Integrated Environmental Planning
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CHAPTER 2

Defining the Environmental Approach

The environment conveys many different meanings in planning. At one level the natural environment supplies the land required to accommodate growth and development. At another, the environment describes a set of resources to draw from and conserve. At still another level, the environment defines a series of natural functions to be maintained, hazards to be avoided, and opportunities to be exploited. Finally, there is the view of the natural environment as an all-encompassing entity that simply exits not as a passive feature there to serve human needs, but as a set of active processes that define a behavior and establish patterns that interact with and redirect human trajectories. The complexities, conflicts, and contradictions inherent to these contrasting explanations of the term "environment" present a challenge to planning and force the planner to look beyond the immediate dictates of land markets and the goals motivating economic growth. The environment demands wider consideration of all the relevant factors that drive planning and shape the landscape.

It was the recognition nearly four decades ago that wider environmental considerations needed to be incorporated into plan-making that contributed to the evolution of environmental planning. Today that recognition remains a top priority, and continues to broaden the scope and purpose of environmental planning and the role the environment plays as a decision criterion in the planning and development process (Honachefsky, 2000; Leitman, 1999). To appreciate the significance of environmental planning as both a school of thought and a professional practice, we need to explore precisely what it means, what differentiates this approach from the more traditional forms of land use and urban planning, and how one performs planning according to this theory.

The nature of environmental planning

If we take all the various definitions of planning offered in the previous chapter and assemble them into one simple statement, we can characterize the purpose of planning as the process of allocating functions to their appropriate spatial location. So stated, this basic explanation poses a question that provides an important point of departure from traditional planning approaches and suggests room for an alternate strategy. Looking carefully at the definition offered above, the notion of allocating functions to an appropriate spatial location asks us to consider what is meant by the word appropriate. In the majority of instances, our response to the question would center around a set of common decision points: economic rationality, efficiency in the provision of services, accessibility with respect to population, attractiveness in relation to amenity or aesthetic qualities, feasibility considerations with respect to engineering and construction concerns, and acceptability given the local political landscape. Using these decision points, a site becomes appropriate for a given development proposal when it falls comfortably within established parameters for categorizing each criteria as such. Of course, there are alternative definitions of the term "appropriate," and one critical definition absent from the above is an environmental definition. Consideration of appropriateness from an environmental perspective opens a gap for environmental planning to fill.

Utilizing an environmental rationale, appropriateness directs us to consider, in addition to those criteria listed above, the **compatibility** of the proposed function within the fabric of the ecological system, its **suitability** in relation to the physical and environmental qualities of the site, its **susceptibility** with regard to the potential environmental impacts, and its **sustainability** as explained relative to the long-term functioning of environmental processes and the maintenance of environmental integrity. These considerations and alternative views of the concept create the need to maintain balance between the productive use of the land and natural resources and the maintenance of ecological functioning. Approaching this balance and recasting "appropriateness" considerations with greater emphasis on environmental criteria is the fundamental goal of environmental planning.

While a succinct definition may be elusive, environmental planning as an activity involves the use of biophysical and sociocultural information to suggest opportunities and constraints in relation to land development in a manner that seeks to explain the fitness of the environment to support a given function. A more comprehensive definition of the concept has been offered by Baldwin (1985). According to Baldwin, environmental planning may be defined as the initiation and operation of activities to direct and control the acquisition, transformation, distribution, and disposal of resources in a manner capable of sustaining human activities with a minimum disruption of physical, ecological, and social processes. Although definitions will vary, the environmental approach to planning seeks to explore economic growth alternatives that are socially and environmentally sustainable.

The overriding goal of environmental planning involves balancing human needs *with* the dynamic properties that constitute the environment. In fact the concept of balance is so central that is rests at the core of everything the environmental planner does (Holling, 1978; Westman, 1985; Margerun, 1997). However, balance is a difficult quality to achieve for a variety of reasons, and thus remains a challenge that propels the evolution of this form of planning (Baldwin, 1985). The factors that frustrate the balancing of human needs with environmental quality include:

- The complexity and interrelatedness of environmental problems and solutions.
- The evolving nature of environmental planning knowledge.
- The frequent omission or discounting of environmental goods and services during conventional value analysis.
- The difficulty of achieving environmental goals that require significant changes in lifestyle.
- The conflict between environmental goals and community development goals.
- The difficulty in establishing environmental priorities and defining trade-offs.
- The lack of consistent commitment of resources to environmental programs.
- The general lack of information and support tools needed for sound environmental decision-making.

While achieving such balance is a challenge, environmental planning theory and practice has produced a variety of approaches to the formulation and implementation of solutions to meet that challenge. Each approach reflects a particular philosophy or mode of analysis regarding the environment and how environmental problems may be conceptualized, defined, studied, and solved (Briassoulis, 1989). To begin this discussion of environmental planning strategies, it is instructive to first review the philosophical foundations that influence environmental planning thought.

Philosophical antecedents

Environmental Planning describes a specific set of views strongly influenced by a lineage of ideas, beliefs, and values that color our present-day perceptions and practices. The evolution of modern environmental thinking has been examined extensively by Pepper (1984) and Ortolano (1984). From these reviews we can conclude that our web of environmental beliefs takes shape based on a set of some very fundamental principles (Buchholz, 1993):

1. **Conservation as the efficient use of resources** – this principle recognizes that using the natural environment to satisfy material needs is a necessity. However, resources are scarce and consideration must be given to their efficient use and the minimization of waste.
2. **Maintenance of harmony between people and nature** – the impact of human actions on the environment forms the basis for this ideal. As human activities introduce disruptions that effect natural systems, there is a need to maintain balance between people and nature and preserve the integrity of natural systems.
3. **The environment as spiritual renewal** – the beliefs expressed under this heading define the environment in moral, religious, and aesthetic terms. Taken together, these ideas characterize the environment as an entity possessing ethereal qualities that are worthy of preservation and protection simply because they exist. While these beliefs may be seen purely as philosophical argument, they are deeply ingrained in cultural values and suggest that the environment is seen as more than a source of resources, but also a source of renewal, recreation, and amenity.
4. **Natural rights and the shared existence of humans and nature** – the ideals expressed here identify the belief that natural objects and nonhuman animals enjoy "rights" that ensure their existence and survival. Central to this set of environmental beliefs is the idea that humans "share" the environment and are bound by an ethic that should influence the way we make choices that will affect whether or not the biotic community will remain a viable habitat apart from human occupation.

These ideals form the basis of our environmental consciousness and serve as the foundation for understanding contemporary environmental attitudes. Although when one is confronted with an environmental problem a combination of ideas and attitudes will be expressed, the voices of concern typically align themselves with positions

- that hold to principles of conservation and the wise use of resources;
- that maintain the need to control human actions and reduce irreversible impacts on natural systems;
- that ascribe aesthetic and spiritual qualities to the environment;
- that appeal to ethical principles calling for restraint on human actions that adversely affect the environment.

Perhaps the most significant aspect of our environmental web of belief is that it is subject to change and made complicated by variations in personal backgrounds, perceptions, and values. Presently, the dominant environmental paradigm views all environmental issues in a global context rather than expressing them within a regional or local framework. At this global scale, environmental questions are highly interrelated, foster collective action, and involve much broader agendas than simply those of economic expansion. Thus while the contrasting expressions that define environmental thinking may appear confusing, the underlying concerns on which they are based have been translated into ethical norms and governmental policies that guide the way decisions affecting the environment are made (Ortolano, 1984).

