby has begun resulting in the disorder of native vegetation. According to Tsuchiya, the main reason for heat pollution is the excessive use of fossil fuel.[22] Japan's consumption of heat resources increased by 6.5 times and that of petroleum increased by 24 times from 1955 to 1975.[23] In 1979, 2.3 billion kilolitres of petroleum as fuel was sold in Japan, which accounted for 55 per cent of the country's heat source. The amount of heat produced by this petroleum was equivalent to 2.2 per cent of the total solar energy the country's flat land receives in a year. In the prefectures of Tokyo, Kanagawa and Osaka, the corresponding values were as high as 13.8, 15.8 and 15.9 per cent.[24] If fossil fuel were not so abundant, it could not be used like this and heat pollution might remain negligible.

Since modern technology has been successful in achieving the agelong dream of material affluence, people, believing in technology and economic efficiency, tend to cope with these environmental problems technologically. In other words, people often try to solve environmental problems by further separating themselves from biogeochemical cycles in the natural environment. For example, in order to deal with the problem of waste disposal, urban society has adopted a large-scale sewer system rather than developing a method of treatment making use of ecological cycles in the natural environment. Murota criticizes a large-scale sewer system as follows. First, it contributes to degradation and depletion of underground water, and ground subsidence. This is because a large-scale sewer system prevents rainwater from feeding underground water veins. Second, at present it is

technologically impossible to treat industrial and domestic waste water containing synthetic detergents sufficiently to prevent water contamination. Third, the construction of a large-scale sewerage requires vast amounts of material resources such as limestone, gravel and petroleum, the exploitation of which may result in environmental degradation of the supplying areas. Fourth, the operation of a large-scale sewage plant requires vast amounts of electricity and heavy oil. Fifth, the cost of constructing a large-scale sewerage has become a heavy financial load on both the national and municipal governments. Murota argues that society should give up such ecologically unsound products as synthetic detergents and should leave this resource-consumptive sewerage for an alternative method that is more efficient in resource terms and cheaper in financial terms. He describes the soil sewage-disposal method (Dojo-joka-ho) as an example of the alternatives.[25] This method is a way to treat domestic waste water by employing the decomposing capabilities of bacteria in surface soil. This method is already used in practice in Kanagawa, Japan, for example, and is said to be more efficient in treating waste water and cheaper than the prevailing method.[26]

It should be noted that technological solutions or countermeasures of the kind described above are largely dependent on fossil fuel, and that these measures often create a vicious circle. Even if these measures are successful temporarily and locally, they will likely make the problems even worse from a long-term, wide-ranging perspective. The situation may be understood more clearly by considering the example of air conditioning. On a hot day in summer, in an asphalt-covered, highly-industrialized and densely-populated metropolitan area, such as Tokyo and Osaka in Japan, people cannot stay inside because of the heat. The heat-island phenomenon

is obvious in these cities, and people do not want open windows, because of air and noise pollution. One solution may be to recover soil, plant trees, introduce tougher regulations for factory operations and regulations to reduce the number of vehicles. Usually, however, an easier solution is adopted: people are implicitly and explicitly encouraged to purchase air coolers and stay inside closed rooms. This solution increases the Gross National Product (GNP). On the other hand, this solution makes the problem worse. Because of the waste heat from air cooling, neighbouring families decide to buy coolers and the heat-island phenomenon is increased. Furthermore air conditioning increases electricity consumption and stimulates commodity production thereby adding to environmental pollution. In this way, although air conditioning creates a comfortable small-scale environment, the larger environment is doomed to further degradation. As this example shows, a technological solution to one environmental problem may contribute to the degradation of the natural environment as a whole.

It is important to understand that there is a limitation to the capability of the natural environment to treat wastes discharged from human society. Some chemical compounds do not decompose quickly in the natural environment and remain toxic to living organisms. The utilization of coal and petroleum has introduced many chemical compounds which the natural environment is unable to decompose into harmless substances for recycling. Wastes therefore begin to accumulate when the amount has passed the decomposing capability of environment. It is worth noting that much of these wastes, both in quality and quantity, would not have existed if coal and petroleum were not available.

Modern industrial society is extensively dependent on fossil fuel. The freedom from natural restraints, provided by coal and petroleum, is the

essence of modern civilization. After World War II, the consumption of petroleum increased rapidly, and it now seems that we have entered a new domain where the restraints imposed by nature are critical in another way. Although we have gained freedom in production and transportation by innovative technology and interregional trade, problems of the new type, concerned with resource depletion and environmental pollution, can hardly be solved technologically or by the magic of fossil fuel.

The relationship between human society and its ecological resource base has experienced a drastic change because of the advent of technology subsidized by fossil fuel. We used to assume we could behave on the implicit assumption that the natural environment was unlimitedly benign and forgiving. We can no longer assume limitless environmental capacity, as serious environmental degradation is now easily triggered. Environment, both as a supplier of materials for production and a receiver of industrial wastes, should be understood in a different way, by taking account of the critical change in the scale and intensity of human impact on it. Fossil fuel is a double-edged sword. It is time for us to develop a mode of production and consumption which is compatible with the myth of Nature Perverse/Tolerant.

(4) The Mentality of Industrialism and Regional Planning

According to Catton and Dunlap, the "Dominant Western Worldview" can be represented by the followning four beliefs:

(1) People are fundamentally different from all other creatures on earth, over which they have dominion.

(2) People are masters of their destiny; they can choose their goals and learn to do whatever is necessary to achieve them.

(3) The world is vast, and thus provides unlimited opportunities

for humans.

(4) The history of humanity is one of progress; for every problem there is a solution, and thus progress need never cease.[27]

The implicit assumption of unlimited capacity of the natural environment, together with anthropocentricism, has established a certain mentality in industrial society. Sale calls the value system prevailing in industrial society the "industrio-scientific" paradigm. In this paradigm, according to Sale, the view of the economy is characterized by emphasis on exploitation, change/progress, world economy and competition, as opposed to conservation, stability, self-sufficiency and cooperation.[28] A belief in constant economic growth is representative of this industrial mentality. In 1960, the national government of Japan launched the Income-Doubling Program and rushed into a period of high economic growth. During this period, people were constantly encouraged to consume more, and even the slogan "Consumption is a Virtue" was created. Increase in the Gross National Product (GNP) was widely regarded as prerequisite to the welfare and happiness of the national population, and this widely-spread belief in economic growth was named the GNP myth.

Regional planning has also been geared to this industrial mentality. Such approaches to regional planning as the growth-pole strategy and the theory of incremental economic growth are typically based on the worldview of Nature Benign and the big-is-necessary philosophy. The basic idea of the growth-pole or growth-centre approach is that urban economic growth can be diffused to peripheral regions by establishing a concentrated industrial core as an economic booster in these regions. Friedmann ans Weaver state that "[r]egional planning doctrine in the 1950s and 1960s revolved essentially around the idea of growth centres."[29] They tell us that:

> it is surely surprising that regional planning almost succeeded in making a fetish of growth centres to the neglect of other dimensions of regional policy. Area or territorially specific policies receded into the background of academic discussions. As a result, insufficient attention was paid to questions of natural resources, political implementation, administrative organization, and above all, to rural development. Growth centres had become the universal solution to every regional problem.[30]

Following the idea of growth centres, the government of Japan set about the National Comprehensive Development Plan in 1962. This plan was launched in order to reduce regional disparity by establishing a growth centre at selected spots in underdeveloped prefectures. Shimazu describes the Kashima Industrial Zone Program as representative of the 1962 plan.[31] This program aimed at developing an industrial complex of steel and petrochemical plants on a sparsely populated land (3,300 hectares) on the Pacific coast in Ibaragi Prefecture. Shimazu observes that this development resulted in degradation of local and neighbouring ecosystems by polluting water and air[32] and concludes that the local business and people, who were most affected by pollution and land expropriation, did not necessarily benefit substantially from the development, that is, their overall gain did not necessarily exceed their overall cost.[33] In the mid-seventies, there were about ten similar development programs in Japan that involved more than 1,000 hectares, including Tomakomai-East in Hokkaido and Mutu-Ogawara in Aomori.[34]

Development is a key concept of industrialism. Economic development has been regarded as prerequisite to happiness and welfare. Some people believe that development is firmly associated with economic growth, mega-projects and increases in population. For example, the CCRD (Canadian Council on Rural Development) observes that:

> the present-day approach to development tends to view different areas of human and institutional development as separate from each other. There are those who believe that a community with a depressed economic base can solve its problems simply by introducing some new industry or industries into the community along with the limited infrastructure which is required to support such development.[35]

To these people, the term development is interchangeable with the economic expansion measured by such indicators as the Gross National Product (GNP) and the Gross Regional Product (GRP), that is, the growth of production and consumption, measured by the amounts of goods and services traded in the market. This is an inadequate conceptualization of development.

Henderson argues that GNP/GRP have lost their appropriateness as indicators of something desirable, criticizing the "current linear preoccupation with maximizing industrial growth as measured by the Gross National Product (GNP) which, incomprehensively, adds these social costs as positive contributions to production and wealth."[36] Criticism of this kind, rooted in the recognition that the negative output of industrial production, environmental and social costs, should be explicitly incorporated into economic analysis, is becoming more relevant because of the change in the relationship between human society and the natural environment and the enormous impact of mega-projects on the local community. The CCRD states that:

> we must resist the assumption that the shortest route to well-being in the Mid-North is via massive industrial interventions to create jobs. It is now recognized that the human and social costs, plus the hidden economic costs associated with large industrial projects, make it increasingly difficult for these projects to have a positive impact on the local communities.[37]

It should be noted that there is not always a parallel between the welfare of local communities and economic development measured by the GNP/GRP. The

term economic development needs to be liberated from its traditional exclusive commitment to economic growth by industrialization.

The concept of economic efficiency is another example of the industrial mentality. Economic efficiency usually measures productivity in terms of the input of dollars or labour force, but not in terms of natural resources as input, or of industrial wastes as output. Economics has not paid as much attention to natural resources as to finance and labour force, and the contribution of the natural environment to economic production is not appropriately appreciated. Schumacher begins his famous Small Is Beautiful by arguing this problem:

> One reason for overlooking this vital fact [that we are rapidly consuming the 'natural capital,' "which man has not made, but simply found, and without which he can do nothing"] is that we are estranged from reality and inclined to treat as valueless everything that we have not made ourselves. Even the great Dr. Marx fell into this devastating error when he formulated the so-called 'labour theory of value.' Now, we have indeed laboured to make some of the capital which today helps us to produce--a large fund of scientific, technological, and other knowledge; an elaborate physical infrastructure; innumerable types of sophisticated capital equipment, etc.--but all this is but a small part of the total capital we are using. Far larger is the capital provided by nature and not by man--and we do not even recognize it as such. This larger part is now being used up at an alarming rate, ...[38]

Schumacher criticizes economics for its excessive commitment to market prices and neglect of human dependence on the natural environment. He then empahsizes the necessity to expand economics to include environmental consideration so that it can provide a meaningful framework for economic studies at present and in the future.[39]

In order to maximize economic returns, industrial operations tend to be capital-intensive where capital is available, and an effort is made to enlarge the scale of production and improve dollar-term efficiency. This

dollar-term efficiency may be improved in two ways. First, this is achieved by realizing economies of scale. Second, efficiency improves when production elements are replaced with substitutes that are cheaper in terms of market prices. In this second case, mechanization, from a vending machine on the street to an engineering robot working at an automobile plant, has been introduced, for one reason, in order to replace human labour, which is regarded as a relatively expensive element of production in industrial society. Obviously, a mechanized operation is not as efficient in terms of environmental costs as a labour-intensive operation, because the former generally requires more nonrenewable natural resources to construct and maintain than the latter. The main reason that automobile companies adopt mechanized production processes is that they contribute to improvement in dollar-term efficiency, while environmental costs are usually left out of considerations. Companies are also indifferent to their discharge of wastes into the environment because the market economy traditionally assigns no value to the environment as a receiver of wastes. For example, smelters are most often reluctant to use low-sulphur coal as fuel or equip a scrubber to reduce sulphur dioxide emissions because these result in lowering dollar-term efficiency, while acid rain is regarded as one of the most devastating environmental problems in North America.[40]

In short, improvement of economic efficiency has been achieved by industrialization at the cost of the natural environment. Industrial operations that are efficient in dollar terms are thus prone to be inefficient in terms of environmental costs. Schumacher tells us that "[t]he most striking thing about modern industry is that it requires so much and accomplishes so little," and continues that "[m]odern industry seems to be inefficient to a degree that surpasses one's ordinary powers of

imagination."[41] In the world where the myth of Nature Benign is valid, economic efficiency in terms of labour force or dollars might serve as a meaningful criterion for economic production. However, this is not the case in present industrial society. Improvement in economic efficiency may sound desirable, but we have to clearly understand what it really means.

Simon and Kahn are two of the major thinkers who deny the premise of this thesis. For example, they argue that natural resources are getting more available now than before showing that the price of copper, for example, relative to wages has declined in human history.[42] According to Simon and Kahn:

> The cost trends of almost every natural resource have been downward over the course of recorded history. . . . These trends mean that raw materials have been getting increasingly available and less scarce relative to the most important and most fundamental element of economic life, human work-time. The prices of raw materials have even been falling relative to consumer goods and the Consumer Price Index. All the items in the Consumer Price Index have been produced with increasingly efficient use of labour and capital over the years, but the decrease in cost of raw materials has been even greater than that of other goods. This is a very strong demonstration of progressively decreasing scarcity and increasing availability of raw materials.[43]

If they measured the scarcity of a natural resource by the total amount of fossil fuel required to obtain a unit of the resource, Simon and Kahn would reach a different conclusion. One of the major reasons for the downward cost trend of natural resources is that society has constantly improved labour efficiency subsidized by fossil fuel and its related technology. Their argument is misleading because they ignore environmental costs that are associated with an effort to make natural resources available to society. Any argument about the availability of natural resources must consider related consumption of nonrenewable resources and generation of

wastes including heat. Now that the global resource base is degraded by excessive industrialization, more input is needed than before in environmental terms in order to obtain the same amount of beneficial output. Henderson tells us that:

> We must now cycle ever more capital back into the process of extracting energy and raw materials from ever more degraded and inaccessible resource deposits, with ever declining net yields. The theory of continual substitution is over-optimistic and does not deal with simultaneous rates of depletion across a whole range of resources, thus reducing substitution options.[44]

> Since all energy/materials transformation processes, including recycling, involve the heat losses associated with the Second Law of Thermodynamics, . . . even if an unlimited energy source could be brought on stream in the next thirty years, so that, in principle, all our material problems would be overcome, we would still face the limitations of planetary heat buildup, where even a few additional degrees in temperature can trigger irreversible climatic changes.[45]

The Coming of Post-Industrial Society is one of the bedrock books for the concept of post-industrialism. In it, Bell employs the framework developed by such economists/sociologists as Clark, Hatt and Foote.[46] Bell uses as indices of post-industrial society the contribution of Clark's service, or the tertiary sector, to total employment and Gross National Product (GNP). Bell regards a country as post-industrial when its service sector accounts for more than half of the employment and the GNP,[47] and suggests the general movement of society from pre-industrial (primary) to industrial (secondary) and further to post-industrial (tertiary) in the form of social forecasting.[48] He emphasizes the expansion of Foote and Hatt's quinary sector (health, education, research, government and recreation), and to less extent those of quaternary (trade, finance, insurance and real estate) and tertiary (largely, transportation and utilities) sectors in the post-industrial phase.[49]

It is true that the above argument about the shift of labour force from the primary to the secondary and further to the tertiary sector and the relative shrinkage of the primary sector with the progress of industrialization is useful in describing and understanding what has already taken place in industrialized society. It is questionable, however, if the framework of this argument serves future social and economic forecasts. The reason is that Bell's argument presupposes an infinitely forgiving nature, whose capability to accommodate human activity is virtually limitless. The expansion of the regional service sector is only possible when high labour force productivity is maintained in the extractive and manufacturing industries in a region, or at the ecological sacrifice of other regions. For example, the food-producing sector in a post-industrial region has to support the relatively large labour force in the non-primary sectors unless underdeveloped regions are the suppliers of cheap foodstuffs forever. Post-industrial agriculture must be extremely labour efficient, using heavily mechanized operations subsidized by chemical fertilizers and pesticides. This type of mechanized agriculture has already induced environmental problems such as soil erosion and ground water pollution. If this kind of food production, which employs petroleum-dependent technology, cannot be sustained in the long run, post-industrial society has no choice but to collapse entirely unless it goes on ecologically exploiting other regions or countries as food suppliers.

Bell's argument about post-industrial society is therefore something that does not go beyond a mere extension of industrialism. It is constructed upon the major presupposition of industrialism or the myth of Nature Benign. What is necessary is to consider a mode of food production

which is ecologically sound and can be sustained in the long run, on the understanding that there is an absolute limit to the expansion of human activity in nature. If post-industrialism literally means something that is to come after industrialism, post-industrial society will find humankind re-embedded in the ecological cycles of the natural environment, rather than sitting in an electronic cottage separated from the natural sphere, the world of soil, air, water and life. Post-industrial food production will likely be more labour-intensive and efficient in terms of environmental cost.

Under the circumstances where environmental pollution and/or natural resource depletion are well-advanced, a collapse will be unavoidable if we continue to search for a boom. If the goal of regional planning is regional welfare in the long run, it is necessary to give priority to identifying resource utilization that is compatible with regional environmental imperatives rather than elaborating a strategy to maximize short-term economic returns or encourage continuous growth in the GRP. The concepts of continuous growth and economic efficiency need to be replaced by those of steady state and sustainability. It is also necessary to reconsider interregional trade, which is essential to industrial society. Today most regional economies in industrial countries are extensively dependent on interregional transactions. But, as will be seen in the following chapter, a region that commits its economy to interregional trade, when we cannot assume infinite capabilities of the natural environment, is unlikely to be acting in the long term interests of its inhabitants. It has become important to build a regional economy on the basis of inherent regional resources. In short, "regional development" must be achieved within the

environmental capability of the region, and regional planning needs to abandon its growth-oriented mentality.

CHAPTER III

VIABILITY OF A REGIONAL ECONOMY

(1) Introduction

The purpose of this chapter is to consider what type of regional economy can best serve the overall interest of the regional inhabitants. I assume that their interest is in enjoying an economically stable and environmentally comfortable life in the long run, rather than a materially affluent and unlimitedly convenient life, which cannot be sustained without the degradation of their environment. A viable region can be built on the basis of a viable economy that can meet this overall interest of the regional population. Viability can be defined as capability to survive disturbances and crises and continue to function in an adequate way in perpetuity. Therefore, I define a viable regional economy as a regional economic system that can survive disturbances from outside the region, such as abrupt price changes in world markets or reorientations in resource policy of the central government. It can in other words provide the regional population with appropriate subsistence constantly in the long run. In this chapter, I examine concepts that are likely to support efforts to improve the viability of a regional economy. I conclude that sustainable regional resource management and self-reliant regional economic activity are two of the major props required to sustain such a viable economy.

Following this introduction, I discuss several concepts relevant to achieving viability in a regional economy. The concepts to be discussed are: (i) economic efficiency and development, (ii) self-reliance and self-

sufficiency, (iii) sustainable resource utilization, supply-based approach and steady state, and (iv) restructure planning. I then review the Final Report prepared by the Slocan Valley Community Forest Management Project (1974). This report, which includes an explicit awareness of the limited capacity of the natural environment and aims at the long-term welfare of the local community, provides a valuable illustration for my argument about the viability of a regional economy. Finally, I look at the linkage between my concepts concerning a viable region and the Slocan Valley Community Forest Management Project emphasizing the local perspective or viewpoint of the community. I describe the meaning of a local viewpoint in the context of natural resource management and utilization, and argue why a local perspective needs to be incorporated into decision-making processes on resource policy. I also look at how ecology becomes linked with economy in the interest of the local community.

(2) Concepts for a Viable Regional Economy

Efforts to achieve a viable region in a natural environment whose capability to accommodate human activity is limited, requires a way of thinking and a set of concepts that are fundamentally different from what now prevails. Considering what is a viable regional economy, I have encountered several major concepts, which can support efforts toward it. In this section, I try to clarify these key concepts and describe the associations between some of them.

(i) Economic Efficiency and Development, Redefined

Growth-oriented approaches to regional planning, the growth-centre strategy for example, were established on the implicit assumption that the

natural environment had unlimited capability to accommodate human economic activity. When this assumption is not relevant, the approach to a viable regional economy has to be fundamentally different. In Chapter II, I argued that usual connotations of such familiar words in regional planning as economic development and economic efficiency are no longer relevant when the human impact on the natural environment is sufficient to threaten the well-being of even large ecosystems on the planet. In a sense, we have already passed the ecological limits to growth of human activity, and present society is temporarily sustained unecologically by fossil fuel. Under the new assumption that there are limits in nature, alternative meanings for economic efficiency and development may be developed incorporating economics and ecology.

As argued earlier, economic efficiency or productivity usually designates the amount of beneficial outputs or products, measured in the dollar terms, per unit of input that is evaluated and priced through the market or per unit of labour. Now that the natural environment has become a critical element of production, it is meaningful to define economic efficiency in terms of its impact on the natural environment so that the concept will serve as a tool for designing a mode of production compatible with regional ecological properties. Economic-environmental efficiency may be defined as: the amount of beneficial outputs (products) of a particular production process per unit of [1] input materials and energy (natural resources) and [2] adverse outputs (wastes). Traditionally economic efficiency is measured by the ratio of inputs and outputs in dollar terms. In the case of economic-environmental efficiency, however, such a common measure or a universally acceptable denominator does not exist. Therefore, in an analytical study of a production process using this new concept, all

the relevant items of inputs and outputs will have to be listed and then evaluated. The final judgment, the determination of the appropriateness of a certain production process within the context of regional characteristics, will be made mainly on the basis of trade-offs. Nevertheless, if desired, a common denominator for the purpose of comparing the costs and benefits in a numerical way can be developed regionally, by evaluating the properties of both human and natural systems in the region. The concept of economic-environmental efficiency may be employed along with existing efficiency concepts, rather than dropping those familiar ones. The concept of labour efficiency, for example, may often be complementary to the proposed concept. What is necessary is to explicitly incorporate the adverse impact on the natural environment into economic-efficiency studies.

After World War II, economic development has often been regarded as what can be adequately indicated by the amount of goods and services traded in the market. The GNP/GRP are among the most widely employed yardsticks of economic growth. Since, as Brown says, "in affluent nations, the quality of life becomes confused with an ever-expanding consumption of goods and services"[50] and GNP is used "as the measure of well-being,"[51] it is not surprising that economic development has become firmly connected with such indicators as the GNP and GRP. Although criticized in various aspects,[52] these economic indicators still seem to remain convenient and popular tools for economic studies. Under the situation where limits to human economic activity do exist, the concept of economic development loses validity unless it is liberated from its adherence to economic growth. It is meaningful, therefore, to try to define economic development so that the term will designate the desirable qualitative evolution of an economy.

Development or progression, according to Trist, "refers to processes by

which a system reaches higher order steady states of a more adaptive nature." Trist thus attempts to define development in the context of the adaptive process of a system to its environment.[53] This definition is rich in implications for a definition of regional development emphasizing the long-term welfare of a regional community. If one of the major goals of regional planning is to ensure the well-being of the regional population in the long run, it is reasonable to have regional development refer to processes by which a regional community improves its viability. For this argument, Goulet's concept of development and his distinction between "economic progress" and "a progressive economy" are most significant. According to Goulet:

> Development is not a cluster of benefits "given" to people in need, but rather a process by which a populace acquires greater mastery over its own destiny. Even in purely economic terms, a vital difference separates economic progress from a progressive economy. The first is measured by gains in production, increased revenue, or volume of trade. Thus, economic progress takes place when local production is doubled, thanks to the installation of a new factory, even if technicians and skilled workers must be brought from other regions to staff it, or even if the factory monopolizes markets or eliminates local handicrafts. . . . Investments made in paternalistic fashion can perhaps generate economic progress in material terms, but they do not make the economy progressive. An economy becomes progressive when men who had hitherto been passive now conjugate their efforts to eliminate ignorance, disease, hunger, mendicity, servility, and exploitation.[54]

Although Goulet makes this argument in the context of the Third World development, his point is valid to the full extent for regional development planning in industrial countries. What is important is that he emphasizes the qualitative change or evolution of a local economy or people who compose it, not a quantitative expansion of a local economy induced by transplanting capital and technology from outside without paying sufficient attention to the local characteristics, people and land. In the same vein, the CCRD

(Canadian Council on Rural Development) describes what they call "the development process" as follows:

> The Council describes this process as: "people being involved in identifying their own needs, interests and potential; people developing their own skills, social institutions, economic enterprises and cultural pursuits; people learning how to manage these developments; people modifying their value systems and social philosophies to incorporate this process of change into a stable and coherent social system."[55]

The ideas of Goulet and the CCRD, emphasizing the importance of promoting self-reliance, share the ground with Omo-Fadaka's concept of "development from within," which is to be briefly reviewed in the following sub-section.

Economic development needs to be defined so that it will contribute to overall regional development including social and cultural aspects. It is an integrated component of overall development and cannot be meaningfully isolated from the rest. I define regional economic development as follows: regional economic development designates processes by which a regional community enjoys realizing its potentials and explores further possibilities to increase its self-reliance and thereby improves its economy in such a way that it can support the life of regional residents at an appropriate level in the long run. This definition of economic development is consistent with a viable region, as defined in Chapter I. In this proposed sense, a developed economy is rich in flexibility to absorb extraregional economic disturbances, rich in future policy options and self-supporting to a high extent. Here economic development does not necessarily mean expansion of economic activity evaluated by a market system.

(ii) Self-Reliance and Self-Sufficiency

It seems that self-reliance and self-sufficiency virtually mean the

same thing, that is, to support oneself and persist. Both are properties of individuals, institutions or communities that exist by their own wits and abilities. Nevertheless, I use these words with slightly different connotations. In my view, while self-sufficiency emphasizes on being perfect or the capability to persist on one's own account even if completely isolated from the rest of the world, self-reliance is a more general term designating the act or state of providing oneself with necessities. A third term is self-sustenance. In this thesis, I employ this term as a property of a resource system that is managed in such a way as to ensure its stable long-term persistence. What I am arguing is that in order to achieve a viable region a regional community should develop economic self-reliance using regional resources in a self-sustaining manner. Regional economic self-sufficiency is an ideal state.

Interregional trade is indispensable to sustain urban areas, which have grown by expanding the interregional flow of materials and goods. Their prosperity depends on the benefits of these interregional transactions. On the other hand, it is not unusual that resource regions specializing in the export of staples do not correspondingly benefit economically, although these export staples create great wealth outside the region. In other words, it is often the case that the long-term economic well-being of peripheral resource regions is not ensured by increasing their staple exports.

In a resource region where its staple resource can be depleted, it is critical to the viability of the regional economy to determine how far the region can develop economic self-reliance. Omo-Fadaka argues that "[s]elf-reliance is a prerequisite of economic stability"[56] and advocates "development from within" in Third World countries. According to him, Third

World countries can achieve economic development that serves their people not by transplanting capital and technology from the developed nations but by utilizing their own natural resources, land and large labour forces, in such a way that communal traditions are revitalized and levels of not only subsistence but also human dignity and freedom are raised.[57] This argument about development from within also seems relevant in resource-oriented hinterlands in developed countries. In order to obtain freedom from dependence upon staple exports, it is necessary for these regions to re-establish their economy on the foundation of regionally available resources. The concept of self-reliance should be carefully evaluated in resource regions in the context of possible environmental degradation including the depletion of major staple resources.

In its strict sense, regional self-sufficiency may be unrealistic. Nevertheless, in order to achieve a viable economy, efforts need to be made to enhance regional self-supporting systems and push the regional economy as close to self-sufficiency as possible. It is necessary here to consider what can be supplied on what area of land or what size of economy. For example, daily produce and simply crafted products may be supplied virtually self-sufficiently within a small community roughly represented by the size of a creek (see p.95), that is, these commodities are likely supplied by subsistence agriculture and subsistence crafts. On the other hand, large sophisticated furniture and paper products may only be made in an area represented by at least the size of a river. Many industrial commodities may be supplied self-sufficiently only in a region represented by a major drainage or even in a group of such regions. Moreover, since the distribution of natural resources is not constant and climatic characteristics vary, some commodities are not available in every locality.

The interregional exchange of regional specialties is likely to contribute to the improvement in the standard of living in both regions. I understand regional self-reliance not as a limited concept like self-sufficiency in its strict sense, which precludes every interregional economic transaction, even if it would be ideal, but as a conceptual tool to realize and improve the primary capability of the region to support its population. What is necessary in evaluating a regional economy in terms of self-reliance is to determine what can be replaced with regionally-produced commodities and what can be given up in order to decrease regional dependency on interregional trade. This determination requires a trade-off according to the social and cultural needs of the regional population.

The concept of self-reliance is prone to be associated with the idea of decentralization. Clavel argues that there are two kinds of regionalism, which differ from each other in an essential way:

> On the one hand there is a proliferation in Western countries of what might best be termed regional nationalisms, which often represent true political mobilization. . . .
> On the other hand, administrators and politicians try to take territorial interests into account as they oversee increasingly centralized state machinery, which has resulted in a proliferation of regional councils, regional administrative districts, and regional authorities of various sorts.[58]

Efforts to achieve self-reliance in regional community are prone to be associated with Clavel's first kind of regionalism, "which directly and dramatically represents a political movement toward autonomy from central government."[59] The viability of a regional economy which serves the interests of the regional population in the long run can be achieved and retained by the responsible involvement of the regional community. A certain degree of administrative and political autonomy is necessary to assure regional economic self-reliance. It is also likely necessary for

ensuring sustainable resource management and utilization that regional residents have an access in a direct way to the decision-making process of resource management and economic policy. This is because people who are rooted in the soil and water of their territory will be more concerned with the long-term effects of resource management and utilization than those who do not share the same regional identification.

(iii) Sustainable Resource Utilization, Supply-Based Approach and Steady State

Expendable surplus is one of the key concepts that serve sustainable resource utilization, which is essential to the long-term well-being of a regional economy. Expendable surplus or sustained yield designates an amount of a renewable resource that humans can harvest without deteriorating the renewability of the resource base, so that it can go on utilizing the resource in perpetuity. It is necessary to understand the ecological relationship between a resource to be utilized and the rest of the natural environment, and expendable surplus must be determined before extraction, on the basis of the investigation into the relationship between all the resources in the area, where resource development is to take place. The 1980 World Conservation Strategy describes sustainable utilization as follows giving an analogy:

> Sustainable utilization is somewhat analogous to spending the interest while keeping the capital. A society that insists that all utilization of living resources be sustainable ensures that it will benefit from those resources virtually indefinitely.[60]

The 1980 strategy considers the sustainable utilization of ecosystems and species as one of the three priority requirements for achieving conservation, which is defined as: "the management of human use of the

biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations."[61] It also argues that the following is necessary:

> Determine the productive capacities of exploited species and ecosystems and ensure that utilization does not exceed those capacities.[62]
>
> Management objectives should take adequate account of important relationships between the exploited species or ecosystems and the species and ecosystems with which they are linked. They should allow for error, ignorance and uncertainty.[63]

When we attempt to determine expendable surpluses in a regional context, it is necessary to exclude extra surpluses produced by human intervention subsidized by imported commodities and petroleum-derived products. By doing this, we can obtain information about the genuine producing capability of natural and human systems in a region, that is, what can be made available in an ecologically sound way without being dependent on the extraregional economy. This information is indispensable for an effort to improve the self-reliance of the regional economy. In planning a regional economy, expendable surpluses of the regional resources should be determined first, and on that basis an appropriate regional economic structure should be designed considering the social needs of the region. This is what supply-based planning means. What is available without imposing stress on the natural environment, rather than human demand, must come first in designing a future regional economy. A supply-based approach is thus derived from the concept of the sustainable utilization of renewable resources.

Supply-based planning is the antithesis of a demand-based approach which is linked to the belief in constant growth. In other words, a supply-

based approach advocates a steady-state economy, not a constant growth one. Steady state, however, should not be confused with stagnant. A steady-state economy is active in pursuing better quality commodities and services within the capability of the natural environment. A steady-state economy is quality and stability oriented. Under a steady-state economy, little or no quantitative economic growth is achieved because the absolute capacity of the natural environment is respected. On the other hand efforts are constantly made to increase the ability of society to support people at a satisfactory living standard, to survive in the long run, and to satisfy human demands in an environmentally feasible way. In Goulet's terms (see p.43), efforts are made to transform an economy into a more progressive one while little economic progress is sought. Steady state does not refer to an inactive state which remains unchanged. In a steady-state economy, economic development can hardly take place in its traditional sense, but it does take place within the meaning I proposed earlier in this section.

(iv) Restructure Planning

Modern industrial countries are entirely committed to petroleum-based technology. The prevailing mode of production and consumption is dependent on petroleum especially in urban areas, and to a lesser but still significant extent in rural areas.[64] The dependence upon petroleum undermines the viability of a regional community in two ways. First, it increases the dependence of the regional economy on interregional transactions and thereby makes the economy vulnerable to extraregional economic fluctuations. Secondly, excessive consumption of petroleum and petroleum-derived products is prone to result in wastes that, both in quality and quantity, exceed the decomposing capability of the natural

environment, thereby inducing environmental contamination, which not only deteriorates the living environment of regional residents but may also substantially undermine the ecological resource base of the region. It is necessary today to re-evaluate the dependence of human society on petroleum.

The 1980 World Conservation Strategy argues that humankind is faced with "a long list of hazards and disasters, including soil erosion, desertification, loss of cropland, pollution, deforestation, ecosystem degradation and destruction, and extinction of species and varieties."[65] As pointed out in the strategy, one of the reasons for this may be that people often take "a short-sighted approach when exploiting natural resources."[66] Besides the above, there is another major reason for the long list of environmental hazards. It is that the dominant mode of production and consumption is probably using more than can be supplied by the natural environment on a sustainable basis. It seems that the problem is not only the method of extracting resources or the practice of resource management but also the absolute amount of natural resources consumed by humankind today. It is likely that we are consuming somewhat more than what we could under sustainable conditions.

If the above argument is relevant, it becomes one of the most important tasks of regional planning to restructure the regional economy, which is consuming too much. Consuming excess resources does not necessarily mean increased benefits to regional residents, because a substantial portion of them could be consumed in a wasteful manner, for nothing beneficial to the inhabitants of the community. When the presumption of an unlimitedly forgiving nature becomes invalidated, it is necessary to restructure the regional economy so that it will be compatible with its environmental requirements. In this process, the concept of economic-environmental

efficiency, which I proposed earlier, may serve as a useful tool. The current mode of production and consumption, which is now taken for granted, may have to be fundamentally changed. It seems necessary to establish what may be called "restructure planning" in regional planning in order to redirect the regional economy so that a viable regional community can be achieved within the limited capability of the regional environment.

(3) Slocan Valley Community Forest Management Project

The Slocan Valley Community Forest Management Project, hereafter, the Slocan Project, was a six-month effort, beginning on January 1, 1974,[67] to study the natural resources and the socio-economic structure in the Slocan Valley located in southeast British Columbia. The community is part of the Central Kootenay and its population was estimated at approximately 4,500 at the time of the project.[68] It was a small rural community. The study area was the Slocan Public Sustained Yield Unit (P.S.Y.U.), which "consists of a 70-mile-long [110-kilometre-long], deep, north-south valley which is dominated by steep mountain ranges" and "surrounds an area of 558,074 acres [2,258 square kilometres] of which 517,862 [2,096] are considered primarily as forest areas."[69] The initial intention of the project was to "conduct a feasibility study into several areas of forest use" in order to "create new sources of employment without hazard to the Valley environment."[70] The project, however, ended up with an overall study of both the natural and human systems in the valley. It went far beyond the perspective of a forestry study on economic feasibility or environmental impact. This is mainly because an explicit emphasis was put upon the perspective of the valley community itself. The project staff thought it a serious problem for the future of the valley, that the local community was left unaware of

information about their natural resources and was alienated from resource management. The project produced the Final Report later in the same year, which the authors described as "written by and for the local community," not "by outside experts for use in Victoria" like some fifteen studies of the area done in the past.[71] A steering committee composed of local residents hired the project staff and provided them with direction throughout the project.[72] The project staff gathered information from the community by questionnaires and public meetings,[73] as well as from literature and on-site studies. According to the authors, the report "does reflect an honest portrayal of a real situation which exists here."[74]

As their investigations began, the project staff soon found that the existing situation in the valley was full of problems.[75] Their major findings include:

[1] Economic dependence of the community on a single corporation

The company provides 500 (61%) full-time jobs out of 819 found in the valley. These 819 jobs include 155 school and other government related jobs.[76] "From 34 local, independent logging operators and 19 sawmills in 1952, we now have one foreign-owned mill and only one major employer in the Valley."[77]

[2] High unemployment

"[T]hat unemployment is very close to 20% is probably not an overstatement. Estimates indicate some 350 people who need some form of employment."[78]

[3] Unproductive timber utilization

The existing volume-oriented utilization is characterized by low local value added and tremendous waste of timber resource. "Within the local forest industry, . . . , the present emphasis on volume, rather than quality, production results in the waste of a good deal of usable wood. . . .