From an exclusively human-centered orientation, decisions affecting the natural environment couch the problem of selecting among alternatives in terms of one of several evaluative strategies. Several of the more relevant to environmental planning have been examined by Ortolano (1984) and include:

- **Utilitarianism** – a decision-making framework based on estimates of the beneficial and harmful consequences of a policy to society as a whole. The principle of utilitarianism is based on the premise that decision-makers should select that alternative that produces the greatest net balance of beneficial over harmful consequences to society. Adopting a utilitarian perspective wil encourage judging an action entirely by its outcome to society in total. This approach carries the implicit assumption that harmful and beneficial consequences of an action can be predicted and evaluated in terms that can be equated with a net effect that provides evidence that satisfactorily weighs benefits against costs.
- **Cost/benefit rationale** – a more formal adaptation of the utilitarian strategy. The significant departure of cost/benefit decision-making is based on defining beneficial and harmful consequences in monetary terms. Accordingly, social benefits of an action are expressed relative to the amount of money individuals would be willing to pay to obtain the beneficial consequences, while the social costs are measured in relation to the opportunities society gives up when its resources are used to implement the proposed action. To the decision-maker the criterion for choosing among alternatives simplifies to the selection of that alternative with the greatest numerical difference between monetary benefits to costs. The principal limitation with this approach and a continuing source of controversy frustrating its application centers around the problem of (1) equating human actions in monetary terms, and (2) relating those actions to intangible environmental qualities. This has contributed to the use of qualitative comparisons that enable a more systematic evaluation of alternatives (Swartzman, Linoff, & Croke, 1982).
- **Equity distribution** – applies principles of fairness to decisions affecting environmental quality. Equity distribution is concerned with the just allocation of benefits to costs and attempts to reconcile the disparity that while some individuals enjoy environmental benefits others must incur a disproportionate level of costs. Although the concept of fairness has received increased attention, the analysis of equity issues is frequently confounded by problems in measurement and by concept inconsistencies.
- **Rights to a habitable environment** – as a basis for decision-making, this approach directs the decision-maker to consider whether an alternative will affect the moral rights of humans and other living things to an environment that they can exist within. In this context, a moral right is one that is independent of any legal system and is based more on moral norms than legal definitions. While the notion that humans have a right to a livable environment may seem self-evident, extending this principle to include a wider interpretation of habitat directs the decision-maker to consider alternatives based on their ability to maximize the viability of habitat for the range of species that may be affected.
- **The context of future generations** – no other concept cements environmental thinking as much as the question of future generations. Because planning decisions frequently set into motion a series of irreversible and irretrievable commitments of land and other resources, the context of future generations directs the planning problem beyond the immediate concerns of the present and forces consideration of the implications of a decision that may (1) foreclose on future options or (2) introduce risks that future generations will have to confront. While the question of whether future generations have a moral right to an environment that has not been depleted of its resources remains in debate, the idea that each generation is a trustee of the environment for succeeding generations has placed an important role in shaping environmental policies (Smith, 1995).

The strategies identified above, together with the primary avenues of thought pertaining to the environment, remind us that the environmental planning problem can never be addressed on the basis of a single set of principles or an individual point of view. Depending on the situation and the factors involved, utilitarian cost–benefit approaches might form a dominant rationale for decision-making, while at other times questions related to fairness and individual rights may influence the path we follow. Yet, in environmental planning we bring to the decision an environmental perspective that places emphasis on maintaining balance between human need, environmental sustainability, and efficiency, along with an approach to planning firmly grounded in ecological principles.

The inclusion and consideration of ecological principles in planning and the decision-making process is the distinguishing characteristic that separates environmental planning from other expressions of the planning model. Ecological and environmental science is so central to this form of planning that it can be easily forgotten in professional practice. Nevertheless, to understand environmental planning theory, ecology, and the natural factors and principles that guide the environmental approach demands detailed examination and review.

Ecology's niche

The role of ecology in environmental planning and management is widely recognized. Examples of the work undertaken to demonstrate and refine the connection between ecology and planning include McHarg (1969), Park (1980), Steiner (1991), Westman (1985), and, most recently, Archibusi (1997). A common theme in this literature is the treatment of ecology not as science in its purest sense, but rather as a metaphor for synthesis. Ecology suggests a bringing together of elements into one combined system whose functioning takes on discernable patterns we recognize as the world we live in. This preoccupation with synthesis is not to discount the science of ecology, yet in planning the science is applied in a somewhat different way; as a language of design as well as one of description and explanation.

Ecology, by definition, is concerned with the study of the structure and function of organisms and their environment. As a science, ecology seeks to explain the interrelationships between living organisms and their environment and how they interact. This traditional view of ecology as the science of living things in relation to their environment provides the connection to the environmental planning problem and identifies ecology's major contribution to the management of the environment. When discussing the planning problem, we identify the need for planning as a response to the complexity and interrelatedness inherent to the landscape. The planning process was designed to manage that complexity and provide an avenue to direct understanding of how factors relate within the context of a given problem. Managing complexity and forming this fundamental understanding of relatedness does not occur in the absence of an organizing body of knowledge and theory. Ecology lends that knowledge and offers its theories to help support the environmental planning approach. Hence, through the lens of ecology we look at the planning area as a functioning "organism" and those things that comprise the planning area (people, houses, trees, water, etc.) all play a role.

As a science, ecology proceeds at three levels (Buchholz, 1993):

1 The individual organism.
2 The population identified as individuals of the same species.
3 The community composed of several populations.

At the level of the organism, the goal of ecology is to explain how individuals are affected by, and how they affect, their environment. At the population level ecology strives to describe the trend and fluctuations of a particular species and the factors that influence its presence or absence. When attention is directed at the community level, ecology seeks to define the structure and composition of communities and the processes that influence their living and nonliving elements. Translating these levels of analysis into the context of planning produces a model that can be used to examine the implications of an alternative and a strategy that can be used to frame our thinking with respect to

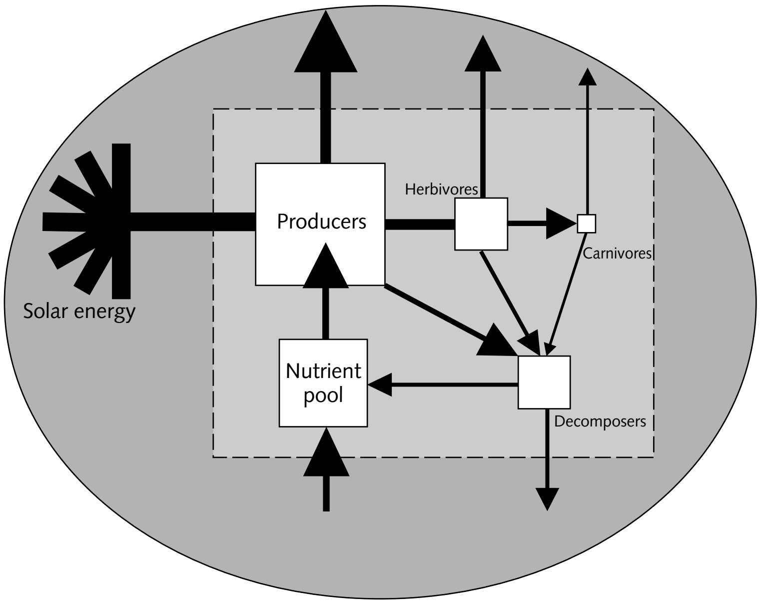

Fig. 2.1 Generalized character of terrestrial ecosystems.

the relationship between a plan and the levels of the environment that a plan may effect.