Planks of all species are often exported for resaw elsewhere, costing the Valley jobs. . . . Only approximately 35% of our standing timber becomes boards when it is logged."[79]

[4] Trend toward large-scale capital-intensive production

A labour-efficient operation often fails to provide "specialized techniques vital to good forest management" and "faster production often results in decreased quality, increased waste, and fewer jobs" per unit of production.[80] While the volume of extracted wood escalates, employment opportunities do not increase correspondingly.[81]

[5] Pronounced damage to the valley environment by timber extraction

Problems exist in access road construction, clearcut by tractor/skidder, slash burning and fertilization.[82] "[T]he emphasis is on speed, and 'maximize cut to minimize costs' has become a slogan of the forest industry."[83] Even "poor" and "low" class sites, which are often ecologically fragile, are logged with caterpillar tractors and skidders.[84] The existing management is only for one resource--wood fibre, and "consideration for water, fish, wildlife, etc" is precluded.[85]

[6] Lack of effective resource management by government agencies

The agencies "have historically been so underfinanced that 'resource management' cannot take place. Thus, resource allotment is their only possible function."[86] $235,000 was spent on resource management in the valley in 1973, but this was only 43% of the government stumpage revenue or 22% of the total revenue from the forest industry in the valley.[87] Furthermore, each agency operates independently with different jurisdictional boundaries, with little opportunity for cooperation. Since the "budgets dictate single-resource management for timber," the reality is far from multiple-resource management.[88]

[7] Lack of involvement of the local community in resource management "The Slocan Public Sustained Yield Unit is totally committed to industry, precluding private access to timberland."[89] "The people of the Slocan Valley are not included in the decision-making process that manipulates their jobs, their environment, their quality of life."[90]

The Project staff also studied both the natural and human history of the valley,[91] and tried to identify how the existing situation had evolved. Here they examined how local small-scale forest operators had been liquidated.[92] They also saw how the distinctive rise and fall of the mining industry provided an example of the relationship between the long-term welfare of the local community and short-sighted resource extraction. It demonstrated the vulnerability of the local economy controlled by the larger external economy.[93]

Since the staff, at the early stage of the project, came to regard the existing situation as totally unacceptable in terms of local well-being in the long run, the "project ceased looking to the existing situation for its direction," and they "began to research the capabilities of the Slocan P.S.Y.U. itself, seeking positive solutions rather than reactionary recommendations."[94] The project staff conducted a full study on site capability, timber and related forest resources such as fish, wildlife, water and recreation opportunities, and the community, namely, people and their livelihood.[95] Their conclusion was that:

> Our forests, when combined with agricultural and mining capabilities, speak of a valley with varied resources capable, with proper planning, of supporting our population for years to come.[96]

The project staff advocated:

[1] resource management for multiple use of multi-resources based on the

concept of sustained yield;

[2] explicit involvement of the local community in resource-use planning;

[3] planning ahead of development as an economic and ecological investment for the future; and

[4] more intensive utilization of a lesser volume of extracted resources.'[7]

Obviously the basic objective was to achieve long-term well-being for the local residents, and recommendations were made on the basis of the above four principles. The recommendations were:

[1] to form a local resource committee, composed of six local government agencies and six elected local residents to be responsible for both budget and jurisdiction over natural resources in the valley, and for hiring a resource manager;

[2] to establish planning and management process, including a resident multiple-use resource manager to implement planning and oversee management, and a multi-disciplinary term to develop resource folios required for the preparation of long-term development plans;

[3] to lower the allowable annual cut in order to prevent further ecological overcommitment of the valley to industry and to protect ecologically fragile forest sites;

[4] to institute a system of rural woodlots, which would ensure qualified local residents a long-term lease of woodlots under a set of regulations and supervision of the Forest Service, so that local residents can obtain access to public forest lands;

[5] to have government implement the major 1955 recommendations of the British Columbia Forest Service, including access road construction and maintenance, and tree marking for selective logging, so that sensible resource management will be ensured;

[6] to reinvest all the stumpage from the valley into local resource management through the resource committee;

[7] to construct a small product mill in order to minimize timber wastes, create job opportunities and increase local value added in the valley;

[8] to create the Valhalla Nature Conservancy Area, and preserve its natural environment for recreational use;

[9] to use non-salable timber wastes as fuel;

[10] to establish a finger-joint plant in order to achieve further close utilization of timber resource; and

[11] to renegotiate the government's artificially low chip price in the West Kootenays, so that it will be economically feasible to utilize currently unused timber resource.[98]

In 1976, two years after the project, a resource committee had been granted (see recommendation [1]) but none of the other recommendations had been implemented.[99] In 1983, the Valhalla area was designated as a provincial wilderness park (see recommendation [8]). However, the valley community has to the present not been granted control over their own destiny as described in the report. In the "Preface to the Second Edition," one of the authors wrote:

> Two years ago, we had just spent $50,000.00 of the taxpayers' money and felt obliged to provide our report to every government bureaucrat, politician and university forester who might be influential enough to help us to implement our recommendations. As a result, a lot of government bureaucrats, politicians and university foresters have copies of this report collecting dust on their bookshelves. They told us that we had done a good job, but were "pretty naive" if we thought that we could control our own destiny. (Which was pretty astute of them because that is precisely what this book is about.)[100]

According to Shadrack, that "is where full implementation of the Final Report ends."[101] In December, 1975, one and half years after the project, the government of the New Democratic Party, which had granted $50,000 to the project, was defeated and the Social Credit government, which Shadrack describes "holds to what is known as a 'free enterprise' spirit,"[102] has since been in office. This government "has removed the BCFS [British Columbia Forest Service] staff and office in New Denver [which is located in the valley] and given jurisdiction over the valley to the Nelson office outside the Slocan PSYU."[103] The present government has been thus rather

hostile to the recommendations of the Final Report. Although he regards this as a partial reason, Shadrack thinks that the Final Report has failed to be implemented primarily because the project staff did not pay sufficient attention to the basic political structure of the province. Shadrack criticizes the Final Report for lacking implementability arguing that "good thoughts without a means to enforce them are nothing more than wishful thinking."[104]

However, the Slocan Project, despite limited implementation, was not a total failure. We should look at how the Final Report has performed an educational role not only within the valley but also in the province of British Columbia and possibly even in a larger area. In the "Preface to the Second Edition," one of the authors states:

> Once we had squandered our first printing on the powers that be, we began to get requests for the report from villages, Indian Bands, conservationists, regional districts--all sorts of people around B. C. It seems that other people have had the same idea and would like to use the report as a sort of framework to control their own destiny[105].
>
> We have, in the past, travelled to various places around the Province to discuss this report, and are willing to do so again if requested.[106]

People who had been involved in the Slocan Project formed the Valley Resource Society, and continued their effort to push the proposals made in the Final Report.[107] It seems that they learned much by doing all these, and contributed to an increase in the awareness of the constraints facing the sort of planning they favoured as well as in environmental awareness in the valley community. For example, much of the experience and knowledge of the Slocan Project seems to have been incorporated into the Slocan Valley Watershed Alliance (SVWA), which was formed in 1981 and has been active in requiring "comprehensive, sustainable planning" of the valley.[108] The SVWA

is an important actor in the British Columbia Watershed Protection Alliance (BCWPA), which was established in the For Love of Water (FLOW) Conference held in the Slocan Valley in 1984.[109] The BCWPA, having various participants including "villages, Indian tribal councils, watershed groups, improvement districts, and individuals,"[110] aims at achieving good watershed management throughout British Columbia by inducing "more local awareness" and forming "a broad grassroots political force."[111] In this way, larger netwroks are also being built and maintained.

We can learn much from the Slocan Project, even from their failure. One of the implications drawn from their failure in full implementation is that we ought to pay more attention to what can be implemented by local residents even without the support of the central authority. This is consistent with the "balanced strategy of change"[112] of bioregionalists (for bioregionalists' notion of region, see Chapter V (2)), who seem to share many ideas with the Slocan Project staff. Aberley tells us that:

> Bioregional practice thus becomes a vital mix of changing the existing control structure whenever possible, while at the same time building regional alternatives independent of government support.[113]

We can also learn that it is necessary to build a network of local efforts and form a united front, in order to realize decentralists' proposals. The Project staff became aware of this necessity by 1976. According to the "Preface to the Second Edition":

> In the past two years we have come to understand that the problems facing our community are not unique in B. C.--that Smithers' SPEC is right in saying, "Do you think you can have local control while we can't?" No, of course we can't, and it is our intention, through this reprint, to share what we've learned with people like us.[114]

It should be noted that the Slocan Project has performed a powerful educational role by enhancing awareness of the constraints facing

decentralists and by disseminating a new way of thinking about the relationship between a community and its resource base, both within and outside of the valley. The Final Report deserves particular attention in that it provides most valuable concepts concerning a local economy and resource management based on the perspective of local residents. This point is to be further analyzed in the following section.

(4) Viewpoint of a Local Community

As viewed in the previous section, the Slocan Project produced the Final Report for the local community and demanded high-degree autonomy for the valley community in local resource management in the form of a joint resident-agency resource committee. This was contrary to the traditional means of inducing regional economic growth by inviting large capital investment from outside. The Slocan community was by no means a rich subregion in terms of average household income at the time of the project.[115] Nevertheless, the Final Report did not recommend such a traditional way to induce economic growth. This is because a local viewpoint, which gave priority to the long-term welfare of community residents, was firmly maintained throughout the project.

According to the Final Report, three steps are necessary for ensuring sound management in resource development in a wilderness area:

[1] Definition of the area and its resources;

[2] Investigation into the "interrelationship between all of the area's resources" and determination of its "expendable surpluses"; and

[3] Utilization of "those surpluses for economic gain."[116]

The authors of the Final Report referred to change in the relationship

between humankind and its ecological resource base. They saw that existing resource management remained within the traditional framework and failed to keep up with that significant change.

> Development of the Slocan Valley began at a time when the depletion of its natural wealth appeared impossible, and the second step was skipped. Today, however, forest technology and the demand for timber has escalated to a point where management agencies can do little but catalogue the harvest. These agencies are hampered not only by their workload but, more basically, by the lack of an accurate appraisal of the expendable surpluses of the whole unit; in other words, by the lack of information which would have been supplied by the missing second step.[117]

When the second step is omitted, resource development is prone to harvest more than the expendable surpluses and can lead to depletion of not only the directly extracted resources but also their ecologically related resources. This type of resource development gives priority to economics over ecology, looking for the maximization of economic efficiency. This may look like a familiar description, but it is important here to consider whose economics we are talking about and in whose interest is this economic efficiency.

In a local community, the overall interest of the residents is often different from that of large corporations involved in the local economy, notably externally-controlled well-capitalized ones, even though these companies are major suppliers of job opportunities. That is to say, while the corporations' concerns are largely located within the maximization of short-term economic gains, the residents' concerns may be found in the environmental and social costs of industrial operations and/or the community's economic stability over a long period of time. The difference in concerns comes mainly from the difference in degree of commitment to the locality, its place and life, between residents and corporations.

In the corporations' perspective, economics has an absolute priority

over ecology. However, when the local environment is degraded by environmental pollution and/or resource depletion as a result of intensive industrial operations which serve the corporations' economics, it is not the external capital, but the local people that are adversely affected. Whenever the area is no longer economically attractive, large corporations can leave the area for an alternative location. In contrast, local residents, who are well settled in the community, cannot leave it easily without physical and emotional costs. For a local community, it is a good ecological environment that constantly provides it with sufficient livelihood and a comfortable habitat thereby ensuring its overall welfare, including its economic well-being, in the long run. Therefore, from the perspective of the people who live in the community, good economics is not contradictory nor even competitive with good ecology, but the former is logically part of the latter. Thus from a local perspective, a good local economy can be ensured only when its ecological supporting systems are carefully tended.

The Slocan project was conducted on the explicit premise that "good ecology is good economics."[118] The authors assumed that:

> logging will incur either planning expense ahead of development or environmental costs afterwards. We found that planning is cheaper than repair. Thus, good ecology equals good economics.[119]

It is apparent that this approach was based on the perspective of the valley community, not somebody-else's. The project staff went further and expressed their belief that only the local community could be responsible for ecologically sound resource management because the local residents were most directly affected.

> We believe that only an involved and informed local populace can effectively participate in ecologically sound resource

management and utilization.[120]

> The local community represents the only visible group with a binding interest in the long-term sustenance of this valley's resources, for it is they who will have to live with the results of our management policies, good or bad.[121]

It is on the basis of this philosophy that the project recommended direct participation of the valley community in resource management and utilization through a local resource committee and rural woodlots.

There is also another reason why the Slocan Project did not recommend the traditional approach to economic growth, that is, invitation of large capital from the outside. It is because the traditional approach to development, especially in a resource region, is prone to create dependence of the local community on a larger extraregional economy. This occurs in two ways. When the community becomes excessively dependent on the external economy by expanding its staple-export sector, the local economy loses flexibility and closes future options. It is thus doomed to suffer from its vulnerability to price changes and the advent of substitutes in the external market. The community then loses its control over its own future and becomes unable to ensure its economic well-being. A local community can develop an excessive dependence on the external economy by specialization in its economy by utilizing a single natural resource, and by accepting large external capital investment.

It is likely that in the short term a local community benefits from specializing in utilizing a particular well-endowed resources such as timber, coal or fish. High wages and rapid economic growth can be expected from specialization compared to diversification. In the long run, however, specialization, notably the single use of one resource, makes the local economy excessively export-oriented and vulnerable to external economic

fluctuations. It is even possible that the crucial resource, the only prop sustaining the local economy, becomes depleted. The specialized economy has little capability to persist absorbing these abrupt disturbances in an adequate way. This type of economy is fragile in a changing world full of unknowns. It is slow to re-adapt to a new economic state, and may often fail to keep up with change in the economic climate. This economy is also vulnerable to ecological fluctuations that affect the key resource. Thus, from the local perspective, local specialization is not necessarily good economics in the long run.

Secondly, a small resource community quickly becomes exceedingly dependent on large capital when a large corporation is involved in resource utilization. The company soon becomes a major job supplier, and may even develop a monopoly position by liquidating small local operators, because it is better-capitalized and more competitive. Naturally, this type of large corporation behaves with little consideration for the well-being of the community when its own interest is at stake, because it has an absolute priority on its own economic welfare. The more the local community becomes dependent upon this kind of externally-controlled corporation, the less control it can exercise over its own future and the more it becomes subordinated to decisions made by someone else outside the community. Then the community becomes unable to ensure its own economic future.

Local industrial specialization and the dominance of large capital described above often take place together. It occurs because the area is advantageously endowed with a valuable resource attracting large corporate investment. In this case, the investment will likely be concentrated in the most profitable aspect of utilizing that resource because the corporation will seek to maximize its short-term economic gain. When the location is no

longer economically attractive, because of resource depletion or price changes in the world market, the corporation can simply leave for another location. Large corporations, notably multi-national corporations, which are usually better informed than resource regions, can decide to withdraw whenever necessary, and the community is then left with an economic disaster. The local economy in this case cannot re-adjust quickly and likely fails to persist.

Ocean Falls, a small isolated town on the coast of British Columbia, provides a most distinct example of the tragedy resulting from local industrial specialization and external capital dominance. The town started as a pulp centre in 1906 and specialized in pulp and paper production. Ocean Falls was described as "one of the oldest of company towns,"[122] and Crown Zellerbach, a San Francisco-based pulp and paper company, had dominated the town until it withdrew in 1973. The company decided the withdrawal simply because the operation was no longer profitable. The town's paper mill was obsolete and quality timber in the area was running short. Since Ocean Falls had no other industry besides pulp and paper operations, to shut down the mill meant the end of the town. When Crown Zellerbach announced in 1972 to the people of the town that "their town was to be destroyed within little more than a year,"[123] they had no way to influence the company's decision. Despite a high labour turnover,[124] there were well-settled people, for whom it was extremely hard to leave the community. Answering a magazine reporter, a town resident said:

> Now we know that when we leave we will never see this place again and neither will anyone else. The kids that were born here and the ones that grew up in this town will never be able to come back and walk familiar streets again. When they fill out a form asking where they were born, they will name a town that is no more.[125]

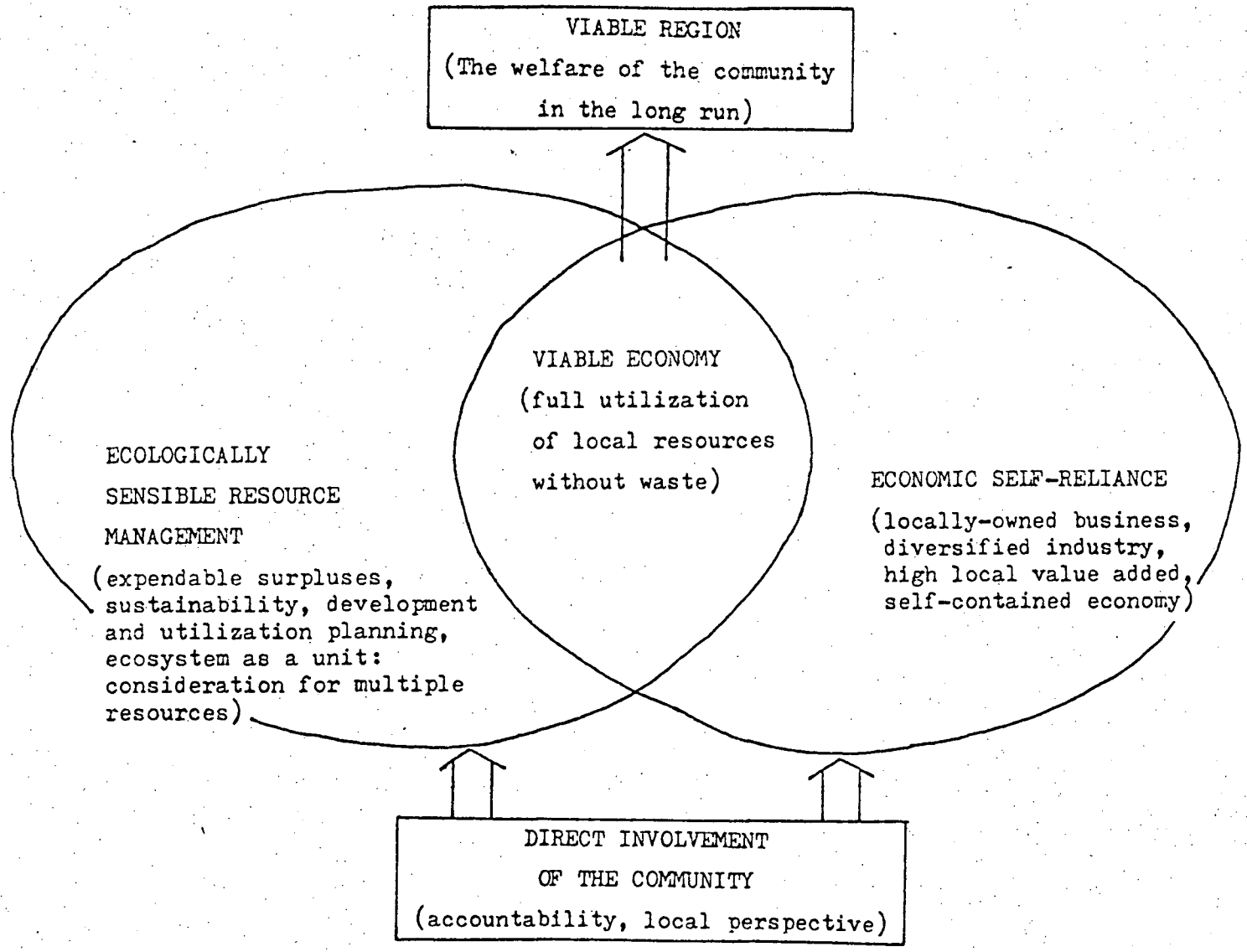
Another resident said:

> One of the hardest things about this [saying goodbye], . . . is that this [Ocean Falls] is a close community. It is hard to say goodbye because you know people so well. I would say you know casual friends here as well as you'd know your best friends in the city.[126]

At the very last moment, the provincial government stepped in and bought the paper mill and other facilities as a social measure thereby saving the town from extinction. The New Democratic Party government, however, was defeated by the Social Credit Party in 1975, and the new government actually closed the mill down in 1980 for a financial reason. Again the community could do nothing to influence the decision made outside Ocean Falls. Then most of the community was gone. In the mid-sixties, the town's population was 3,500, and it decreased as Crown Zellerbach scaled down the operation. It was 1,500 in 1972, when the company announced a total shut down, and it became less then 700 in the following year. Then the government bought the mill and people were called back. In 1980, when the government shut down the mill, 1,800 people were in the town. In 1985, the number of the residents was only fifty.[127] Ocean Falls totally lacked what I call viability.