Perhaps the most important construct borrowed from ecology is the concept of an ecosystem. The ecosystem applies the logic of systems analysis to explain a device for organizing the complexities and connections that define the environment. To the ecologist, the ecosystem is the basic functional unit that incorporates organisms, populations, and communities together with the causal mechanisms that define the relationships, interdependencies, and pathways that direct energy flow and control the properties of the system. Taken into the realm of planning, the ecosystem concept can be used to form a root definition of the planning area, its living and nonliving elements, the relationships that connect them into a functional form, and the processes that govern their behavior. In ecology, it is common to consider the ecosystem as a complex of both biotic and abiotic components dependent either directly or indirectly upon the input of solar energy. The input of energy into the system produces a flow as it moves from one component of the system to the next. This flow establishes critical cycles of matter and energy that sustain ecosystem structure and complexity in a dynamic balance over time and space (Fig. 2.1).

Applying the ecosystem concept to the planning problem makes it possible to adapt a functional view of the landscape and structure elements of the problem into a representation that facilitates basic understanding of how things in the planning area fit together, what processes are actively influencing their structure, and how they change or modify over time. Using such a representation schema, we can explain the natural environment and characterize pathways that connect human processes to the natural system. The ecosystem framework further allows the planner to explore the dynamics of the environment using a process orientation that focuses attention on the flows or matter, energy, and resources through the system and permits definition of their direction and magnitude. This facility is perhaps the most significant quality of the ecosystem concept when used as an organizing framework in planning, simply because it enables the analysis of change to be grounded in an observable and measurable construct.

Using the ecosystem as an organizing structure with human activities embedded in it, and dependent upon it, the planner can trace the consequences of human actions on the model, describe the implications of human-induced change on the overall balance of nature, and assess the quality and stability of the environmental system. Functional stability introduces two valuable features of the ecosystem that help to frame the environmental planning approach: (1) self-maintenance and (2) self-regulation. Ecosystems maintain a dynamic equilibrium through a complement of self-maintaining and self-regulating strategies. As a consequence, ecosystems are constantly adapting and adjusting to natural fluctuations and perturbations that will influence community structure and composition. When human intervention is introduced, changes can be produced that create forms of stress that self-regulating and maintaining strategies cannot compensate for or adapt to. In these instances, the community can become threatened or critical functions can become "disorganized." This dynamic element of ecosystem development must be carefully understood by the planner, since it explains the principal source of conflict between the human-centered goals encouraging maximum productive use of the environment and the natural systems strategy of maximum support of complex ecological structures. Reconciling this conflict is the underlying purpose of environmental planning. However, to achieve reconciliation certain ecological principles must be incorporated into the foundations of the plan.

Guiding ecological principles

Environmental planning differs from other planning approaches by its inclusion of environmental factors into the decision-making process. However, planning with the environment, rather than against the environment, requires a sensitivity to the natural laws and principles that direct environmental functioning. It also requires a willingness to incorporate those laws and principles as a basis for design (McHarg, 1969). Planning in accordance with the principles and laws of ecology becomes one means to minimize the entropic effects of human development while encouraging greater balance between social progress and environmental process. The rationale for adopting these principles as planning guidelines is based on some very simple observations:

- Opportunities to develop and inhabit new areas have diminished.
- Development is increasingly directed toward areas or greater environmental sensitivity and constraint.
- Resources used to support the future will likely originate in environmentally sensitive areas where the costs and risks are greater.
- Postindustrial societies have become less willing to accept the social costs of growth and development.
- Greater consideration is being given to alternative and more sustainable forms of development at local, regional, and global scales.

Given these realities, connecting planning with the physical laws that govern the ecosystem further erodes the notion that human and environmental systems can be treated as non-interacting entities. By explaining these laws and principles in general terms it becomes possible to apply them and to demonstrate how they may exert a controlling influence on the scale and magnitude of human activities.

The laws and principles that direct environmental planning can be summarized and discussed under three major divisions: (1) primary physical laws, (2) laws of the biosphere, and (3) unifying ecological principles.

1 Primary physical laws

The relationship between energy and ecosystem maintenance can be explained in part by the fundamental laws of physics. Among the more germane to environmental planning are the law of conservation of matter, and the first and second laws of thermodynamics. The law of conservation of matter simply states that matter (mass) can neither be created nor destroyed, but merely changes from one form to another. To the environmental planner this suggests that materials are never really "produced" or "consumed." They change in form from raw materials and products to wastes and residuals without a change in quantity (Baldwin, 1985). Therefore, over time, in any stable system the amount of matter entering the system must equal the amount stored, plus the amount moving out. Therefore, those trucks that haul away the trash each week do not disappear once they round the corner. The matter they hold is simply being transferred elsewhere – nothing is ever really thrown away.

Energy interactions are governed by the laws of thermodynamics. The first law of thermodynamics, also referred to as the law of conservation of energy, states that energy can neither be created or destroyed, it changes from one form to another. As energy changes form and distribution, the quantity remains the same. Therefore, energy is neither produced nor consumed, it is simply converted from one form to another. The second law of thermodynamics introduces the principle of entropy. According to the second law of thermodynamics, within any closed system, the amount of energy in a form available to do work diminishes over time. This means that as energy changes form it becomes less useful, and less organized. This loss of available energy represents a reduction in a system's capacity to maintain "order" over time. To the planner, the law of entropy is important both with respect to natural and social systems (Baldwin, 1985). Because of the presence of entropy in order to sustain or enlarge any system, whether in the case of an organism or city, an expenditure of energy will be required. However, as energy changes form it become less organized, and because of entropy it takes more and more to yield less. Many of the management problems confronted in planning are a manifestation of entropy, whether those problems are expressed in a physical or social context.

2 Laws of the biosphere

The biosphere, or life-layer, describes a level of organization and an intricate set of relationships between its components and the physical environment they occupy. These relationships form a biotic pyramid whose shape represents the concentration of biomass and/or population at each level (Castillon, 1996). Using this pyramid concept it is possible to place elements of the ecosystem into a trophic structure that suggests where organisms relate in terms of the available energy and defines how they organize into food webs within the ecosystem. Five of the more central to the issues surrounding environmental planning include:

- **The law of production** – for the biosphere the law of production states that production must always equal or exceed consumption. Thus, at each level of the tropic pyramid, a carrying capacity can be defined which if exceeded will result in a reduction in population size or complexity.
- **Law of adaptation** – based on fundamental Darwinian principles, this law maintains that: (1) a species will produce more offspring that can survive, (2) these offspring possess the genetic traits of their parents, (3) these genetic differences in individuals of any species establish a competition for food and space, (4) those with genetic advantages survive the competition, and (5) the survivors pass the genetic advantage for survival to their offspring.
- **Law of fertility** – introduces the concept of nutrient cycling and maintains that nutrients must recycle to keep the environmental system functioning.
- **Law of succession** – with respect to biotic communities, this law states that there is a sequence of plant species that will occupy a recently altered or newly formed landscape.
- **Law of control** – introduces the idea that species have control mechanisms that govern population size and strategies for maintaining equilibrium given the nature of its habitat.