Figure 8 presents a summary of the conceptual components of the viability of a local economy. In order to achieve long-term welfare of the local community, it is indispensable to establish a viable economy within its territory. A viable economy is sustained by both sensible resource management which ensures a sound ecological life-supporting systems and economic self-reliance which helps the local economy survive fluctuations in the external economy. Efforts to maximize the portion of local resources in the process of production and minimize the waste of resource utilization

Figure 8 Components of a Viable Economy



characterize the linkage between a sound local ecosystem and a self-reliant local economy. Ecologically sensible resource management means managing local natural resources as an ecosystem, taking adequate account of interdependent relationships. The goal is to keep ecological life-supporting systems from breakdown and help biogeochemical cycles fulfill themselves. An indispensable step toward this goal is to determine the expendable surplus of each renewable resource, and to keep the supply-based economy informed of this surplus. Harvests of natural resources are to be carefully monitored so that they will be carried out on a sustainable basis. Local economic self-reliance is sustained by local ownership of economic activity and diversification of industry. The ultimate goal is to maximize self-reliance in the local community under a certain set of conditions, for example, a desired life style. As explicitly expressed in the Final Report, both sensible resource management and economic self-reliance are underpinned and enhanced by the direct involvement of the local community. The participation of the local residents ensures accountability in resource management, which protects local resources from depletion. In order to ensure sensible resource management and thereby prevent unhappy surprises, a local community may need to be provided with expertise on local ecosystems provided by external researchers and scientists, in addition to its own traditional and modern knowledge. What is important is that the involvement of a local community consistently encourages the use of such knowledge in practice for the purpose of keeping the local ecosystems functioning in an adequate way. This is because it is local inhabitants who have to live with the results of resource management in the long run, whatever they may be. Local residents, on the other hand, contribute much to economic self-reliance by participating in diversified locally-owned business rather than

working for a large extraregionally controlled corporation.

The Slocan Project staff seem to have learned much from the history of mining in the Kootenays. The mining industry in the Kootenays provided an example of regional inability to control its own future and ensure its economic well-being. It demonstrated the boom and bust,[128] and vulnerability of the regional economy.[129] Unlike mineral resources, forest resources are renewable. Nevertheless, forest resources can be depleted by timber mining and history can be repeated in the forest sector. If this ecological disaster takes place, the community will be economically devastated. The ecological life-supporting system of the forest resource is what the valley community depends on for its welfare. From the perspective of the valley community, ecological depletion must be prevented by any means. Furthermore, the project studied what should be done in order to increase the viability of the valley economy from a long-term perspective. The Final Report advocated multiple use of multiple resources, not a single use (e.g., export of lumber and planks) of only one resource, timber. The authors made recommendations on the awareness of the significance of diversified industry and the danger of developing dependence on the external market system. For example, rural woodlots and a product mill were intended not only to create new job opportunities and realize ecologically sound resource utilization but also to increase local economic self-reliance by replacing some imports with locally-produced commodities.[130]

As reviewed in the preceding section, the project staff made eleven recommendations in the Final Report. Figure 9 presents a summary of the recommendations and their associated objectives. The viability of the local economy is achieved on the foundation of a sound ecological resource base

Figure 9 Recommendations and Intended Objectives

○ Directly Associated

△ Indirectly Linked (May not directly intended but connected in a way)

OBJECTIVES FOR A VIABLE LOCAL ECONOMY	RECOMMENDATIONS: 1. Resource Committee	2. Planning Process	3. Lower ACC	4. Rural Woodlots	5. Permanent Acess Road and Selective Logging	6. Return Stumpage	7. Product Mill	8. Valhalla Proposal	9. Wastes for Fuel	10. Finger-Joint Mill	11. Raise Chip Price
1. Ecologically Sound Resource Management/ Utilization											
(a) Management Accountability	○	○		○	△	○		△			
(b) Management Practice		○	○	○	○	○		○			
(c) Reduction of Resource Extraction		△	○				○		△	△	△
(d) Resource Utilization without Waste							○		○	○	○
2. Diversified and Independent Industry											
(a) Multiple Use of Multiple Resources	○	○	○	△			○	△			
(b) Locally-Owned Business	○	△		○	○		○	△		△	△
(c) High Local Value Added				△	△		○			○	△
(d) Import Substitution	△	△	△	○	△		○		○	○	

and a diversified and independent local industry. In order to ensure the former, the project staff thought it necessary to have ecologically sensible resource management under explicit accountability, supported by the community residents. In order to achieve the latter, they advocated diversity in resource utilization, local ownership, high local value added and increased economic self-reliance of the community, replacing some imports with local products. Obviously these objectives are dependent on each other.

In response to their questionnaire, the project staff received a letter from an inhabitant of the valley. In this letter he wrote:

> I have lived on a farm on Slocan Lake almost since white man time started here. . . . I'd like to give you my summary of the Slocan Valley. The area is a very desirable location for the simple business of living. . . . The nature of the agricultural land is such that it lends itself very favorably to subsistence farming. [If "logged in a scientific and sensible manner,"] [t]his perpetual timber crop would insure the subsistence farmers of steady employment to provide the necessities that the farm can't produce. It seems to me that this makes for a very happy situation and once it is established, most of the other desirables will automatically follow. On the other hand, if the timber is not sensibly harvested, we can find ourselves in a very sorry state in the not too distant future.[131]

The authors of the Final Report concluded that a "rural way of life" based on subsistence farming and supported by forestry was the locally chosen lifestyle:

> Most of the people who live in this valley do so because they enjoy a rural way of life. The small farm holding has traditionally provided the framework for this lifestyle in the Slocan Valley, just as the forest industry has been the support structure.[132]
>
> We believe that the small farm is a viable insitution, and that with some care it can be preserved within our valley, as a socially and economically sound way of life.[133]

What the project staff sought was to protect this way of life, or the steady

state of the community. The project staff observed that the relationship between human beings and their ecological resource base was no longer identical with what it had been when the valley began to be developed. As seen earlier in this chapter, they thought that the depletion of the valley's natural wealth was no longer unimaginable, unlike thinking in the early days. On the basis of this observation, they determined that existing resource management and utilization could not be sustained in the long run, and proposed an alternative approach which was both ecologically and economically sound when seen from the local perspective. They made recommendations to achieve a viable local economy, ensuring the overall welfare of the community in the long run. It deserves special attention that the Slocan Project staff presented an alternative view of economics from the perspective of the local community.

CHAPTER IV

THE CONCEPT OF CARRYING CAPACITY

(1) Introduction

The purpose of this chapter is to clarify and explore the concept of carrying capacity and to define a framework for regional planning based on the concept.

After this introduction, the carrying-capacity concept which originated in bioecology, is briefly reviewed in order to clarify it. In the following section, I look at how the concept has been extended and applied to planning. This is followed by my criticism of existing applications of carrying capacity to growth-control planning. Emphasis is put on realizing an appropriate meaning for petroleum subsidization and interregional trade. Based on this criticism, the final section proposes a capacity concept for regional economic analysis. This carrying-capacity concept applied to human society explicitly incorporates such variables as technology, level of living, and interregional transfer of commodities, into the scope of analysis. It is unlike the original model of carrying capacity in bioecology. I define the concept as applied to regional planning and present an argument concerning the components of "intrinsic" and "enhanced" carrying capacities of a region.

(2) Concept in Bioecology

The concept of carrying capacity originated in population dynamics in biology. It is observed that when yeast, for example, is introduced into a continuous culture its biomass increases, gradually reducing the rate of increase, until it is stabilizes at a certain point. The explanation of this behaviour is that environmental resistance (in this case, detrimental factors produced by yeast itself) increases as the biomass of yeast increases.[134] Also in a field population, a similar behaviour is observed. For example, sheep were introduced on the island of Tasmania sometime around 1800, and the number, after reaching almost 2 million around 1850, fluctuated around 1.7 million until the 1930s, when this was reported. Some of the fluctuations after 1860 are considered to be "due to variation in climatic factors."[135] Carrying capacity usually designates the level of population where growth becomes stagnant as seen in these two examples, and implies that the population size of a species is ultimately controlled by the limitations of the environment supporting it. A typical definition may be: "the maximum number of individuals that can be supported in a given environment,"[136] or "the total population the environment can support at balance."[137] Since the first definition, by using the word support, implies the notion of balance (that is, no catastrophic change in the population in the long run), these two definitions are substantially identical. The notions of maximum and at balance are essential to the concept of carrying capacity.

In the textbooks of bioecology, the concept of carrying capacity is usually introduced in company with the presentation of the logistic model, a well-known mathematical representation of population growth with a limitation. In this simple model, population growth is represented by an S-

shaped form: "the population increases slowly at first . . . , then more rapidly; but it soon slows down gradually as the environmental resistance increases percentagewise . . . , until a more or less equilibrium level is reached and maintained."[138] This level of equilibrium is identified with carrying capacity, as the following quotations show:

> For each set of environmental conditions, a level of population density exists at which birth and death rates exactly balance each other and the population neither grows nor declines. This point of population equilibrium is referred to as the carrying capacity of the environment (K).[139]

> The total resources available divided by the minimum maintenance requirement of each individual (P/M) represents the equilibrium number of individuals in the population--often referred to as the "carrying capacity" of the environment (K) for that population.[140]

As seen above, this simple model descibes a theoretical equilibrium determined by the total amount of the resources available and the minimum biological requirements of a certain species in a particular environment. This basic theory, without modification, is not useful when applied to human society. This is because it is seldom meaningful to study human carrying capacity without regard to, for example, levels of living and technology. However, this does not mean that carrying capacity is a meaningless concept for the purpose of studying human society. It is possible to modify the basic concept, as I attempt later in this chapter, so that it can be applied to society in a meaningful way, that is, so that its essential message--"limits to growth"--will be understood.[141]

I understand carrying capacity as the level of population that indicates the capability of an environment to accommodate a certain species. When the number of individuals exceeds that level, the limitation of environmental capability becomes obvious, for example, in shortages of food

and shelter. The population is then adversely affected and starts to decrease. The farther the population passes the boundary of sustainability, the worse are the effects on it. In conclusion, my definition of carrying capacity as applied to non-human species is as follows: carrying capacity designates the size of population of a certain species possible to be sustained in the long run in a given environment.

(3) Applications to Planning

The meaning of carrying capacity within the context of natural resource management is well illustrated in the famous story about the herdsmen's cattle and the pasture. It was reintroduced by Hardin[142] and is today known as the "tragedy of the commons." Godschalk wrote in 1974: "While only recently applied to the urban and regional context, carrying capacity has a long history in resource management."[143] Willard argues that the key implication of "carrying capacity" is the "phrase 'without straining,'" observing that the concept "has been used to refer to the number of cars a freeway can carry smoothly, to the weight of a structure that may rest on a given substrate, and to the interest an individual can be expected to bear on a loan."[144] He applies the notion of carrying capacity to state park design and planning, and argues that "[i]n terms of carrying capacity, planning should maximize the number of people enjoying the activities [such as hiking, camping, nature study and fishing] without straining the environment."[145] Here the concept of carrying capacity is extended to designate the number of people who enjoy recreational activities in a given environment. In the field of park management, carrying capacity was referred to in the early 1960s.[146] The application of carrying capacity to park design and management, an explicit expansion of the meaning of carrying

capacity, appears to have encouraged its further application to the urban and regional context.[147]

By the early 1970s, carrying capacity started to be explicitly employed in urban and regional development planning. Here the concept of carrying capacity is applied both to natural and human-made systems within the context of growth management and land-use regulation. The Carrying Capacity Concept as a Planning Tool by Schneider et al. gives a good summary of this type of carrying-capacity analysis in planning, with brief descriptions of twenty-two applications in the United States. According to them:

> Carrying capacity, as the term is generally used by planners, may be defined as the ability of a natural or man-made system to absorb population growth or physical development without significant degradation or breakdown.
>
> Carrying capacity analysis, as a planning tool, studies the effects of growth--amount, type, location, quality--on the natural and man-made environment in order to identify critical thresholds beyond which public health, safety, or welfare will be threatened by serious environmental problems unless changes are made in public investment, governmental regulation, or human behavior.[148]

This kind of application emphasizes the capacity of human-made systems, from physical infrastructure such as sewerage and transportation, to social institutions such as administrative and political entities. Godschalk, for example, emphasizes the necessity to develop the notion of "institutional carrying capacity" or "socially determined capacity" in order to "link the demand for social resources, such as planning, with the available supply."[149] According to Godschalk, "[i]n designing a state growth policy, for example, it would be necessary to explore the complex of laws, agencies, and people constituting the state growth management resources."[150] In the same vein, for example, Rahenkamp and McLeister advocate a fiscal capacity analysis in order to assess the fiscal impact of new growth on a community,

which is firmly associated with public welfare.[151] The reason for this emphasis on human systems is that an area's carrying capacity can be substantially altered by human intervention: by introducing new technology, increasing public investment, or regulating human behaviour, for example. When applied to humans, carrying-capacity analysis would be meaningless if human-made systems were excluded from the scope.

(4) Limitations of Current Applications

It is said that carrying-capacity analysis, when applied to urban and regional planning, suffers several limitations. Schneider et al. and Odell separately point out major drawbacks such as difficulties in model construction, data collection and output interpretation.[152] Schneider et al. even state that:

> For reasons of time, money, lack of political commitment, or the sheer difficulty in trying to assess carrying capacity limits, it may not be feasible or even advisable for many planning departments to undertake capacity studies.[153]

Nevertheless, they conclude that "as a way of thinking about planning, carrying capacity is useful."[154] This is a very suggestive comment, which likely implies more than what the authors initially intended. Carrying capacity was originally a conceptual representation of "limits to growth," and is therefore capable of underpinning an approach to regional planning which is appropriate for an era where the myth of Nature Benign is no longer valid. Current application, however, does not appear to let the capacity concept fulfill its intrinsic meaning as an antithesis of the "demand-based" orientation. In other words, existing studies are located within the growth-oriented mentality, and do not challenge the dominant view of nature.

In the current application of carrying capacity to urban and regional

planning, population growth and/or economic growth are presupposed, and this characteristic seems to impose the most critical limitation on carrying-capacity studies in achieving both economically and ecologically viable communities within environments that are no longer "benign." It is true that capacity studies call for attention to the natural environment and are supposed to produce a supply-based approach. However, the concept has been applied to growth policy, though within the context of "controlling" or "managing" growth. In this application, "growth" comes first in the mind-set, and natural environment is assessed within the framework of growth, as the following quotation shows:

> It [Carrying capacity] focuses attention on the ability of the natural environment to support growth. It suggests that developments should respect the functioning of the natural processes of the environment.[155]

What underlies existing capacity studies is the assumption of growth, which was established on the basis of the Nature-Benign worldview and has been taken for granted. The major concern of these studies is therefore how to locate or accommodate planned/assumed/expected growth without triggering adverse effects within certain temporal and spatial scopes, or at best how to modify expected growth so that it can be achieved in an economically and technologically feasible fashion without significant adverse effects on the natural environment. The concern is not located in, for example, exploring the possibility of restructuring the present economy, to make it compatible with ecological requirements utilizing the framework of carrying capacity.

The concept of carrying capacity is thus currently employed as a tool of growth policy, and fails to serve as a foundation to redirect our growth-oriented economy. In this respect, Odell's criticism is suggestive:

> Any identification of an area's carrying or holding capacity is an invitation to use or fill that capacity. Carrying

> capacity thus becomes almost synonymous with "assimilative capacity." . . . use of the carrying capacity approach can lead to what has been called "accommodation planning," under which growth is assumed and the only question becomes how to accommodate and distribute it.[156]

This is the most critical characteristic of the existing application of the carrying-capacity concept. What is necessary is to redirect the concept away from the currently dominant worldview or growth-oriented mentality.

The existing application is characterized by: [1] lack of appropriate attention to the meaning of interregional trade in the analysis, and [2] lack of assignment of an appropriate meaning to the present human dependence on fossil fuel. These two defects are by no means independent. They are complementary in contributing to the limitation of existing capacity studies. According to Simon and Kahn:

> Because of increase in knowledge, the earth's 'carrying capacity' has been increasing throughout the decades and centuries and millenia to such an extent that the term 'carrying capacity' has by now no useful meaning.[157]

To these thinkers, carrying capacity is thus almost totally manipulatable. However, it is necessary to consider what has contributed to the increase in what they call "the earth's 'carrying capacity.'" It seems that the main reason for this increase has been technological innovation and expansion of interregional transfer of goods and materials. I agree that the advent of the bow, the introduction of agriculture and the invention of the wheel, for example, expanded the earth's carrying capacity. I also agree that the technology subsidized by fossil fuel along with the present massive interregional trade has contributed to the increase in the number of people that can be temporarily supported on the planet. However, I do not agree that the latter case is identical with an increase in carrying capacity, because this development, as argued in preceding chapters, cannot be

sustained in the long run and thereby violates one of the most essential qualifications of carrying capacity. At the age of industrialization, production has been expanded in an unprecedented fashion, by consuming vast amounts of both renewable and nonrenewable natural resources, and discharging wastes exceeding the decomposing ability of the natural environment both in quality and quantity.

Grain production in North America is highly productive in terms of human labour and today contributes much to sustaining the world population. In 1980, the net export of North America was 131 million tons and "over a hundred countries rely on North American grain."[158] "North America's emergence as the world's breadbasket began in the forties,"[159] when farmers began "to abandon traditional rotations that included soil building pastures and hay, in favor of continuous planting of corn and other row crops,"[160] and "the overall gains in grain production since mid-century have been impressive."[161] This new grain production is highly mechanized and dependent on chemical fertilizers, which "require substantial amounts of energy to mine or synthesize and to transport,"[162] and petroleum-derived pesticides/herbicides. It is thus very consumptive of fossil fuel. This grain production is also most dependent on interregional transportation for its input (machines, fuels and chemicals) and output (grain). This practice will collapse even before the depletion of fossil fuel because it is not environmentally sustainable. For example, Shinohara criticizes this type of production of putting emphasis on maximum yield rather than sustainable maximum yield and obtaining high yields at the cost of the soil fertility for the future.[163] According to Rees:

> we export "grain", but are not accustomed to thinking of it as the phosphates, nitrates, organic matter, etc. effectively removed from the soil in the process. In this sense,

> agriculture can be very much a form of mining, and just as non-renewable. (E.g., we've removed 60% of the "natural" nutrients and 50% of the organic matter from prairie soils.)[164]

Soil erosion is a related problem which is undermining the fertility of land. Brown tells us that:

> Fourteen years of data gathered at the Missouri Agricultural Experiment Station show land planted to a corn-wheat-clover rotation losing an average of 2.7 tons of topsoil per acre annually through erosion, whereas comparable land planted continuously to corn lost 19.7 tons per acre annually. While the first loss is well within the tolerance range [within the natural rate of soil formation] established by soil scientists, the latter leads to a progressive thinning of the topsoil layer and a steady decline in inherent land productivity.[165]

Simon and Kahn state that "the food supply has been improving since at least World War II, as measured by grain prices, production per consumer, and the famine death rate."[166] In my view, however, this does not mean an increase in the earth's carrying capacity because industrial agricultural production, which has contributed much to the recent grain production, is not sustainable in environmental terms in the long run. The recent grain production in the prairies is undermining the earth's resource base, rather than increasing its carrying capacity as Simon and Kahn suggest.

Big cities, totally unsustainable with local resources, are today actually "sustained." This is, however, the beginning of the problem. In order to sustain these cities, a tremendous amount of commodities such as food, fuels and industrial materials must be imported. Thus the bill is forwarded to somewhere else. When the size of the bill goes beyond the capability of the hinterland, the latter will suffer environmental degradation. Furthermore, cities have to deal with the problem of negative output, or of wastes. Because of the quantity and kind of wastes resulting from the imported input and a partial loss of functioning of biogeochemical

cycles inherent to the natural environment, waste accumulation becomes a serious problem. Cities have to pay the bill in the form of air pollution or again forward it by constructing tall smokestacks resulting in acid precipitation in a broad area. It is therefore misleading to argue that the carrying capacity of a particular area has been expanded based only on the observation that it appears to "sustain" a larger population than before. If we wish, today we can even build a city in the middle of a desert by employing innovative technology and importing necessary materials and fuels, food and water by interregional transportation. However, this does not mean that the area's carrying capacity increases from zero. Carrying-capacity analysis lacking sufficient attention to petroleum-dependent technology and interregional trade can thus produce a most misleading result.