Taken together these laws or principles help to establish a better understanding of the underlying logic that guides environmental processes and basic biosphere functions. More importantly these law-like principles provide important support for environmental planning efforts by emphasizing equilibrium concepts and the importance of "balance" in maintaining a sustainable system.

3 General ecological principles

Because environmental planning strives to achieve a balance between development processes and environmental sustainability, development proposals and the motivations to transform land resources to more intensive forms of human use should be considered in relation to how "in tune" they are with respect to ecological realities of the planning area. Several ecological principles that govern the interaction of organisms and their environments exert a degree of control in establishing that relationship. These same principles can also be used to help direct environmental planning facilitate balance.

One ecological principle that carries important implications for the environmental planner is Ashby's Law of Requisite Variety (Baldwin, 1985; Margalef, 1970). Although this principle is more commonly expressed as the law of diversity and stability, the Law of Requisite Variety states that stable environments tend to develop diverse ecological communities over geologic time. Conversely, less diverse communities overall tend to be more vulnerable to environmental disruption. According to Baldwin (1985), the ramifications of this principle are fairly simple: "Don't put all your eggs in one basket." This fact holds for human systems as well as environmental given the general observation that social systems with greater economic and resource diversity tend to be more stable and tend to adapt more successfully to environmental, political, social, or economic changes. This principle also reminds the planner that diverse (high-variety) problems must be matched by a solution that equals the level of variety exhibited by the problem.

A second ecological principle that guides environmental planning has been referred to as the Brontosaurus Principle (Miller, 1998; Baldwin, 1985). Using an analogy with the ill-fated dinosaur considered the largest land animal and which became extinct approximately 75 million years ago, this principle asserts that bigger is better up to a point, whereafter size becomes a liability. The Brontosaurus Principle cements the notion that thresholds exist in the environment. When growth exceeds these thresholds it will become increasingly difficult to manage the system involved. For example, when San Jose, California, was a city of 100,000 people it was comparatively easy to repair the streets, inspect the water lines, accommodate the needs of the population. Now as a city of nearly 800,000 encompassing large portions of the Santa Clara Valley, its not easy or cheap to tend to the day-to-day business of managing the city's infrastructure. In this context, the size of a community will constrain the ability of any unit to manage its size (complexity) and adapt to new conditions. We can further illustrate this point by considering the example of a small town that benefits from growth through the improvements made to public services, cultural amenities, and economic opportunities, to the point where that town is no longer small. At that larger size (both in terms of population and geographic scale) a "limit" (real or perceived) is reached where the benefits of growth have diminished and the city has to manage urban disamenities and a more costly, complex arrangement.

The notion that size imposes a constraint on the functioning of a system introduces the next and perhaps most influential ecological principle in environmental planning and decision-making, the carrying-capacity concept (Lein, 1993a). Carrying capacity can be defined as the maximum population that can be sustained by an ecosystem over time. In the context of environmental planning, carrying capacity describes the level of human activity that a region can sustain in perpetuity at an acceptable quality of life (Bishop et al., 1974).

The carrying-capacity concept was originally introduced in biology to explain the relationship between the resource base, the assimilative and restorative capacity of the environment, and the biotic potential of a species. The biotic potential of a species, describing the maximum rate of population growth that could be achieved given the number of females that reached and survived through their reproductive spans, is the controlling variable in this relationship. With adequate food supplies, living area, and the absence of disease and predation, biotic potential contributes to a growth in population that must be accommodated by the environmental system. Environmental resistance, however, regulates biotic potential by imposing limits on food supply and space, and other inhibiting factors such as predation and disease. Out of this interplay, carrying capacity emerges as the limit or level a species population size attains given the environmental resistance indigenous to its location.

In a planning or management context, carrying capacity is used to characterize the ability of a natural or human-made system to absorb population growth without significant degradation. Applying carrying-capacity concepts in planning requires careful treatment of four underlying assumptions (Lein, 1993). First, that there are limits to the amount of growth and development the natural environment can absorb without threatening human welfare through environmental degradation. Secondly, that critical population thresholds can be identified beyond which continued growth will trigger the deterioration of important natural resources. Thirdly, that the natural capacity of a resource to absorb growth is not fixed but can be altered by human intervention. Lastly, that how capacity limits are ultimately determined may involve an act of judgment. Although these assumptions make simple application of the concept difficult to uniformly apply, the concept of environmental carrying capacity has several important uses, including studies examining the effects of human actions on natural ecosystems, standard-setting for pollution control, and developing sustain-yield/renewable resource management programs. In each of these examples carrying capacity forms the basis for setting priorities and establishing levels of tolerance or thresholds in relation to critical environmental processes.

The concept of carrying capacity provides useful background to help understand a related unifying idea in the environmental sciences; the connection principle. The connection principle is based on the supposition that when examining the form and process of the environmental system, everything is somehow connected to everything else. While the scientific explanation supporting this assumption remains elusive, the philosophical meanings attached to the idea that all life is connected plays a central role in how the environmental planner views the landscape. It also promotes a type of causal thinking where environmental relationships, actual or implied, become the framework for tracing cause and effect pathways. As Bush (2000) explains, every living thing survives by numerous and subtle relationships with all living things and the inanimate environment. When all living things are considered together, these connections appear as complex, interdependent, and self-regulating structures. Within these structures, any one form of life depends on the rest of the system to provide the conditions needed for its existence. While the earth has not always provided suitable environments for human habitation, over the millennia it was made hospitable by functioning ecosystems. The connection principle becomes one way to reconcile the theory that all things are intertwined in a complex web of hidden and subtle relationships that are presently beyond our comprehension (Baldwin, 1985). The value of this conceptualization of the environment to planning is that it forces the planner to examine cause and effect more carefully and to explore possible relationships that may not be obvious at first glance.

Although a more detailed discussion of central ecological concepts and their role in environmental planning could be undertaken, the physical laws and principles explored above provide a foundation to assist the planner in forming a better and more comprehensive view of the relationship between human systems and the natural environment. The principles reviewed above also remind the environmental planner that achieving a harmonious balance between human needs and the environment must be based on logic and a strong conceptual understanding of how the environment works.

The environmental planning process

The motivating purpose for environmental planning is to integrate environmental considerations into the planning process. With the inclusion of the environment, the planner is able to explore a wider range of alternative solutions and form a

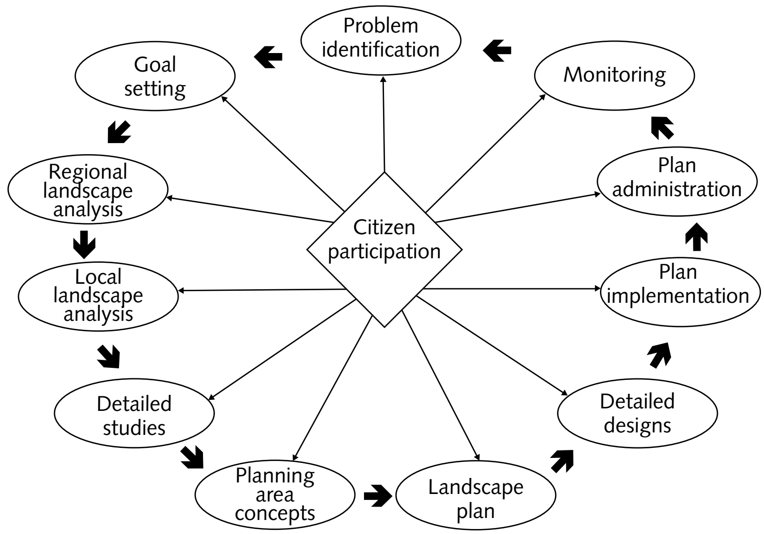

Fig. 2.2 The ecological planning model.

better understanding of their spatial implications. Through the integration of environmental variables along with socioeconomic criteria, a more comprehensible, efficient, and accurate information base for landscape decision-making is provided. This information feeds the planning process during the formulation, analysis, and selection of alternative solutions, and helps to determine which satisfy the established planning goals (Anderson, 1980). In this process the environmental planner introduces the "balancing" information that enables a broader interpretation of planning goals and an assurance that efforts to identify alternatives that promote sustainable development will not be compromised. In this sense, the environmental approach to planning asks us to look at the "other side of the coin" in order to see the complete picture.

Linking the environmental aspects of the planning problem into this process complements rather than replaces the stages of the traditional planning process. With the inclusion of the environment, the model can be reformulated as suggested in Fig. 2.2. Connecting to this information and to goals that are uniquely environmental, characterizes a new procedure for acquiring information and treating that information in a way that facilitates analysis and insight regarding the environmental controls that influence landscape development. In this context, the environmental planning method is primarily a set of procedures for analyzing the biophysical and sociocultural systems of a place to reveal where specific development objectives may be practical with a minimum of environmental consequences (Steiner, 1991). This new procedure is defined by eleven interacting phases. As illustrated in Fig. 2.2, each explains a pathway for environmental information to focus decision-making, and together they describe a process where design plays a critical role in generating a successful outcome. This procedure, outlined by Steiner (1991), is an adaptation of the conventional planning process as defined by McDowell (1986), Moore (1988), and Stokes (1989), and builds on procedures developed originally for landscape planning (Marsh, 1983; Duchhart, 1989; Lahde, 1982).

The basic phases of this environmental planning model, based on Steiner (1991), can be summarized as follows:

1 Identification of planning problems and opportunities

The first step in the environmental planning method describes the exploration of issues that concern the interrelationships between the development process and the environment. This search basically requires consideration as to how development opportunities may conflict or adversely affect environmental resources and ecological functioning.

2 Establishing planning goals

Once specific issues have been identified, goals are established to address these problems. These goals provide the basis for the planning process and help crystallize an ideal future situation. Goal-setting is dependent on the cultural-political system and requires participation of all groups affected by a given issue.

3 Regional landscape analysis

This phase is unique to the environmental planning approach. Regional analysis describes the process of systematically characterizing the regional environment that constitutes the setting of the planning area. Generally, regional characterization focuses on the drainage basin or a related delineating feature that sets the region apart and enables detailed analysis. Within this regional setting, information is collected and a regional scale inventory of the natural and human factors relevant to the planning problem is produced. At this scale the collected information base is necessarily generalized and is used primarily to enable the planner to gain an "overview picture" of the region, its form, function, and situational characteristics, that allows important questions to be asked related to human/environmental relationships and permits simple "what if" scenarios to be explored that may suggest the need for more detailed studies. The purpose of conducting a regional analysis and inventory is to aid basic insight into how the regional system functions.

4 Local landscape analysis

Moving to a local-scale analysis concentrates on the collection of information regarding the appropriate physical, biological, and social factors that define the planning area. At this scale of analysis the goal is to obtain a detailed understanding of the natural processes and their relation to human plans and activities. Local analysis implies a much more in-depth inventory of critical natural factors and a classification of landscape characteristics that provides a systems view of human/environmental interaction. A key feature of local-level analysis is the addition of a sociocultural inventory that helps shape a cleared expression of human ecology within the planning area. Human ecology in this sense defines the manner by which people interact with each other and their environment, together with the relationships this interaction describes.

5 Detailed studies

Detailed studies connect the inventory and analysis of information to the problems and goals identified earlier in the process (Steiner, 1991). Although the term "study" can be a bit misleading in this context, this step in the environmental planning process describes the place where the information gathered during regional and local landscape inventory is subjected to specific analytical treatment. Anderson (1980) refers to this phase as landscape analysis modeling, since it represents the desire to form "models" of key environmental relationships that can be used to generate expressions of important environmental perceptions, values, and characteristics. Analytic models applied during this phase may include descriptive or predictive designs, or some combination of the two. In all cases, models are used primarily to evaluate specific conditions in relation to a goal in order to support:

1. specifying alternative programs or actions that might be chosen;
2. predicting the consequences of choosing each alternative;
3. scoring consequences or qualities according to a metric goal of achievement;
4. selecting the alternative that yields the highest score.

Common models applied to assist the environmental planner in these tasks include suitability models, separation models, vulnerability models, and attractiveness models.

6 Planning-area concepts

This step centers on developing concepts for the planning area. Planning concepts take the form of options derived from a conceptual model or scenario of how a goal may be achieved or a problem solved. These concepts typically express suitabilities or constraints produced through the combination of the information gathered during the inventory and analysis phases.

7 Landscape plan

Through the articulation of planning concepts, a series of preferred options are brought forward to serve as the foundation for the landscape (environmental) plan. The plan becomes a strategy to guide local development and offers flexible guidelines for decision-making. Topics given particular attention in this plan include considerations such as how best to conserve, rehabilitate, or develop the planning area. Unlike the comprehensive or general plan, which may have specific mandated requirements, emphasis here is on the landscape, giving greater importance to the natural and social factors that will direct the plan. As such, the landscape plan is designed to address the combined influences of land uses within the context of the total local/regional environment.

8 Citizen participation

The continuous involvement of the affected public remains the nucleus of the environmental planning model. Public participation occurs through a variety of educational and information dissemination programs. Beginning very early in the planning process, when issues are first being identified, public involvement introduces itself at each stage of the environmental planning process. This involvement is essential simply because it will help ensure that the goals emanating from the community are realized as objectives in the plan. With meaningful participation, important issues can be brought forward and resolved. If the public is included throughout the process, opposition to policy programs and recommendations will be limited, and the objectives of the plan will fit more closely with the desires of the community.

9 Detailed designs

The goals and objectives expressed in the landscape (environmental) plan will eventually influence the future spatial arrangement of land uses within the planning area. This design phase of the process offers decision-makers an opportunity to visualize the consequences of the policies and programs described in the plan, and to examine the geographic form and arrangement the plan will assume. Through careful assessment of various design alternatives, comparisons can be made regarding the short-term benefits of the plan with respect to long-term economic and ecological goals. Also, by rendering specific designs based on the landscape plan, the future distribution of land uses and the spatial organization of the environmental system can be critically reviewed before an irreversible commitment to development is made that may lead to adverse environmental changes.