According to Godschalk and Parker, a planning method for environmental carrying-capacity analysis is composed of four steps:

> [1] completing resource inventories;
> [2] defining the relationships between each resource and its expected or potential uses;
> [3] defining the most critical resource, that is, the limiting factor in growth; and
> [4] studying the remaining resources to see if they impose additional carrying capacity limits of their own.[167]

The carrying capacity of a study area is thus determined by the availability of the limiting resource defined at Step [3] with consideration of the result of the study at Step [4]. In industrial society it is most likely that water, air or land will be defined as the limiting resource, while it is less likely that food and fuel will be identified, although they are also critical. This is because at the present time it is often the case that the former group cannot easily be supplied by interregional trade while the latter group can be imported in an economically feasible way. It is true

that water can be supplied from outside as is notably done in California, but water transfer is highly dependent on geography and cannot be compared to the interregional transfer of food and fuel. In growth accommodation, air and water are uniquely critical as agents to "wipe off" wastes, both heat and matter, resulting from industrial operations and people's daily life.

Nieswand and Pizor advocate "current carrying capacity"--"the measure of a region's ability to accommodate growth and development within limits defined by existing infrastructure and natural resource capabilities." They argue that it is "determined by three factors--water supply, water quality, and air quality." According to Nieswand and Pizor, "although a wide variety of planning factors are important," these three factors can practically determine current carrying capacity because "natural resource availability, technological capacity, public fiscal capability, and the police power perspective of health and safety" are incorporated into each one of these factors.[168] This argument typically shows the character of the carrying-capacity analysis applied in urban and regional development planning. Existing capacity studies pay little attention to the meanings of interregional trade and petroleum-subsidized technology.

Suppose a particular resource, water for example, is identified as the limiting factor in a capacity study. Then the carrying capacity or the maximum growth permissible is determined on the basis of the area's availability of water. Nevertheless, if a technological breakthrough, new desalination or diversion technique for example, is introduced and additional water intake becomes economically feasible, the limit to development set by the capacity study loses its foundation, even though the new technology is accompanied by a serious adverse impact on the natural

environment. This means that capacity studies are subordinated to the market and are often powerless in coping with the degradation of the natural environment.

As described above, without appropriate evaluation of interregional trade and fossil-fuel subsidization, carrying-capacity studies can end up as mere economic or technological feasibility studies. These can serve only traditional growth-accommodation planning. This type of application is not a way to materialize the primary message of carrying capacity, namely "limits to growth."

(5) Proposed Definition and Framework

When applied to human society, carrying capacity becomes a much more complicated concept than when it is applied to non-human species. This is because the application of the concept to human society requires human intervention and the material standard of living to be incorporated into the scope of the analysis.

Nevertheless, the original definition in bioecology, which was briefly reviewed earlier in this chapter, still seems valid here. My definition of the concept applied to regional planning is therefore based on that bioecological definition and is as follows: regional carrying capacity is the maximum number of people that can be supported at a certain material standard of living in the long run by utilizing natural and human resources within the region.

The qualification "in the long run" in the definition implies that human economic activity in the region are virtually free from resource depletion and waste accumulation. This is because the regional environment, where the myth of Nature Benign is no longer valid, cannot support a given

number of people "in the long run" if resource depletion or waste accumulation substantially undermines the regional capability to accommodate humankind. My definitions of these two terms are as follows:

> Resource depletion refers to a state where the environment can no longer go on supplying humankind with a particular resource because [1] all the available amount of the resource has been harvested, in the case of the nonrenewable resources, or [2] the ecosystem as the producer of the resource has been adversely affected by over-exploitation and/or environmental pollution and has stopped functioning, in the case of the renewable resources.
>
> Waste accumulation refers to a state where a particular matter discharged as waste into the environment remains harmful to organisms there, without being decomposed into non-toxic elements or reduced to a harmless level by biogeochemical cycles, because of the chemical character of the matter or its large amount beyond the assimilative capability of the natural environment.

It should be noted that the above definition of regional carrying capacity excludes interregional transaction as a supporting system and regards a region as a closed or an isolated system. This is not only because the carrying capacity indicated by the largest population possible would be practically meaningless unless interregional transaction were excluded but because it is useful to have an understanding of the "intrinsic" capability of a region to support human society and thereby to realize the divergence of the current production/consumption mode from the one permissible without the subsidization of imported commodities including fossil fuel.[169] However, this does not preclude the interregional flow of goods and materials from the scope of analysis. This element is critical for regional capacity analysis and, as shown later, has to be explicitly incorporated into it.

There are three major elements of "intrinsic" carrying capacity of a region. They are:

[1] natural capability;

[2] human intervention; and

[3] level of consumption (or standard of living).

Regional carrying capacity can be thought of as a function of these three variables, and is determined by their values.[170]

[1] Natural Capability

This variable is to be determined by completing a regional inventory of natural resources. Natural capability means what and how much raw materials nature can supply for a regional economy and what and how much wastes of human society nature can receive on a sustainable basis. The resources that naturally flow into and flow out of the region, such as air, water, fish and wildlife, deserve special attention. That is, we must not utilize these resources in such a way that they are depleted or their quality/quantity are substantially affected. For example, the natural capability of a river to supply water does not mean all the water that can be taken from the river. Water intake to the extent that it substantially affects downstream regions is not permissible. In the same vein, dumping toxic wastes into a river to be washed away affecting a downstream region is not acceptable.

[2] Human Intervention

This variable is composed of the human elements of production and waste disposal such as labour force, technology and infrastructure. Obviously, only human interventions that are possible by using intraregionally available resources can be counted under this category for calculating intrinsic carrying capacity.

[3] Level of Consumption

It is crucial to incorporate the material standard of living into the analysis because regional carrying capacity fluctuates substantially in

relation to consumption per capita. Carrying capacity increases when the level of consumption is lowered. As viewed in Chapter II, the material standard of living has been traditionally regarded as an indicator of happiness and satisfaction. However, the concept of "quality of life" shows that satisfaction is not simply a function of material wealth. What is happiness and what is satisfaction are highly subjective, and the choice of the most desirable level of consumption or a regionally chosen lifestyle is a socio-political question.

It should be noted that the analysis of the interactions of the three major variables plus interregional transaction is one of the most important parts of a regional carrying-capacity study. These four variables are dependent on each other and are firmly associated in complicated ways including important feedback loops and causal links. No variable can be isolated easily in any meaningful way. For example, the following situation may not be unusual: a particular resource is necessary to sustain a certain lifestyle, but the resource cannot be extracted without employing a particular technology, which requires petroleum, which is brought into the region by interregional trade, and furthermore the technology produces a particular type of pollution that can be dealt with only by applying another oil-subsidized technology, which is likely to develop another type of pollution.

The proposed concept of carrying capacity may be written as follows:

$$icc = f(n, h, c)$$

where icc is intrinsic carrying capacity;

n is natural capability;

h is human intervention; and

c is level of consumption.

As is to be argued in Chapter V, a certain kind of interregional commodity transfer is ecologically sound and in some cases plays an important role in enhancing regional carrying capacity. It is necessary to introduce this variable to the proposed framework because there is a case where interregional exchanges of commodities benefit all the involved regions without violating ecological imperatives. In order to incorporate the variable of interregional flow of goods and materials, the concept of "enhanced" carrying capacity is introduced: enhanced carrying capacity is the maximum number of people that can be supported at a certain material standard of living in the long run by utilizing regional resources with a certain level of subsidization by interregional transactions.

Enhanced carrying capacity can be written as follows:

$$ecc = f(n, h, c, i)$$

where ecc is enhanced carrying capacity; and
i is interregional flow of commodities.

Intrinsic carrying capacity is again written by using this equation as follows:

$$icc = f(n, h, c, i=0).$$

This framework is supposed to generate an approximate image with some quantified information under each set of assumptions. It is expected to be an aid to explore a future vision of a regional economy which is compatible with ecological imperatives.

CHAPTER V

SYNTHESIS

(1) Introduction

The purpose of this chapter is to synthesize the arguments in the preceding chapters and to describe how the proposed framework of carrying capacity can be applied to a study of a regional economy.

The first half of this chapter is devoted to the consideration of what regions are appropriate as the subject of regional planning. In this argument, ecologically-determined regions are advocated, and the necessity to recognize the nested structure of regions is emphasized. The second half describes how the proposed carrying-capacity framework can be applied to a regional economic study. This application is composed of six major steps. Through these steps, each major variable of enhanced carrying capacity is examined in turn and limits to "supply" are determined. This application is intended to yield a normative image of a regional economy, toward which the existing form of production and consumption is to be restructured.

(2) The Region as the Subject of Regional Planning

Since "region" is not always a clear concept, it is necessary to consider what types of regions the proposed carrying-capacity framework should be applied to. Regions may be explored and classified based on character and size. Using these two aspects, I consider what types of regions are appropriate as the subject of carrying-capacity studies aiming at achieving a viable region.

One clearly defined meaning for "region" is an administrative subdivision of a country or a province. In this case, the region is defined by distinct boundaries. Administrative/political boundaries of this type already exist. By using these existing boundaries, a well-defined region, covering either a large or a small area, can easily and quickly be obtained as required. Unfortunately, however, these convenient boundaries do not usually represent ecological reality. The Slocan Project emphasized the interrelatedness of the resources in the valley, and argued that it was necessary to study the subject area "as an ecological system, that is an interdependent complex of many resources including the community itself."[171] The project advocated managing their "resources as an all-inclusive, totally integrated resource unit."[172] For example, they proposed the preparation of "resource folios for all major drainages within the Slocan P.S.Y.U." so that each drainage would be managed "as a unit" on the basis of long-term development plans.[173] It is reasonable to deal with natural resources as an interrelated entity or an ecosystem in order to ensure ecologically sustainable resource management and utilization. Therefore, for the purpose of a carrying-capacity study for achieving a viable economy, a region should be defined taking account of ecological properties.

The concept of "bioregion" provides a set of useful criteria to define a region for the purpose of carrying-capacity studies. According to Berg and Dasmann, a bioregion is in some ways different from such ecological regions as Dasmann's biotic province and Udvardy's biogeographical province.[174] In short, the concept of bioregion was created by adding the perspective of regional residents, who are deeply rooted in their territory, to the concept of regions defined in ecological terms. Berg and Dasmann

argue that:

> The term [bioregion] refers both to geographical terrain and a terrain of consciousness--to a place and the ideas that have developed about how to live in that place.[175]

"A terrain of consciousness" should not be confused with a view of environment possessed by humankind in general. What is emphasized as a component of bioregion is a residents' recognition of their territorial realities. According to Sale, a bioregion is:

> any part of the earth's surface whose rough boundaries are determined by natural characteristics rather than human dictates, distinguishable from other areas by particular attributes of flora, fauna, water, climate, soils, and landforms, and by the human settlements and cultures those attributes have given rise to. The borders between such areas are usually not rigid--nature works of course with flexibility and fluidity--but the general contours of the regions themselves are not hard to identify by using a little ecological knowledge. Indeed, those contours are generally felt, understood, or in some way sensed, by many of the inhabitants of the area, particularly those close to the land.[176]

> Ultimately the task of determining the appropriate bioregional boundaries--and how seriously to take them--will always be left up to the inhabitants of the area, the dwellers in the land, who will always know them best.[177]

Ecological characteristics perceived by the inhabitants define a bioregion. Inhabitants mean people who have lived in a particular area for a reasonably long period of time, ideally for generations. It seems that the borders of a region perceived by those especially rooted in territorial ecosystems are seldom inconsistent in a major way with the distribution of ecological properties. Thus, bioregions have a unique character fundamentally different from most of existing administrative ones.

As Sale states in the above quotation, bioregions do not have distinct boundaries. There is not even an established way to define bioregional boundaries. There may be however little need to determine rigid and hard

boundaries, and the best method of definition likely varies according to each domain to be defined, because both ecological realities and inhabitants' perception fluctuate. Dodge states that:

> the criteria most often advanced for making bioregional distinctions are biotic shift, watershed, land form, cultural/phenomenological, spirit presences, and elevation.[178]

According to Aberley, bioregions are defined by mapping the following boundaries:

a. Plant and animal communities
b. Watersheds
c. Physiographic regions
d. Aboriginal territories
e. Historical and current human use patterns
f. Psychophysical sites
g. Cognitive homelands
h. Climate
i. etc.[179]

Both Dodge's and Aberley's presentations of the criteria for defining bioregions are consistent with Sale's description of bioregions. A stress is put on [1] the biogeographical properties of a territory and [2] the recognition of the people who are closely connected with these ecological realities.

In Dwellers in the Land, Sale gives three notions of regions that may serve as bioregions. The largest is an "ecoregion," which takes "its character from the broadest distribution of native vegetation and soil types." It is roughly "several hundred thousand square miles," and the North American Continent contains about forty "ecoregions," according to Sale. The Ozark Plateau and the Sonoran Desert are given as examples.[180] A "georegion" is smaller, and is "identified most often by clear physiographic features such as river basins, valleys, and mountain ranges." Sale describes a watershed as "a particularly distinctive kind of georegion."

Examples are the White River watershed within the Ozark Ecoregion and the Central Valley of California within a Northern California ecoregion.[181] A georegion may "break down into a series of smaller territories of perhaps several thousand square miles," that is, "morphoregions," which are "identifiable by distinctive life forms on the surface--towns and cities, mines and factories, fields and farms--and the special land forms that gave rise to those particular features in the first place." As an example, Sale describes how the georegion of the Connecticut River Basin changes, as the river flows from its headwaters to its mouth, perceptibly creating several morphoregions.[182]

The concept of bioregion is transferable to the process of defining a region for the purpose of regional studies based on the framework of carrying capacity I proposed in Chapter IV. This is because the bioregion concept contains in itself the explicit designations of two major requirements for a viable regional economy, which is to be the goal of those carrying-capacity studies. As described in Chapter III, a viable economy needs [1] ecosystem-oriented resource management and [2] constant input from the resident public, which correspond with the criteria for defining a bioregion, that is, ecological properties and residents' perspective. Ecological properties and the inhabitants' perspective will serve as major criteria for defining a region for regional planning in order to achieve a viable region.

Regions vary in size. "Regional" is located somewhere between "global" and "local," but does not designate any particular area of land. Therefore, it is necessary to clarify what is meant by "region" or "regional" in this thesis. In other words, it is significant to consider what size of land is

appropriate as the subject of carrying-capacity studies for regional viability.

In order to achieve a viable region, it is necessary to build a self-reliant economy sustained by ecological properties inherent in the area. For this purpose, Sale's three kinds of bioregions may be appropriate. However, it also seems necessary to apply the proposed framework of carrying capacity to a much smaller area. This is because Sale's bioregions are likely to be too huge for its inhabitants to be involved in a direct way. The world where a local perspective is rooted is a much smaller area. Sale's ecoregions and georegions are definitely too large for humans to experience in daily life and understand what is happening. Even Sale's morphoregions, several thousand square miles, may be too large. People cannot actually perceive what is happening in their large watershed if they can only understand it at an abstract level.

It is in a small world of local community that people can live an ecologically sound life embedded in the natural environment. It is there that people can be truly familiar with other members of society and their ecological properties. Today people actually live in a global region, but they do not care about its long-term well-being. It is almost impossible to be interested in such a huge area. The Slocan Project stated that "[t]he local community represents the only visible group with a <u>binding interest</u> in the long-term sustenance of this valley's resources."[183] This "binding interest" may develop into a sense of identification or belonging to the place. Murota advocates the scale of land represented by a creek as an appropriate area for a place of living. He studies the relations between water and entropy flow within the context of life-supporting systems and advocates the size of an area represented by a creek, not by a big river, as

a living space in which humans are rooted based on mutual understanding and cooperation.[184] In a community of that size, most residents know each other and can be familiar with the natural environment to a considerable extent. This is a place where Bookchin's "profound sense of unity between the individual and the group"[185] is possible. Therefore, local community, which is roughly represented by the size of a creek, is where the exploitative relationship of humankind and the ecological resource base can begin to change into a symbiotic one. The level of the local community is important because it is at this level that efforts to establish a self-reliant economy can be initiated. The local community is where people can be personally committed to and responsible for sustainable resource utilization. It may be impossible to achieve self-sufficiency at this level, but by networking these local efforts, a self-sufficient region may be achieved.

A carrying-capacity study can be conducted on a large ecologically-united area, such as Sale's ecoregions and georegions. On the other hand, a small area can be an appropriate subject as well. That is, it is meaningful to study the territory of a local community, which is also an ecological unit including the human community itself, in terms of carrying capacity. Between an ecoregion and a local community, several levels of analysis can be selected as required. Commodities vary in their availability. Some can hardly be supplied self-sufficiently in many localities, while others may be easily supplied locally in almost every local community. It may therefore be meaningful to design a self-sufficient circulation of a particular commodity at a certain intermediate level. Not only this, in order to achieve regional self-sufficiency, efforts should be made to increase self-reliance at each subregional level which is ecologically meaningful.

A multi-levelled view of a region seems necessary in a regional study for the purpose of constructing a viable region. Figure 10 describes one possible set of subregions as the subject of study of regional planning. Figure 11 shows the "nested" structure of regions using the same set of subregions. The view of a region as a multi-levelled system is useful for designing a mode of economy that helps enhance economic self-reliance at each subregional level. The multi-levelled view of a region makes it easier for regional planners to take adequate account of the characteristics of certain ecological units, large or small, when designing a viable region.

(3) A New Application of Carrying Capacity

According to Schneider et al.:

> Because of its origins in the natural sciences, the term carrying capacity suggests an objectivity and precision that is not warranted by its use in the planning community.[186]

It is true that we cannot expect pure objectivity and impartial quantification in the application of the carrying-capacity concept to environmental planning and policy formation. For one reason, human judgment is always involved when a set of assumptions is made for conducting a study. For example, such steps as selecting variables and determining the interrelations between them are all based on these assumptions. Nevertheless, a carrying-capacity study does provide an approximate but explicit representation of limits to growth inherent in the study area in the form of quantified information. Although the quantified output of a capacity study is by no means absolute, it does serve as a valuable tool for designing a viable economy if the meaning of the assumptions underlying the study is understood in an appropriate way.