10 Plan design and implementation

Making the plan work requires various strategies and procedures to realize the adopted goals and policies (Steiner, 1991). Several mechanisms common to planning include instruments such as:

- voluntary covenants,
- easements,
- land purchases,
- transfer of development rights,
- zoning,
- utility extension policies,
- performance standards.

11 Administration

Once the plan is adopted and implemented it must be administered to ensure that the goals and objectives established are achieved over the long term. Administration focuses on the role of planning commissions, citizen boards, review agencies, and other "overseeing" bodies that exist within the fabric of local government. The bodies

Table 2.1 Strategies and principles guiding environmental planning.

General planning principles:
Identify the planning process to be followed
Identify site-specific environmental goals and objectives
Evaluate new technology from ecological, natural resource, and social perspectives
Examine the conceptual and technical justification for a proposed project
Assess new project's environmental impact
Undertake environmental protection planning
Identify institutional capability for any recommendation
Predict for future scenarios the flexibility or reversibility of land-use decisions
Understand the compatibilities and incompatibilities among land uses
Communicate technical environmental information in an understandable form
Evaluate compliance with all regulations and applicable acts
Undertake an evaluation of risk and uncertainty
Incorporate environmental audits into project design
Evaluate assumptions
Natural science principles:
Understand historical ecosystem properties and trends
Undertake a systematic inventory of existing resources
Develop or adapt relevant ecosystem models
Predict thresholds, lags, feedbacks, and other constraint parameters
Identify natural processes and their significance
Identify key landscape indicators
Define pattern of opportunity and constraint
Identify unique geological and biological land units
Determine ecosystem stability–resiliency–diversity relationships
Determine carrying capacity and assimilative capacity limits
Identify significant transboundary ecosystem linkages
Monitor existing and built ecosystems
Design low-maintenance landscape systems
Social science principles:
Understand cultural linkages
Identify community and institutional values and individual perceptions and concerns
Design public participation approaches based on the level of interaction, representational needs and decision-making factors
Develop strategies to evaluate human values
Design outreach and educational programs to enhance public awareness

can be given the responsibility or charged with the duty to carry out or manage specific aspects of the plan, or to monitor and evaluate how well the plan is working.

The environmental planning process is also guided by a collection of technical principles that direct how the process unfolds and how the planner may exercise experience and judgment throughout each of the 11 phases. These technical principles are organized around three thematic areas – general planning, natural science, and social science (Dorney, 1989). These environmental planning guidelines have been arranged according to theme and are presented in Table 2.1.

Integrative environmental planning

How do we manage and direct the effects of change on the landscape? The answer to this question is not simple. To manage change we need to understand it and find ways to explain what it means in a way that makes environmental sense. In this section a "theory" is offered to help us place the connection between people and environmental change into something we can use as we observe and direct human use of the earth's surface. The explanation offered is highly integrative in nature and supports the idea that human use of and changes to the earth's surface are not something strange or unnatural. They are as much a part of this planet as the seasonal migration of birds and butterflies.

Integrated approaches to environmental planning and management have been widely advocated. Integrated planning explains the use of proactive or preventative measures that maintain the environment in good condition for a variety of long-range sustainable uses (Cairns, 1991). Given this definition, integrated environmental planning can be regarded as the coordinated control, direction, and guidance of all human activities within a specified environmental system to achieve and balance the broadest possible range of short- and long-term objectives. In this definition, integration implies synthesis and suggests that with environmental planning resting at the interface between the human/social system and physical/environmental system, a more realistic conceptualization of the planning problem begins to emerge.

Where are we going?

As a methodology, synthesis facilitates the combination of relatively simple parts into a more complex representation. From this representation, characteristics of the system as a whole can be deduced. Only recently has complexity been recognized to contribute important qualities to a system that cannot be predicted from a collection of its components. These attributes have been defined as emergent properties and provide the linking elements that connect the two systems together (Lein, 1989). For example, when one is considering the relationship or impact of land-use change on microclimate, the material structure and composition of the landscape can also be expressed as specific physical properties such as albedo or emissivity that can be measured and quantified. Early attempts at landscape synthesis focused on the interaction between population, economy, and environment, and on their territorial linkages. While such models may be criticized for producing a too highly generalized series of interactions, these approaches have merit for planning purposes, since they offer a general procedure for tracing the linkages between components of the landscape system. They also provide a useful methodology to explore the spatial aspects of interactions.

Synthesis also requires focusing on the interaction of diverse landscape features, drawing careful distinctions to guide assessment, and separate consideration of impact from that of consequence. Thus, through the introduction of synthesis in planning, a unity of process is realized that describes components of the planning area, including people, as elements of a larger system. Conceptually, environmental unity of this type enables the definition of interactions between components of the system that are not directly connected in operation yet exert an influence. For instance, it might be difficult to understand how economic growth might affect the flow of groundwater; the connection isn't obvious until we look for it. We can use the geosystem model to help gain insight into these larger connections. Here, the geosystem represents the combination of botanic, geologic, climatic, zoologic, and human

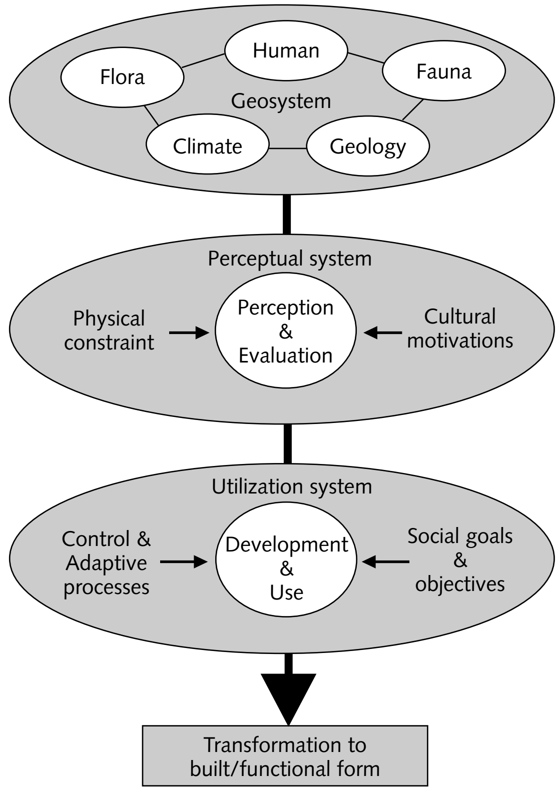

Fig. 2.3 Features of the land transformation process.

constituents that share the landscape. As expressed in relation to landscape development, people interact directly or indirectly with the remaining elements of the geosystem. Through this interaction an anthropogenic landscape is created (Fig. 2.3). This landscape describes an artificial arrangement of materials and energy that transfers its influence back through the geosystem. Anthropogenic landscape, therefore, explains a departure from natural surface form and explains specific surface alterations created by the development process in order to maximize utility from the landscape. These alterations also modify the morphological state (shape and form) of the surface, which changes the flow of materials and energy throughout the natural system. The resulting surface arrangement, its structure and origin, is therefore induced by human activity and becomes a visible product of planning. Just think about the number of times you've seen land being reshaped, raised, lowered to permit construction, the examples of drainage flows moved or altered, trees cut, soils replaced by concrete. Nature doesn't disappear in these areas, but it does look and respond differently, sometimes to our detriment.

However, until there are noticeable changes in the manner and intensity of use, most growth is too obscure to require attention. The isolated building lot or small modification of a road surface isn't going to cause significant change. To the planner this suggests that growth can be interpreted mainly as a change in the pattern of land use from less intensive toward more intensive uses of land where an increase in land-use intensity increases the productivity of land (Schafer, 1977). However, intensification of use can simply be a function of more people using the same land area as before, or it may involve other factors, such as:

- Higher capital investment in the same land area.
- Greater material investment.
- Increased productivity.
- The transfer of products or services.

Intensification also introduces competition. With land defined as a fixed and finite resource, users of land ultimately compete with one another in order to maximize the comparative advantage land enjoys due to its accessibility and resource quality. Emerging from this competition is an assumed rational allocation process that orders the distribution, type, and intensity of land use. At the local level, allocation is directed by the land market forces which determine the relative value of land and its preferred use, and the landscape begins to change.

How do we get there?

One of the better models that describes the spatial expression and dynamics of local land market processes was introduced by Alonso (1964). According to this conceptual model, two principal factors control the pace of development within the land-use system and direct its spatial form: (1) the economic rent of land and (2) its accessibility expressed as a function of distance to the focus of demand in the local economic system. Based on the interplay between these two factors, potential users of land exercise a "bid" to locate at that spot based on (1) the anticipated economic rent (profit) to be derived from the intended use, and (2) the proximity that location offers to the sources of demand. The relationship between land cost (value), explained as a function of its accessibility, coupled with the pull of the market, creates a generalized pattern of land use (Fig. 2.4). The pattern suggested by this characterization suggests that at the surface there will be important variations in the intensity of use. Thus, based on this generalized description, there will also be a corresponding change in the degree of anthropogenic modification as the intensity or "impact" declines away from the locus of primary attraction. The spatial patterns that emerge, however, form only a partial explanation of anthropogenic landscape. The remaining portion of the equation directs attention to the physical consequence of this landscape as defined by its structural and textural properties.

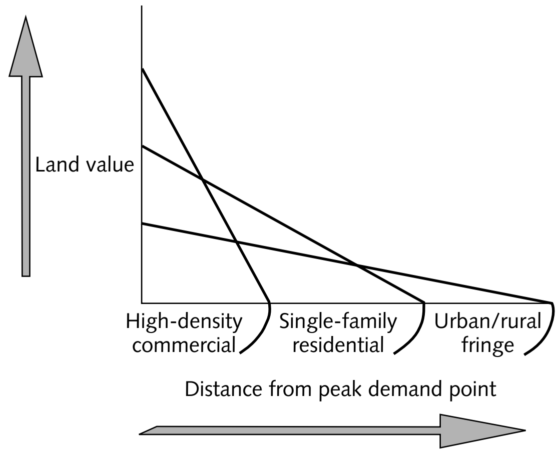

Fig. 2.4 Land-use allocation according to the bid–rent model.

Within the context of environmental planning, the built environment is more than a spatial representation of economic influences and trade-offs. This surface defines a form and texture that, while reflecting technological capabilities and human values, stands separate from these factors when viewed only in terms of its physical consequences. Through the eyes of the environmental planner it's not merely residential land, or commercial development, it's the material fabric those land-use types represent. We've all had the opportunity to look down at the landscape from the vantage point of an airplane window and we've marveled at how different these areas look: the mosaic or shapes, colors, textures; the curving streets and tree filled spaces of the residential area; the stark, wide, and smooth expanses of the shopping mall. These are real surfaces that behave in a physical sense and "do something" when environmental processes act on them.

That consequence becomes the responsibility of the environmental planner. However, the consequence of anthropogenic landscape develops as a function of time as this "designed" space interacts with the physical processes of the environment into which it has been placed. Placement is, therefore, a central feature of the problem and gives renewed emphasis to the plan and the spatial arrangement of future land uses. The precise nature of this placement is likely to be evolutionary as form adapts to a changing set of functional demands. Regardless, the interaction produced is directly attributable to the structural properties of designed space, whether expressed in the form of an agricultural field or a complex urban canyon.

Three underlying forces have been identified that shape urban morphology:

1 Forces that encourage the outward expansion of urban form.
2 Forces that influence the space and areal change in growth patterns.
3 Forces that control the intensity of land occupancy.

These forces include the contribution made by factors such as the pattern of land ownership, land speculation, personal income, land cost, and technological change in urban (built) form. Although these actors adequately explain the physical expansion and increased intensity of anthropogenic landscape, they do not address the concurrent structural or compositional transformations that occur at the surface.

Structural descriptions of landscape morphology must consider the physical composition of designed space and its variation over time. The fabric of this landscape becomes a mix of wood, brick, reinforced concrete, steel, and glass that represent the set of emergent properties that connect human activities to the larger environmental system. Therefore, the planner's allocation of functions to a specific point in the landscape also becomes an indirect decision regarding the new properties that will take hold on the landscape and how those properties react with the natural forces that drive the landscape system. Will the new conditions introduced be beneficial to the functioning of the environment, or will they introduce a stress that will eventually undermine its sustainability?

Building toward sustainability

As noted in the previous section, the introduction of built form presents a new morphological state capable of moving the environmental system to a new equilibrium, bringing into question the issue of sustainability. As illustrated in Fig. 2.5, the predominant threat to sustainability emanates from the stress imposed on the natural system when land is changed from its natural state to some other form. According to Fig. 2.5, the environment in its natural condition can be explained by a use potential that translates into an expression of the landscape's worth, and a use value that describes the ability of the landscape to satisfy one or more societal needs. If a benefit can be identified then the development of that area may be encouraged. The process of development in this context introduces human impact; which for the most part involves the removal, replacement, redistribution, and redefinition of the geosystem. Through this process, the surface is transformed into an explicit functional state. To the environmental planner, the surface now contains distinct functional attributes relating to its use (building, roads, utility lines), a morphological characteristic reflecting its physical structure (a shape), and a set of inherent qualities that define the invariable or stable features not affected by human activity (environmental conditions that have not been modified).

The presence of this new "anthropogenic" state produces real and potential effects as the environ-