Figure 10

Subregional Levels for the Carrying-Capacity Analysis

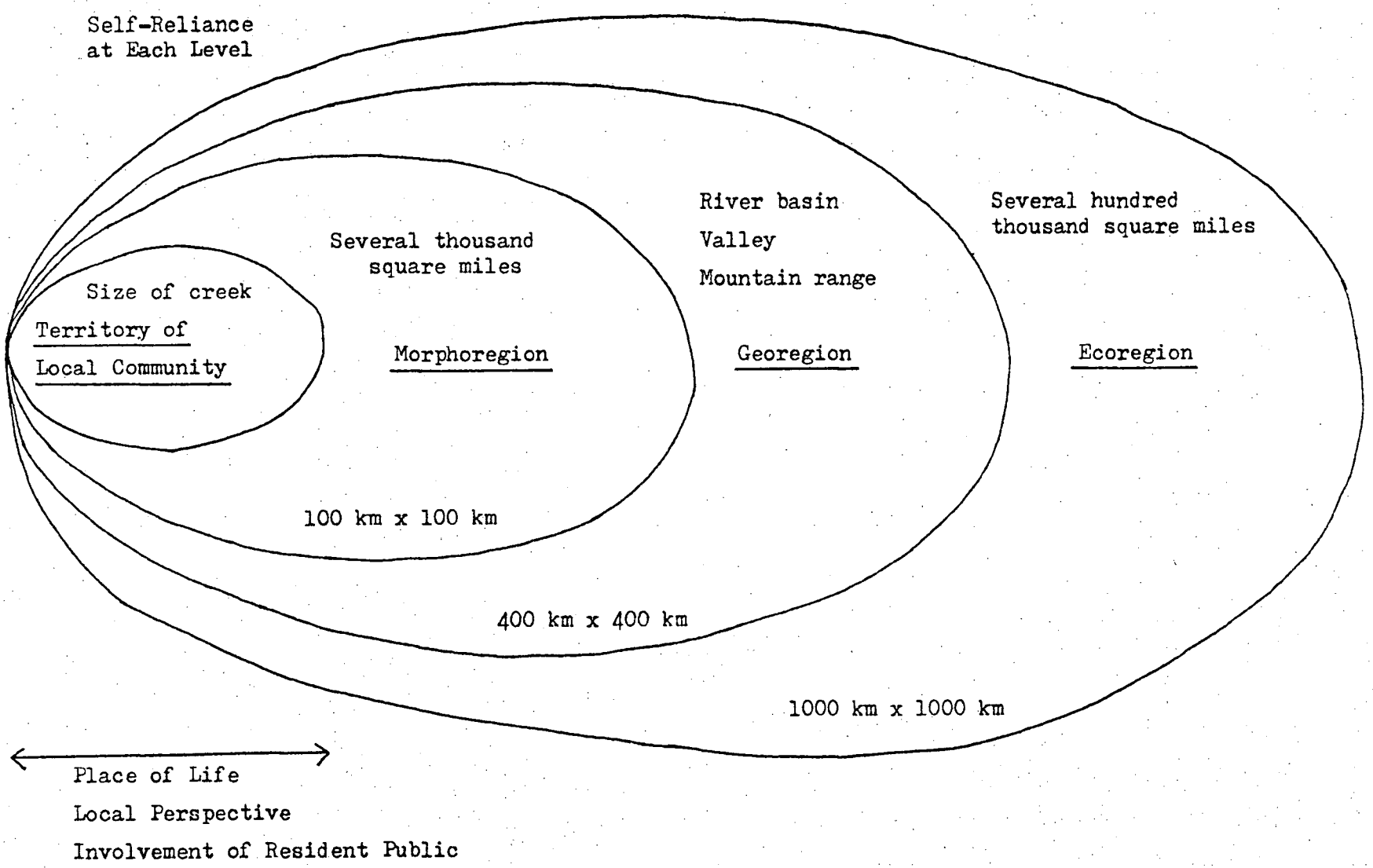
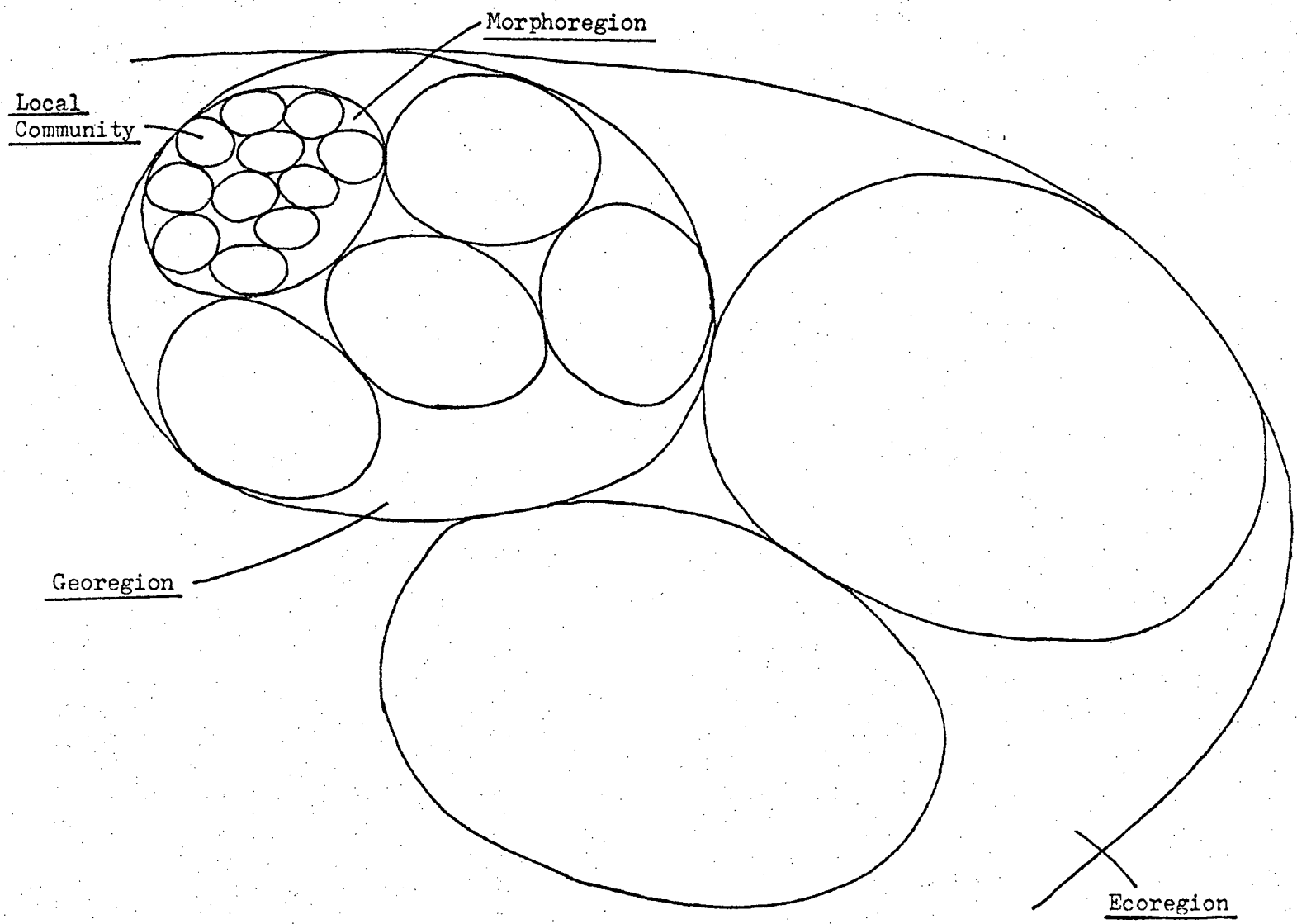


Figure 11 Region as a Nested System



In Chapter IV, I proposed the concept of enhanced carrying capacity (ecc), which has four major variables, that is, natural capability (n), human intervention (h), level of consumption (c) and interregional flow of commodities (i). Therefore, ecc = f(n, h, c, i). Ecc and each major variable except the variable c are in a positive correlation. That is to say, ecc increases as each variable, n, h or i, increases, but not proportionately. The contrary holds for ecc and the variable c. When other variables are held constant, an increase in population can only be achieved by lowering standard of living. In other words, c times ecc is a function of n, h and i. Expressed as a formula,

ecc x c = f(n, h, i), or ecc = f(n, h, i) / c.

Industrialism, or the mode of production and consumption prevailing in today's industrial society, can be understood in this framework as follows.

The essence of industrialism is to increase an area's perceived capacity and improve the material standard of living (c) by employing innovative technology (h) and expanding interregional trade (i).[187] When the effect of the increase in the variables h and i is bigger than the actual population growth, the difference is usually "consumed" by raising the variable c, rather than enlarging a "spare room." This is especially so when the area's population growth has become stagnant and there is little need to increase the area's capability to accommodate new immigrants.

It should be noted that both reinforcement of human intervention and expansion of interregional transactions usually result in an increase in the amount of goods and services traded through the market system, or an increase in the GRP or GNP. It is therefore understandable that GRP and GNP have traditionally been used as a measure to show how advanced a particular area is: namely, how rich the area is and how high the material standard of

living is. If happiness and satisfaction were simply a function of material affluence, human happiness and satisfaction could be as well measured by GRP and GNP.

This strategy of industrialism, that is, raising the material standard of living by reinforcing human intervention and expanding interregional trade, unfortunately often results in deterioration of the natural environment because the strategy is put into practice with little regard to ecological properties, which by themselves have the potential to ensure humankind a particular level of living. In some of the cases of human intervention, the natural environment has been degraded so substantially that the survival of the area's population depends less on the local natural capability to support it than on human-made systems such as industrial production and transportation. Some of the inherent ecological cycles have been adversely affected and have stopped functioning in an adequate way. For example, the local fishery of Kasumigaura, Japan's second biggest lake (168 square kilometres) located near Tokyo, has been devastated since 1972, when the water gate was closed to prevent seawater from running into the lake. The gate was closed in order to make the lake a huge reservoir of fresh water for agricultural and industrial use, notably for feeding the Kashima Industrial Zone (see p.30). Since 1973, the lake suffers an outbreak of aoko (a kind of phytoplankton) every summer and a bad odor annoys local residents. According to Okui, the lake, which used to be rich in fish and shellfish supporting more than hundred species, now has only about five species for fishery. Many people have been forced out of the fishery and are now wageworkers.[188] Metropolitan areas are another example. Even those in ecologically productive regions, look in many ways like an astronauts' colony floating in the space, or like a city in the middle of an

arid land, where the capability of the natural environment to support humankind is extremely poor. Rees tells us that:

> If Man is dependent on them [terrestorial ecosystems], why do such polluted or depleted ecosystems not produce more dramatic impacts and political responses at present? Part of the answer is that essential ecological resources - fresh air, clean water and food - can still be obtained (or automatically flow!) from elsewhere. Indeed there is an implicit assumption in every urbanizing region that regardless of how local environments are allowed to deteriorate in the name of economy and development, the necessities of life can always be imported.[189]

Under industrialism, people try to increase an area's perceived capacity and improve the material standard of living mainly by developing regional dependence upon fossil-fuel-related technology and the interregional flow of commodities, rather than by working upon inherent natural capabilities to produce subsistence and decompose waste.

As seen in Chapter IV, the existing applications of carrying capacity barely challenge the industrial mentality and are not completely free from a demand-based approach. In the previous chapter, I argued that, if the implications of fossil-fuel subsidization and interregional trade are not adequately understood in relation to an area's life-supporting system, carrying-capacity studies can end up with mere economic and/or technological feasibility studies. In the framework of "current carrying capacity" advocated by Nieswand and Pizor[190] (see p.84), no distinction is made between local resources and those imported. For example, one litre of water taken from the local river system is the same as one litre of water delivered from hundreds of miles away, if their economic costs are identical. No distinction is made again in the way a resource is made available. That is, one litre of water desalinated by using locally available technology and resources is exactly the same as one litre of water

desalinated by large-scale petroleum-consuming technology, if the economic cost is identical. Obviously, these four kinds of water differ in their impact on life-supporting systems both within and outside of the region.

When we cannot assume an infinite natural capability to accommodate humankind, it is necessary to identify the effects of fossil-fuel subsidization and interregional trade upon the carrying capacity of a particular area. This is the rationale for the concept of enhanced carrying capacity (ecc), where the elements of human intervention (h) and interregional flow of commodities (i) are explicitly distinguished from the element of natural capability (n). This kind of distinction, which is hardly made in a monetary analysis, is indispensable to develop self-reliance in a regional economy and to promote environmentally sensible resource utilization in order to achieve a viable region.

When carrying-capacity analysis is applied to a regional economic study, two aspects of the regional nature-human relationship need to be analyzed. Traditionally economics pays attention almost exclusively to the process of production, neglecting the process of waste disposal. By contrast, in carrying-capacity studies, it is necessary to assess regional capacity to receive wastes resulting from human activity in order to avoid waste accumulation, as well as assess the capacity to supply the regional population with necessary resources in order to avoid resource depletion, as shown Figure 12. Obviously, the input and the output in Figure 12 are linked in the natural environment as shown in Figure 13. To establish an ecologically sustainable society means to retrieve the ecological cycles shown in that figure, that is, to make human activity become part of these cycles. The capability to receive wastes is part of the supply capability

Figure 12

Natural Capabilities to Supply Resources and Receive Wastes

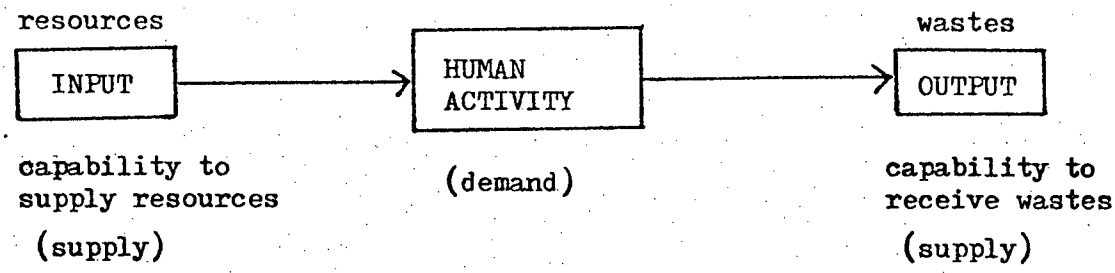
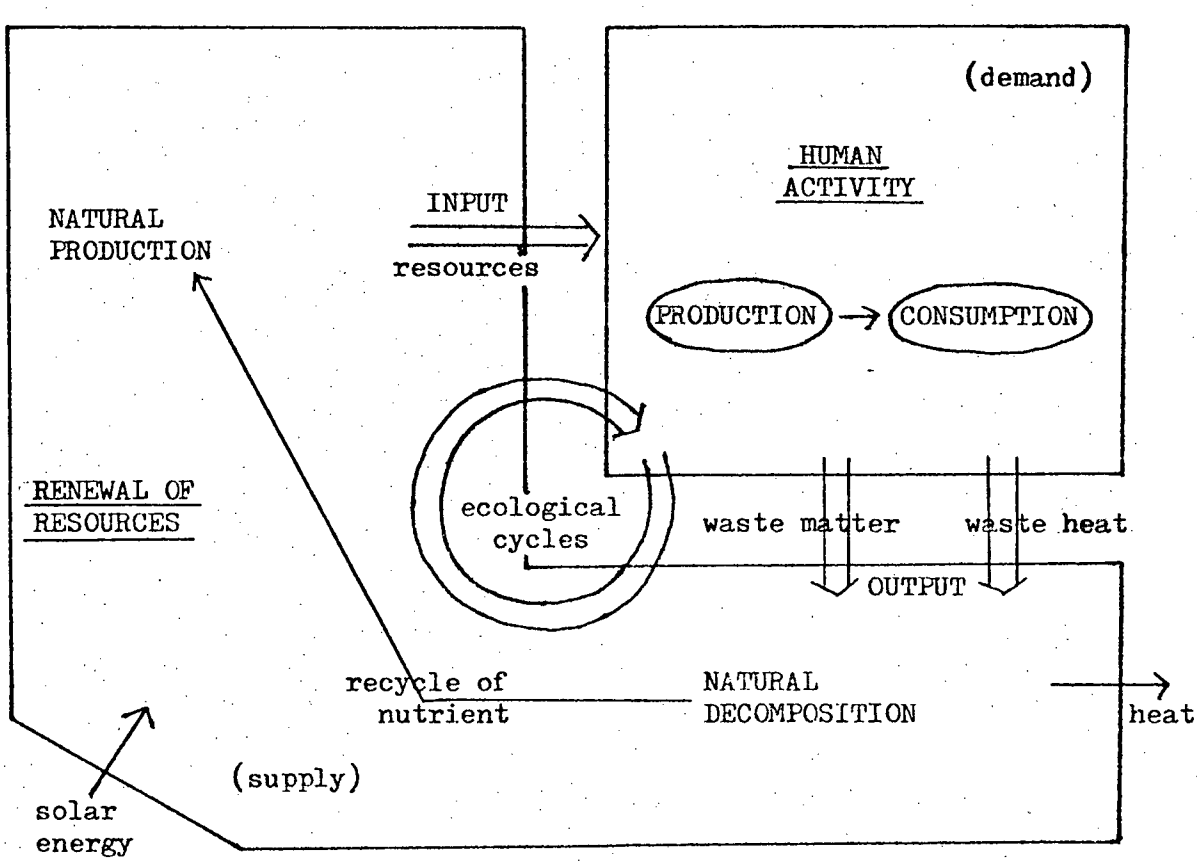


Figure 13

Human Activity as Part of Ecological Cycles



in the sense of supplying humankind with opportunities to get rid of wastes and keep life-supporting systems functioning well. Basically carrying-capacity studies first try to determine what can be supplied locally on a sustainable basis by assessing these two kinds of capacities, and then attempt to identify an appropriate mode of human activity (a form of satisfying human demand) within the given limits of regional supply capacity. Thus, a supply-based approach is taken in carrying-capacity studies and the process of determining supply involves these two aspects of the regional nature-human relationship.

Carrying-capacity studies involve the following six major steps. Steps (i), (ii), (iv) and (v) deal with each one of the four variables in the equation of enhanced carrying capacity--n, h, i, c in that order, respectively. Step (iii) displays the gap between the existing state and a self-sufficient state, and Step (vi) is where the future direction of a regional economy is considered or restructure planning takes place.

(i) Making Resource Inventories

First of all, it is necessary to complete resource inventories and assess the natural capability of a study area to accommodate human activity or the variable n, which is the foundation on which human intervention takes place. Resource inventories are therefore the basis of carrying capacity calculations. This step also includes defining interrelations between natural resources located within the study area. Without knowledge concerning these interrelations, natural resources will not be managed as an ecological unit or ecosystem, and expendable surpluses cannot be determined for the purpose of sustainable resource utilization.

(ii) Assessing Human Intervention

In this step, the capabilities of regional human resources to produce commodities and to treat wastes are assessed. This means making inventories of human aspects of production and waste treatment, which include labour force, technology and infrastructure. It is important to assess each human intervention in terms of impact on the natural environment and dependence on imported commodities, thereby determining its compatibility with the region's viability. Petroleum subsidization is to be analyzed from the above two aspects if a study region imports petroleum. In assessing a particular mode of production, its negative outputs (wastes) as well as inputs (resources) and positive outputs (goods) must be taken into account. This analysis may find a useful tool in the concept of economic-ecological efficiency, described in Chapter III.

(iii) Calculating Intrinsic Carrying Capacity

Using the information generated in the previous steps, the intrinsic carrying capacity of the study area can be calculated. The level of consumption is temporarily set at the present level, and by definition no interregional trade is assumed. Therefore, theoretically, intrinsic carrying capacity = f (n = as defined in Step (i), h = as defined in Step (ii), c = present level, i = 0), and if this value is smaller than the actual regional population, the regional economy is in the state of self-sufficiency or can be directed toward the self-sufficient state immediately. In practice, however, it is impossible to show in any meaningful way the result of the calculation by a single figure which represents the sustainable population because the mode of human consumption is so complex and involves so many commodities that there is no appropriate common denominator that can reduce what is produced and consumed by the regional

population into a single index. What can be done instead is [1] to make a list of what can be prepared for consumption on the basis of information from Steps (i) and (ii); [2] to make another list that shows what is actually consumed at the present time; and [3] to compare these two lists. (The same process can also be followed for wastes and treatment capacity.) If the parameters in the first list are sufficient for what appears in the second, the region is self-sufficient or can move to the self-sufficient state immediately. Unfortunately, however, this may be unlikely in the case of a region located in industrial countries. It is likely that the second list is much larger than the first one. The difference between the two is compensated by interregional transactions. For those "non-self-sufficient" regions, the following two steps, (iv) and (v), have to be followed.

(iv) Determining Acceptable Interregional Transaction

The interregional transfer of commodities is only acceptable within a certain set of limits. First, interregional transaction must be ecologically sound, that is, ecologically sustainable over a long period of time. The exchange of commodities between regions and the processes of producing, transporting and consuming these commodities must be virtually free from resource depletion and waste accumulation in both regions. In other words, what could be transferred interregionally is only what is renewable on a sustainable basis or what is nonrenewable but cannot be depleted in the foreseeable future because of its abundance compared to its consumption. Moreover, the wastes resulting from this exchange must be within the decomposing capability of each region.

Secondly, interregional transaction must not develop "parasitic" or exploitative relationships between regions. That is to say, interregionally transferred commodities must not result in limiting possibilities of

improvement in welfare, or of future options for the regions that supply these commodities. The role of interregional transfers should be understood in general as subsidiary, that is, to make some contribution to the enhancement of regional capability to accommodate humankind. Ideally, commodities from outside the region should be limited to what is biologically indispensable (that is, part of basic human requirements at the level of subsistence) and is not, or barely available within the region. These commodities should be a catalyst enhancing regional viability. That is, they should be used so that their relatively small inputs will activate underutilized resources within the region and help enlarge regional carrying capacity by bypassing bottlenecks.

Salt may be an example of a commodity that can satisfy these qualifications. While it is a basic biological need of human beings, it may not be found in some regions. Theoretically, the intrinsic carrying capacity of these regions is zero. If they have potential capabilities to sustain humankind when salt is made available by interregional transfer, and are also capable of supplying some commodities for export on an ecologically sustainable basis, in exchange for the imported salt, this type of interregional transaction should be regarded as acceptable. It is unlikely that the extraction of salt will result in resource depletion or ecological hazards, because it is abundant compared to the amount necessary to satisfy human biological needs and can be extracted without employing pollution-inducing technology. It is also unlikely that the transportation and consumption of the salt will result in environmental degradation along the transportation route or in the consuming area because the amount necessary for human biological needs is negligible in relation to the natural environment. On the other hand, the salt transferred into saltless regions

is tremendously beneficial in expanding carrying capacity by bypassing a critical bottleneck.

(v) Finding a Sustainable Standard of Living

As mentioned earlier, enhanced carrying capacity (ecc) times per capita consumption or material standard of living (c) is a function of natural capability (n), human intervention (h) and interregional transaction (i). That is, ecc x c = f(n, h, i). In this step, the value of the term, ecc times c, is obtained using the information about the variables n, h and i, generated in Steps (i), (ii) and (iv). The term, ecc times c, designates the total amount that can be made available for regional consumption by combining regional life-supporting systems, both natural and human, with acceptable subsidization by interregional transfer of commodities. The term may be represented in an itemized form. For example, it can be described in a list where the amount available is shown for each item of final product. The term, ecc times c, also varies in terms of its contents. For example, biomass fuel may appear in the list at the sacrifice of part of grain and produce. Therefore, it is possible to obtain as many combinations of commodities as necessary, and the most desirable one can be selected from these alternatives according to the cultural and social needs of the region.

The term of ecc times c divided by the actual population of the region shows what can be made available on average for each individual by a self-reliant and ecologically sound regional economy. If this material standard of living is satisfactory, the regional economy is already ecologically sustainable or has a sufficient potential to achieve a sustainable state. On the other hand, if this material standard of living is lower than the present consumption rate, one of the following three means must be taken in order to achieve a viable, self-reliant and ecologically sustainable,

region: [1] lower the present standard of living; [2] reduce the regional population; or [3] both of the preceding, unless substantial improvement in human intervention, for example a technological breakthrough compatible with ecological imperatives, is expected. This adjustment is virtually a trade-off between size of regional population and material standard of living. This is because the other variables of the carrying-capacity equation are held constant in this adjustment, except that the variable of human intervention may be more or less affected when the regional population is reduced. The normative size of population and the normative standard of living are thus determined.

(vi) Planning for Restructuring a Regional Economy

In this step, efforts are made to design the transformation of the existing regional economy into a viable one. For the regions where a potential to achieve economic self-sufficiency is found in Step (iii) and those where a potential to achieve an ecologically sustainable economy with acceptable level of interregional subsidization is found in Step (v), plans are made so as to help transform the existing forms of human intervention and interregional trade into those compatible with regional viability as identified in Steps (ii) and (iv). For the regions where it is necessary to lower the current standard of living and/or to reduce regional population in order to meet the inherent ecological limits, extra planning is needed in order to satisfy these prerequisites for a viable economy. In this extra planning, the limits of supply are explicitly recognized, and within these limits a regionally chosen lifestyle is to be explored with consideration of the cultural and social needs identified in the region.

Earlier in this chapter, I described the nested structure of a region

as the subject for a carrying-capacity study. In order to achieve a viable region, it seems necessary to make an effort to restructure an economy not only at the level of large regions but also at other levels including a small locality where people can actually establish a family-like tie with other community members and the natural environment. The framework of carrying capacity described above can be applied to an analysis of an economy at any regional level, and efforts can be made to increase economic self-reliance at each level. The application of this framework yields a normative image of an economy, a mode of production and consumption which is ecologically sound and can be sustained over a long period of time.

CHAPTER VI

CONCLUSION

(1) Summary

In this thesis, I have explored a conceptual framework that provides reliable guidance for regional planning when the major implicit assumption of industrialism, the infinite capacity of the natural environment, is no longer valid.

In order to justify the premise of this thesis, I have examined the character of present industrial society. I conclude that the industrial mode of production and consumption is not ecologically sustainable in the long run and it is only made possible temporarily by the use of fossil fuel. Industrialization has reached the stage where the fossil fuel subsidy results in unacceptable degradation of the natural environment and thereby undermines its capability to accommodate humankind in the long run. In other words, human economic activity is today massive and the human impact on nature is enough so that the natural limitations of the environment have become apparent. Ultimately, there is no way that we can override this limitation without inducing disorder in our ecological resource base. Modern technology, although it has liberated humans from many natural restraints, is not an exception. It does not make it possible for humans to override the ultimate limitation without causing environmental degradation. For example, a technological solution to one environmental problem will likely contribute to the degradation of the natural environment as a whole in the long run. No matter how technology advances, human beings can never

isolate themselves from ecological life-supporting systems.[191] If these systems go on deteriorating, the long-term persistence of human society will be impossible. Present society can no longer afford to neglect the limitations imposed by the natural environment. Many regions of industrial countries have passed their inherent natural limitations, and now live at the ecological expense of other regions. Current industrial operations, which are labour efficient and natural-resource intensive, cannot be sustained infinitely, to say nothing of constant economic growth. This is not merely because of possible depletion of fossil fuel but because of the absolute ecological limitation of the planet. Therefore, the assumption of an infinite natural capacity, which underlies industrialism, must be abandoned as the guide for human behaviour.

Under the circumstance where the existence of ecological limitations cannot be neglected, the traditional approach to regional development planning, which aims at regional economic growth in terms of GRP, will likely fail to serve the long-term welfare of regional residents. I have argued that a viable region, which ensures inhabitants an acceptable level of living over a long period of time, can be built on [1] ecologically sustainable management and utilization of regional resources and [2] a self-reliant mode of a regional economy. Good ecology and good economy become one in the long-term interest of the regional community, and complementarily contribute to the viability of a region. In order to achieve a viable region, regional planning must take a supply-based approach, and a regional economy which has already passed the ecological limitation of its region must be restructured so that it can live virtually on its own account.

I have emphasized that carrying capacity is a useful concept that helps develop a supply-based approach to regional planning because it is an

explicit representation of limits to growth. This concept has already been employed in the field of planning, and the application to urban and regional growth management, which began in the early 1970s, is a notable example. Unfortunately, however, in the application to regional planning, the intrinsic meaning of carrying capacity, the absolute limitation of the natural environment inherent to each region, has not been fulfilled. In these capacity studies the major concern remains how to distribute and accommodate assumed growth. The ecological effects of the subsidization by modern technology and the interregional transfer of commodities are not adequately evaluated. Consequently these studies are in the end mere economic/technological feasibility studies. In order to fully exploit the valuable implication of carrying capacity, I have proposed the concept of enhanced carrying capacity, which is determined by four variables: [1] natural capability of a study area to supply human society with necessary resources and receive wastes resulting from human activity; [2] intraregional human capability to work on ecological life-supporting systems in order to obtain what can meet regional human needs; [3] rate of consumption or material standard of living; and [4] level of subsidization by imported commodities. This concept is expected to serve as a conceptual framework to help regional planning achieve a viable reigon, which is ecologically sustainable and economically self-reliant.

I have suggested a region which is defined by its ecological properties and the perspective of its inhabitants, as appropriate for regional studies employing the proposed framework of carrying capacity. I have also advocated a multi-levelled view of a region and the application of this framework to several levels of a region, from the level of a small community where inhabitants are actually settled and rooted, to the level of a large

area such as Sale's ecoregions and georegions. At each level, efforts to increase self-reliance are encouraged. I have described the six major steps that compose the procedure of the proposed regional carrying-capacity study. Through these six steps, major variables are scrutinized in turn and synthesized to generate a normative image of a viable region. This study is a learning process to find a future vision of a regional economy which can be sustained ecologically and serve the regional well-being in the long run.

(2) Significance of the Proposed Framework

It seems that industrial society is not ready to accept the proposed carrying-capacity approach to regional planning. It is safe to say that the majority of people living in industrial countries are not yet ready to have second thoughts about their ways of living and consider the long-term effects of the current material affluence on the natural environment. The market system, which has traditionally neglected environmental costs, still dominates much of the economic sphere, and the myth of constant economic growth is accepted without thought among the electorate at large. This is because people have not yet adequately grasped what is really happening in ecological life-supporting systems. Although the mass media occasionally cover environmental problems in the world, these issues fail to be personalized and understood in an adequate way by the public. Under these circumstances, it is hardly surprising that people behave according to the guidance provided by the myth of Nature Benign. This set of societal beliefs is very comfortable to humankind.

Where the meaning of the recent change in the nature-human relationship, which I described in Chapter II, is not sufficiently understood, the proposed approach to achieve a viable regional economy by

restructuring the existing one is difficult to implement because of the essential difference in philosophy. First, it is difficult for this approach to obtain enough political and jurisdictional support for implementation. Second, it is not until regional residents fully understand the invalidity of the Nature-Benign myth that the proposed approach can obtain enough support to function as prescribed to achieve its goal. As seen in Chapters III and V, input by the regional population is indispensable in order to define the boundary of a study area and determine a "regionally chosen lifestyle or level of living" under a certain set of limiting conditions. When the negative effects of petroleum-subsidized technology and interregional trade on the natural environment both within and outside of the region are not understood correctly, people have little reason to be interested in economic self-reliance and ecological sustainability.

This, however, does not mean that the proposed framework of carrying capacity is unrealistic and useless in present industrial society. On the contrary, the proposed framework of carrying capacity can serve as a powerful tool for grasping ecological reality, or what is actually happening around us in the natural environment. In other words, this framework can perform an educational role in increasing ecological awareness in society by providing an alternative way of seeing the world. Even a preliminary study using this framework can reveal the ecological status of a regional economy to its residents. That is, by distinguishing the major components of the base of a regional economy, which are represented by the four variables of enhanced carrying capacity, this framework helps people directly understand how their way of living, as both producers and consumers, is sustained in

ecological terms.

The proposed framework has three strengths in increasing the ecological awareness of people who live in a region. First, it can be applied to any size of land or economy. It is supposed to generate a normative image of a viable economy that serves as guidance for restructuring an existing economy at whatever regional level it is applied. Second, this framework encourages people to consider two kinds of supplies. That is to examine regional potential to sustain humankind from the aspect of receiving wastes as well as providing necessary resources on a sustainable basis. We can no longer afford to leave regional capacity to receive waste resulting from human activity outside our consideration, as mainstream economists have traditionally done. The third strength is that the proposed framework can display a personalized image of the ecological status of a regional economy. A regional study using this framework helps regional residents obtain a solid idea about their economy in close relation to their circumstances. The framework of carrying capacity generates information about ecological reality in a familiar way so that people can understand what is happening in and out of a region in ecological terms in a personal way.

The proposed framework performs its educational role in three ways. First, it describes the ecological linkage of a regional economy with the rest of the world in such a way that regional residents can understand their ecological status in the world in a personal way. It is expected to function in a similar way as Rees' concept of "regional capsule" does. This regional capsule idea is designed as an educational tool "to stimulate users to think in new ways about the relationships between their home regions and the global environment in the context of socio-economic development alternatives."[192] Rees argues that:

> the inter-regional flow of ecological goods and services obscures the functional relationships between a given regional population and the biophysical resource base upon which it is dependent.[193]

The regional capsule concept helps people pass this perceptual bottleneck by having them assume their home regions covered by "a large plastic capsule that would pass sunlight, but not material resources,"[194] which is like McHarg's large bell jar.[195] The concept of regional capsule is elaborated in such a way that a study using this concept can perform a powerful educational role.[196] As the idea of regional capsule does, in urban regions, the application of the proposed framework will reveal their "parasitic" character to the residents. While such ecological hazards as destruction of tropical rain forests by clear-cutting and depletion of soil nutrients by monocultural plantation may sound foreign, the capacity framework helps people understand the linkage between these hazards and their daily living by clarifying how far their way of living exceeds regionally inherent capacity and how much ecological commodities are brought into their region, at the ecological cost of the supplying regions, in order to make the accounts balance. People are thus encouraged to increase their ecological awareness by being pushed to face the ecological dependence of their region upon a particular group of other regions. People are also encouraged to see how their regional resources are exploited, possibly, on an unsustainable basis, in order to maintain interregional trade balances.

Second, a proposed regional study provides an opportunity for regional residents to have second thoughts about their current way of living by showing the explicit limitation of regional carrying capacity. When limits are understood, people may begin to examine the value or necessity of what they have taken for granted. When people are informed of this kind of

limitation, they may give up meaningless gadgetry or cut wasteful energy use, even if this does not result in substantial money savings. In industrial society, people are too accustomed to the prevailing consumer lifestyle to re-evaluate its true benefits. The proposed framework thus motivates people to distinguish what is being consumed in a meaningless way from what is actually necessary for their life.

Third, the proposed framework helps regional residents recognize underutilized natural and human resources within a region. This re-discovery will inform efforts to determine a "right" way to supply what has been identified as necessary in the preceding step. A "right" way means a mode of production and waste disposal which can be regionally sustained in an ecologically sound way. For example, it may be possible to eliminate the regional consumption of petroleum as fuel by using regionally available firewood and unemployed labour. It is possible that each region has underutilized resources that have a rich potential to sustain human activity because standardized industrial technology has been extensively transferred even to rural regions without adequate consideration of its ecological and economic appropriateness. Thus a capacity study which lists regionally inherent resources and considers combinations of them will make regional residents aware of alternative modes of production and waste disposal. This will encourage a reconsideration of the current mode of production and consumption.

Environmental problems today defy technological solutions. They are rooted in the basic value system or worldview currently popular in industrial society. It is now necessary to evaluate the relevance of the dominant worldview to the present ecological reality. As seen above, the

proposed carrying-capacity framework can be employed in the effort to increase public awareness of ecological reality. All of the application of this framework should be seen as an educational process. People can learn by studying their home regions using this framework, and the result of the study has an educational value, even for those who have not been directly involved in the study. It is most important to induce arguments about what we have taken for granted concerning the nature-human relationship, if we want to proceed to a viable economy. I agree with Hammond that "[w]hile changing political parties may help, the real solution rests with changing society."[197] Where the myth of Nature Benign is still powerful, the most significant role of the proposed framework is educational, that is, to call for attention to ecological reality by providing a new way of seeing the world.

(3) Direction of Further Study

In this thesis I have described a theoretical framework based on the concept of carrying capacity. The next step will be to apply the framework to the real world and determine its strengths and weaknesses in practical use. A trial application of this framework to an existing region is expected to reveal practical problems in the implementation of the proposed approach. Efforts can then be made to modify and enhance the initial framework so that it will become more implementable in planning practice and more powerful in its educational role.

Japan may be one of the appropriate and rewarding subjects of this experimental study. Its territory is approximately 378 thousand square kilometres and is composed of four major and other smaller islands that are located at the northwest corner of the Pacific Ocean, and had a population

of approximately 120.5 million in 1985. In "bioregional" terms, that is, biogeographical and cultural, the whole territory can be regarded as a single unit, with the possible exceptions of Hokkaido[198] and the Ryukyu Islands.[199] Since there are data at the national and sub-national levels, they may be readily available for the purpose of estimating the capability of natural and human systems to sustain human beings within the country.

Japan is one of the most industrialized countries. The current mode of production and consumption is extensively dependent upon petroleum, and the country imports more than 99 per cent of the crude oil that it consumes in the 1980s. It also imports much food and forest products. The self-supply ratios of these ecological commodities vary.[200] The overall self-supply ratio of food is only about 50 per cent in terms of original calories in 1985.[201] Furthermore, the primary sector, rice and meat production, for example, is heavily subsidized by petroleum-derived chemicals and imported forage and grain.[202] The following argument is common and is widely taken for granted in the country: Japan is a small country and is poor in natural resources while the population is large; therefore the only one way to survive is to encourage further "modernization," which is virtually identical with industrialization, and then make international trade balance.

However, Japan is actually rich in water resources, and its climate is not hostile to agriculture. The country is also rich in marine and forest resources. Furthermore, the traditional accumulation of knowledge about ecological life-supporting systems is not lost. For example, traditional wisdom concerning organic fertilization is still alive in parts of the countryside. The country's total dependence upon petroleum has been established only in thirty years, and this process has left many regionally available resources underutilized. For example, the so-called fuel

revolution, a quick transition from traditional fuel such as charcoal and firewood to "modern" fuel such as petroleum and natural gas, left many forest products unutilized in community commons, and many of these commons are now left unmanaged.

If a carrying-capacity study successfully shows that how many people can be sustained at a certain level of living by the country's natural and human life-supporting systems subsidized only by ecologically acceptable international trade, the study may induce arguments concerning the national premise: self-sufficiency is totally impossible in any way. The population has expanded about four times from what it used to be at the age of seclusion that ended about 120 years ago, and returning to the material level of living at that time is definitely unacceptable to modern Japanese. Therefore, it may be true that modern Japan cannot achieve self-sufficiency. Nevertheless, the arguments about the national premise, which has been taken for granted and has sustained rapid economic growth, may provide people at large with an opportunity to recognize the country's ecological status and reconsider their way of living in an explicit way.

An experimental study can also be conducted at sub-national levels. What is interesting is that there still exists a form of local community called mura in the countryside. A mura is composed of roughly ten to hundred families and is characterized by its traditional bonds to land and spiritual ties among the members. Its boundary also represents ecological properties, especially water systems. A mura seems to serve ideally as a unit to be studied in carrying-capacity analysis. It can represent the small world of the local community that I described as a meaningful subject of capacity studies in Chapter V. Today heavy use of machinery and pesticides largely results in economic disaster and ill health of farmers in

a farming mura.[203] Although it is true that mechanization and use of pesticides have substantially lightened farmers' labour, it is now necessary to re-evaluate the result of modernization. A carrying-capacity study may help this evaluation and re-orientation of the mode of production.

Japan is a typical industrial country living at the ecological sacrifice of its own environment and many other resource regions in the world. An experimental carrying-capacity study at the national level may provide people with some motivation to start thinking about their way of living and national economic policy, for example, in ecological terms and thereby contribute to increasing ecological awareness in society. An application of the proposed framework to an existing mura may result in substantial re-orientation of the mode of production and consumption especially where the negative effects of modernization are well recognized. Also at the level of mura, the proposed carrying-capacity study will perform its educational role by providing an alternative way of seeing the world. If a substantial number of people begin to have even a slight doubt about what they have taken for granted, it means that a great starting step leading to transforming the existing economy into a viable one has been taken.

NOTES

[1] Holling (1978), pp.97-98. (Bracketed insertion added.)

[2] Holling (1978), pp.97.

[3] Holling (1978), p.99. (Bracketed insertion added.)

[4] Holling (1978), pp.99-100.

[5] Holling (1978), p.101. (Bracketed insertions added.)

[6] Holling (1978), p.101.

[7] Holling (1978), p.101. (Bracketed insertion added.)

[8] Holling (1978), pp.104-105.

[9] Holling (1978), p.99.

[10] Holling (1978), p.101.

[11] Hashiura (1969), pp.255-257.

[12] Nishiwaki and Sakurada (1958), pp.383-384.

[13] These assumptions are not always true in the history of whaling. For example, stocks of right whales, which are smaller and slower than blue and fin whales, were depleted in the north Atlantic well before the 1860s, when explosive harpoons and steam-powered whalers were introduced. See Miller and Armstrong (1982), p.436. Also in Japan, it was recorded that a whale stock at Miura, Kanagawa was depleted in twenty-five years in the early seventeenth century. See Hashiura (1969), p.200.

[14] Howard and Perley (1980), p.15.

[15] Howard and Perley (1980), pp.43,47.

[16] Brown devotes a whole chapter to each of these three problems. See

Brown (1981), chs.2-4.

[17] Brown (1981), pp.6-7.

[18] For example, see Johannes (1982) for traditional fishing customs in the tropical Pacific islands.

[19] As for power generation by nuclear fission, I regard it as part of the technology subsidized by fossil fuel. In every way nuclear power generation is subordinated to petroleum. That is to say, nuclear power generation, from the extraction and concentration of uranium to the treatment and storage of nuclear waste, is impossible without the subsidization of petroleum. It cannot save fossil fuel. Murota (1979: pp.72-81) argues that nuclear power generation is a highly petroleum-consumptive technology and shows that it is not always more efficient than thermal power generation in terms of petroleum as input by calculating energy cost of power generation by nuclear fission.

[20] Murota (1982), p.54.

[21] Murota (1982), pp.54-56.

[22] Tsuchiya (1981), pp.114-116.

[23] Based on the information given by Tsuchiya (1981), p.33.

[24] Based on the information given by Tsuchiya (1981), p.114.

[25] Murota (1982), pp.81-83.

[26] Murota (1982), p.83 and Niimi (1985), pp.164-165.

[27] Catton and Dunlap (1980), pp.17-18.

[28] Sale (1985), p.50.

[29] Friedmann and Weaver (1979), p.172.

[30] Friedmann and Weaver (1979), p.129.

[31] Shimazu (1977), p.100.

[32] Shimazu (1977), pp.101-102.

[33] Shimazu (1977), pp.112-116.

[34] Shimazu (1977), pp.145-146.

[35] CCRD (1976), p.60.

[36] Henderson (1978), p.21. (Emphasis in original.)

[37] CCRD (1976), p.63.

[38] Schumacher (1973), p.11. (Bracketed insertion added.)

[39] Schumacher (1973), ch.3.

[40] See Howard and Perley (1980), especially ch.7, for how reluctant such companies as International Nickel Company (Inco) have been to take an action for environmental improvement. Inco is known for its Superstack in Sudbury, the world's greatest single source of sulphur dioxide. It is true that Inco has substantially reduced sulphur dioxide emissions. For example, it reduced the emissions from 5,000 tons per day in the mid-seventies to 3,600 tons in 1978. However, its emissions in 1978 were still far higher than the amount (750 tons) permitted by a provincial government order. See Weller (1983), p.22. Weller (1983: p.24), after reviewing the cases of Inco, Noranda Mines Limited, Ontario Hydro and Cominco Limited, concludes that "[o]nly in a very limited number of cases have companies responded [when identified as a source causing an environmental problem] by utilizing or eliminating the pollutants. In instances where control orders have been instituted, companies have responded with the well worn argument that job losses and unbearable economic hardship for the company will result." (Bracketed insertion added.)

[41] Schumacher (1973), p.97.

[42] Simon and Kahn (1984), pp.14-15.

[43] Simon and Kahn (1984), p.14.

[44] Henderson (1978), pp.29,31.

[45] Henderson (1978), pp.172-173.

[46] In Conditions of Economic Progress [the first edition was published in 1940, and the book was rewritten in 1951 and 1957], Clark examined productivities in "primary," "manufacturing," and "service" industries (chs.V-VII). The definitions of these three subdivisions of the economy appear at the beginning of the corresponding chapter. In the chapter on the distribution of labour (ch.IX), he reintroduced the generalization that "as time goes on and communities become more economically advanced, the numbers engaged in agriculture tend to decline relative to the numbers engaged in manufacture, which in their turn decline relative to the numbers engaged in services" (p.492). Foote and Hatt further developed the argument about the shift of labour force by breaking down Clark's service industries into tertiary, quaternary and quinary sectors [Foote and Hatt (1953): the definitions of the newly created three sectors appear on p.365]. If industrialization is identified with modernization and social/economic progress, the shift of the labour force from primary sector to its deriving sectors can be regarded as an indicator to show how "advanced" a particular economy is.

[47] Bell (1973), pp.14-17.

[48] For example, see "General Schema of Social Change" given by Bell (1973), p.117.

[49] Especially, Bell (1973), ch.3.

[50] Brown (1981), p.350.

[51] Brown (1981), p.366.

[52] For example, see Henderson (1978), pp.21-23,116,266, and Brown (1981), pp.365-369.

[53] Trist (1967), p.9.

[54] Goulet (1971), p.155.

[55] CCRD (1976), p.60.

[56] Omo-Fadaka (1978), p.63.

[57] Omo-Fadaka (1978), pp.58,61,64,65.

[58] Clavel (1983), p.7.

[59] Clavel (1983), p.7. In Opposition Planning in Wales and Appalachia, Clavel examines the role of planning in his "first kind of regionalism," scrutinizing two cases, Wales and Appalachia, which remain "poor regions within rich countries" despite their early coal-related development.

[60] IUCN (1980), sec.4.

[61] IUCN (1980), secs.1,7.

[62] IUCN (1980), sec.7. (Gothicized in original.)

[63] IUCN (1980), sec.7.

[64] By 'a lesser extent,' I mean that rural areas have not yet gone so far into petroleum dependence. For example, rural areas would likely survive even if petroleum abruptly became unavailable while urban areas could not avoid a total breakdown.

[65] IUCN (1980), "Foreword."

[66] IUCN (1980), "Foreword."

[67] Slocan Valley Community Forest Management Project [hereafter, Slocan Project] (1976), p.iii.

[68] Slocan Project (1976), p.4.41.

[69] Slocan Project (1976), p.1.1. (Bracketed insertions added.)

[70] Slocan Project (1976), p.iii.

[71] Slocan Project (1976), p.iii.

[72] Slocan Project (1976), p.iii.

[73] Slocan Project (1976), p.iv.

[74] Slocan Project (1976), p.iii.

[75] Sec.III "The Existing Situation" describes detail on the existing problems.

[76] Slocan Project (1976), pp.4.43-4.45.

[77] Slocan Project (1976), p.2.42.

[78] Slocan Project (1976), p.4.42.

[79] Slocan Project (1976), pp.xii-xiii. (Emphasis in original.)

[80] Slocan Project (1976), p.3.36.

[81] Slocan Project (1976), p.3.48.

[82] For detail, see Slocan Project (1976), sec.3.4, "Environmental Impact."

[83] Slocan Project (1976), p.3.51.

[84] Slocan Project (1976), p.5.7.

[85] Slocan Project (1976), p.xii.

[86] Slocan Project (1976), pp.xi-xii. The insufficiency in management budget (for example, understaffing of management personel) is well illustrated by the comparative analysis presented on pp.3.7-3.10.

[87] Slocan Project (1976), p.3.7.

[88] Slocan Project (1976), pp.3.1-3.6.

[89] Slocan Project (1976), p.xi.

[90] Slocan Project (1976), p.xii.

[91] Sec.II "History" is devoted to the description of the valley's history.

[92] Slocan Project (1976), pp.2.26-2.40.

[93] Slocan Project (1976), pp.2.23-2.24.

[94] Slocan Project (1976), p.xii.

[95] Sec.IV "The Proposed Situation" is a report of this research on the life-supporting capabilities of the valley.

[96] Slocan Project (1976), p.xii.

[97] I referred to the four basic assumptions given on p.xiii.

[98] For detail, see sec.V "Recommendations."

[99] Slocan Project (1976), p.i.

[100] Slocan Project (1976), p.i.

[101] Shadrack (1981), p.142.

[102] Shadrack (1981), p.142. (Emphasis in original.)

[103] Shadrack (1981), p.142. (Bracketed insertions added.)

[104] Shadrack (1981), p.141.

[105] Slocan Project (1976), p.i. (Emphasis in original.)

[106] Slocan Project (1976), p.ii.

[107] Slocan Project (1976), p.i.

[108] For further detail about the Slocan Valley Watershed Alliance, see Hammond (1986), pp.8-9.

[109] Based on the information given by Hammond (1986), pp.8-9.

[110] Hammond (1986), p.9.

[111] Hammond (1986), p.8-9.

[112] Aberley (1985), p.210.

[113] Aberley (1985), p.210.

[114] Slocan Project (1976), p.i.

[115] According to Department of Industrial Development (1976: p.244), in 1971, the average household income of the valley community was $6,502, and more than half of the households were with incomes below $5,000. The

average in the Central Kootenay Region was $7,676, and that in the whole Kootenays was $8,674.

[116] Slocan Project (1976), p.4.1.

[117] Slocan Project (1976), p.4.1.

[118] Slocan Project (1976), pp.xi,5.36.

[119] Slocan Project (1976), p.xiii.

[120] Slocan Project (1976), pp.5.1-5.2.

[121] Slocan Project (1976), p.4.1.

[122] Hanson (1972), p.48.

[123] Grescoe (1973), p.3.

[124] According to Lyon (1976: p.48), the town's labour turnover was 58 per cent a year.

[125] Grescoe (1973), p.3.

[126] Hanson (1972), p.48. (Bracketed insertions added.)

[127] For reviewing the case of Ocean Falls, I referred to Hanson (1972), Grescoe (1973), Lyon (1976) and Bolan (1985).

[128] The mining booms did not leave accumulated wealth nor matured industries, though it did leave depleted mineral veins and ghost towns. Innis (1935: p.256) describes the end of the mining boom around the turn of the century as follows: "Many mines were closed as a result of the 'short-sighted policy of gouging out all available ore and neglecting the proper development in advance of further ore bodies.'"

[129] The mining history with the two peaks in 1905 and 1917 has been dominated by market prices, which are determined largely in transactions outside the region. For detail, see Slocan Project (1976), pp.2.23-2.24. According to Department of Industrial Development, Trade, and Commerce (1970: pp.19-26), "exploration and production are very sensitive to changes

in metal prices," and, when the H.B. Mine operated by Cominco Ltd. was closed in 1966 because of company policy, the residents could do nothing despite its significant impact on the regional economic well-being.

[130] Slocan Project (1976), p.5.22. The authors state that the mill "would be able to buy this material [from the proposed rural woodlots] or trade the local residents for products. At the present time one local trucker is hauling over 70,000 board feet of lumber a week into the Valley as a service to those people unable to buy wood in the community. . . . Our mill would help solve this dilemma by providing a wide range of products at a reasonable price while creating jobs at the same time." (p.5.22. Bracketed insertion added.)

[131] Slocan Project (1976), p.4.52. (Italicized in original. Bracketed insertion added.)

[132] Slocan Project (1976), p.4.49.

[133] Slocan Project (1976), p.4.50.

[134] See Odum (1971), pp.186-187.

[135] See Odum (1971), p.188.

[136] Ehrlich, Ehrlich and Holdren (1977), p.104.

[137] Putman and Wratten (1984), p.130.

[138] Odum (1971), p.183.

[139] Ricklefs (1976), p.247. (Emphasis in original.)

[140] Ricklefs (1973), p.504.

[141] According to Rees (1977: pp.4,6): "Obviously if the demands of a population exceed the carrying capacity of the environment, negative feedback (e.g., malnutrition and disease) will operate to reduce its numbers. Thus, carrying capacity is simply an operational term for the 'limits to (population) growth.'"

[142] Hardin (1968), p.1244.

[143] Godschalk (1974), p.331.

[144] Willard (1971), p.118.

[145] Willard (1971), p.119. (Bracketed insertion added.)

[146] For example, Brandborg (1963) presents the idea of "use capacity" of a wilderness area, and warns an "over-burden of public use" of wilderness areas, which may result in destruction of the qualities of wilderness. In this article, the concept of carrying capacity is used as an explicit limitation inherent to an area which "should not be exceeded."

[147] For example, Jaakson (1971), who applies the capacity notion to lake planning, presents the idea of zoning for on-water recreation. His way of zoning, which is based on the assessment of [1] physical characteristics of the area under study; [2] characteristics of each human use such as swimming and water skiing; and [3] ecological requirements to maintain the lake environment, appears very similar to the methods employed in carrying-capacity approaches to urban and regional land-use planning. Stankey (1972), who develops the notion of sociological carrying capacity in the context of wilderness management (a schematic presentation is available on p.99), is another example. Socially determined capacity is usually a crucial factor in carrying-capacity studies for regional growth management.

[148] Schneider et al. (1978), p.1.

[149] Godschalk (1974), p.331 and Godschalk (1977), p.11.

[150] Godschalk (1974), p.331.

[151] Rahenkamp and McLeister (1977), pp.13-14.

[152] See Schneider et al. (1978), pp.8-9, and Odell (1974), pp.26-28.

[153] Schneider et al. (1978), p.10.

[154] Schneider et al. (1978), p.10.

[155] Schneider et al. (1978), p.10. (Bracketed insertion added.)

[156] Odell (1974), p.26. (The first sentence italicized in original.)

[157] Simon and Kahn (1984), p.45.

[158] Brown (1980), pp.92-93.

[159] Brown (1980), p.93.

[160] Brown (1980), p.18.

[161] Brown (1980), P.18.

[162] Brown (1980), p.103.

[163] Shinohara (1986), p.120.

[164] Rees (1986), p.4.

[165] Brown (1980), p.18. (Bracketed insertion added.)

[166] Simon and Kahn (1984), p.2.

[167] Godschalk and Parker (1975), p.162.

[168] Nieswand and Pizor (1977), p.8.

[169] I developed the idea of region's intrinsic capability to accommodate human beings, helped by a visual image of Rees' (1977: pp.7-14) regional capsule and McHarg's (1969: p.98) large bell jar.

[170] I developed this idea based on Rees (1977), pp.4,6-7. According to Rees (1977: pp.6-7), "we have the potential to regard population as a function of desired "quality of life" (including material standard of living) and technological sophistication (ability to increase production and limit adverse environmental impact)."

[171] Slocan Project (1976), p.1.2.

[172] Slocan Project (1976), p.1.2. (Italicized in original.)

[173] Slocan Project (1976), pp.5.3,5.5-5.7.

[174] Berg and Dasmann (1978), p.218.

[175] Berg and Dasmann (1978), p.218. (Bracketed insertion added.)

[176] Sale (1985), pp.55-56.

[177] Sale (1985), p.59.

[178] Dodge (1981), p.6.

[179] Aberley (1985), p.208.

[180] Sale (1985), pp.56-57.

[181] Sale (1985), pp.57-58.

[182] Sale (1985), pp.58-59.

[183] Slocan Project (1976), p.4.1. (Emphasis added.)

[184] Murota (1979), pp.60-61. A diagram is given on p.168.

[185] Bookchin (1982), p.45.

[186] Schneider et al. (1978), p.2.

[187] I use the term "an area's perceived capacity" because industrialization often results in reducing the land's productivity by inducing environmental pollution and resource depletion. This enhancement may not be sustained in the long run. If this is the case, this enhancement should not be regarded as an increase in the area's carrying capacity.

[188] Okui (1986), p.11.

[189] Rees (1977), p.8. (Bracketed insertion added.)

[190] See Nieswand and Pizor (1977).

[191] Some people may believe that we can duplicate natural life-supporting systems, for example in space-colonies, and thereby become decoupled from the bioshpere. This technocratic solution, however, can be only made possible at a tremendous ecological expense, that is, it requires massive consumption of natural resources and hazardous discharge of pollutants and waste heat into the natural environment. I believe that the

planet's environment cannot afford such a huge expense, and therefore this solution can save only a tiny fraction of the global population, if at all, not every one of us.

[192] Rees (1986), p.1.

[193] Rees (1986), p.2. (Emphasized in original.)

[194] Rees (1986), p.5.

[195] McHarg (1969), p.98.

[196] For detail, see Rees (1986).

[197] Hammond (1986), p.9.

[198] Hokkaido, one of the four major islands, is located to the north of the rest and its climate including fauna and flora is slightly different from that of the rest. This is where the people called "Ainu," which means "people" in their language, had until recently lived a subsistence life. The immigration of the Japanese, who dominate the island today, began about a century ago.

[199] The Ryukyu Islands with Okinawa as the main island are to the south of the four major islands. Since the Ryukyu Islands are located in the warm Japan Current, they share a unique climate. The people in these islands have developed their own culture, and they kept an independent kingdom until it was conquered by one of the feudal lords of Kyushu, one of the four major islands, in 1609.

[200] According to the Ministry of Agriculture, Forestry and Fishery, in the fiscal year of 1984 (April 1984 - March 1985), self-supply ratios (the amount of domestic production divided by the amount of domestic consumption and multiplied by 100) are as follows: cereals 34 (rice 109, wheat 12, barley 15, rye 105, minor cereals 0); potatoes 97; beans 9 (soybean 5, others 47); vegetables 95; fruit 73; meat 80 (beef 72, pork 84, chicken 93,

whale meat 48, others 2); eggs 99; milk and dairy products 86; fishes and shellfishes 104 [in the fiscal year of 1980]; sea plants 75; sugar 33; oils and fats 29 (vegetable oil 7, animal fats 94) [in 1980]. (Taken from Ueda (1986), p.823.) According to the Ministry of International Trade and Industry, Japan imported 64.4 per cent of wood consumed in the country in 1983. (Ueda(1986), p.803.)

[201] Ueda (1986), p.219.

[202] As for rice production, labour efficiency increased about 2.5 times from 1950 to 1975. On the other hand, fossil-fuel-related inputs increased dramatically. For example, the use of machinery increased 11.6 times per unit of land in terms of consumed energy. The consumption of fertilizers and pesticides/herbicides also expanded 4.1 times and 32.5 times, respectively. (Based on the data given by Tsuchida (1981), p.29.) Tsuchida (1981: p.30) argues that it is misleading to say the self-supply ratio of rice exceeds one hundred per cent in Japan because rice is a commodity that is produced by the heavy subsidization of imported petroleum. As for meat production, the self-supply ratio of forage and grain was about 30 per cent in 1985. For the purpose of producing milk and dairy goods, this ratio was less than 20 percent. See Ueda (1986), p.219.

[203] For example, Shiina (1978: pp.14-17) argues that in many cases mechanization has resulted in kikaika-binbo (mechanization poverty) and thereby forcing farmers to work far away from home during winter, and that use of chemical fertilizers and pesticides/herbicides has resulted in not only degrading natural fertility of farm land but also causing physical and mental disorder in humans. According to Ogushi (1972: pp.25-28), about fifty farmers were killed by chemical poisoning every year in the 1960s and the early 1970s (excluding suicides), and 23 to 31 per cent of the

interviewed farmers claimed that they had experienced physical disorder when or after sprinkling pesticides/herbicides in Nagano and Fukui Prefectures.

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