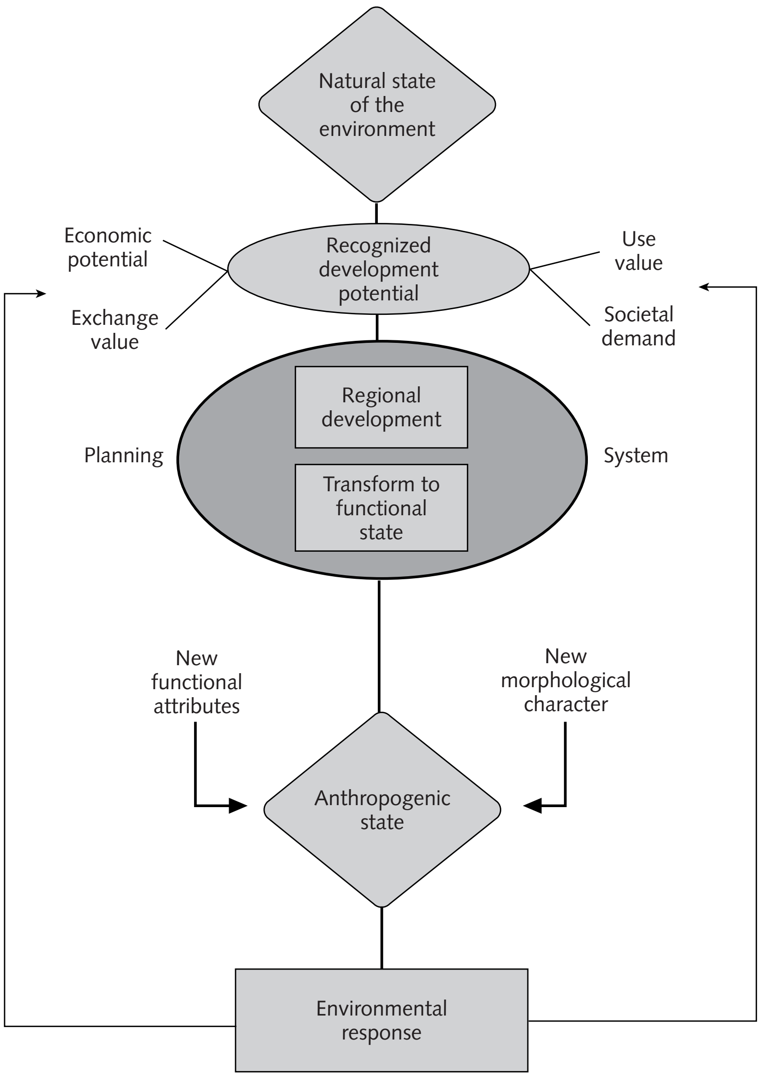

Fig. 2.5 Defining environment/development interactions.

ment responds to change. These feedback effects flow directly into the socio-economic regulators propelling development. The environmental response, as depicted in Fig. 2.5, may initially explain qualitative changes in the structure of the geosystem that may eventually alter its performance. At this point, the capacity of the landscape to satisfy societal demands may be compromised, and the benefits derived from use of the future economic potential of the landscape may be degraded as more resources must flow into management in order to sustain the pattern.

The consequence of human development and intervention as implied by this simple model is similar to the introduction of a stress into any natural system. Stress, in this context, identifies a form of interference with the expected condition of a system (Lugo, 1978). Of course, the effects of stress are most dramatically observed after critical thresholds of tolerance are exceeded and a strain of anomalous response in the system is produced. When this occurs a departure from the expected condition results and a new state develops to which all other elements in the system must adjust. If we abstract the geosystem according to the relation

$$Y = f(x, p, t)$$

The system (Y) is composed of a vector of state variables (x) and a vector of parameters (p) with (t) representing time. By invoking an arbitrary function to represent the state of the system,

$$\beta = f(x_1 * x_2),$$

a strain (s) can be explained. This strain develops out of the deviation in the state β and can be denoted as β*, such that

$$s = /\beta - \beta^*/$$

where,

$$\beta^* = f(x, \phi),$$

with ϕ representing the change in one of the original state variables. A sustainable system, therefore, defines the condition where $/\beta - \beta^*/ = \phi$ and a strain is not produced that results in a system response.

Realizing the condition expressed above where any strain is kept well below threshold levels depends greatly on the approaches available to encourage environmentally sound patterns of development (Naess, 1993). A sustainable pattern is not possible unless development proceeds in accordance with criteria for achieving sustainability. Opinions regarding what is an environmentally sound form of urban development differ. In a review of the topic by Naess (1993), several major themes can be identified to help focus the concept of sustainable development. For example, transportation planners tend to recommend concentrated development patterns (Owen, 1986; Newman & Kenworthy, 1989), while those working in residential design give preference to urban expansion over density increases (Attwell, 1991). Finally, others argue that regional satellite developments are an optimal strategy for combining conservation goals with rural preservations (Naess, 1993).

Recognizing options

In general, by concentrating the development pattern, confining new construction to areas where technical encroachment on the natural system has previously taken place, and utilizing each building site efficiently, the preservation and maintenance of the environmental system becomes possible. Development must therefore respond to a series of goals that together realize sustainable patterns of growth and change. These may include attempts to

1. Minimize energy consumption.
2. Preserve biological resources.
3. Minimize costs.
4. Minimize local noise and pollution.
5. Provide opportunities for outdoor recreation.
6. Preserve landscapes and cultural values.
7. Contribute to the realization of social goals.

It must be recognized that while these goals will do much to improve the present situation, true sustainability may never be achievable (Beatley, 1995; Rees & Wackernagel, 1996).

The major limitation of the concept of sustainability is that it has become a "buzzword" in current planning and resource management discourse (Collicott & Mumford, 1997). When applied, its anthropocentric focus is not always useful within a strict ecological framework. Thus, sustainability should be replaced with the more exacting concept of ecological sustainability. Ecological sustainability takes into consideration more concretely a wider concern for ecosystem health and links to the objects of environmental planning. An attempt to place sustainability concepts into a more ecological context was introduced by Lawrence (1997). Although this outline directs attention toward the environmental impact assessment process, its features are useful and relevant to the general concerns of the environmental planner. The attraction to this framework are the instruments introduced to meet sustainable development goals (Table 2.2). Using these instruments, a conceptual foundation is presented that connects sustainability to the larger environmental issues (Lawrence, 1997). The model suggested by Lawrence illustrates how sustainable planning can take place at the conceptual, regulatory, and applied levels. If sustainability concepts are integrated into the planning

Table 2.2 Fundamental goals directing sustainable development.

Approach problems from a sustainability systems perspective
Adopt a long-term view of human–environmental conditions
Strive to span jurisdictional, disciplinary, professional, and stakeholder boundaries
Ensure that values and value differences are made explicit
Keep options open
Be sensitive to the consequences of being wrong
Ensure that the means to achieve sustainability are sustainable
Design approaches to suit the context of community need and aspirations
Ensure a full accounting of social and environmental costs
View global environmental management as a shared responsibility of all

process, changes should be produced in the ways in which environments are managed. The main obstacles frustrating this ideal are those of implementation and the larger problem of generating an understandable method to express the concept in substantive, quantifiable terms.

Forming a useful expression

Recently Rees and Wackernagel (1996) have suggested an approach to quantifying sustainability they term "our ecological footprint." Adapting this approach to planning may produce a better expression of the ecological impact of the urban "built" environment. Their approach is based on the observation that urban development represents a human ecological transformation. Therefore, the shift in human spatial and material relationships with the rest of the environment is the critical link to sustainability. Using the definition of environmental carrying capacity as the maximum persistently supportable load, sustainability can be redefined with carrying capacity as the operator governing its expression. According to this logic, no development path is sustainable if it depends on the continuous depletion of productive capital. Thus, to foster sustainable development, a critical amount of such capital must be conserved intact and in place. This will ensure that the ecosystems upon which humans depend remain capable of continuous self-organization and production (Rees & Wackernagel, 1996).

Realizing this goal depends on forming better definitions of human carrying capacity and the maximum entropic load that can safely be imposed on the environment (Catton, 1996; Rees, 1996). The "footprint" concept recognizes that as a consequence of the large increase in per capita energy and material consumption made possible by technology and global-scale trade dependencies, the ecological locations of high-density human settlements no longer coincide with their absolute geographic locations. Our feet have simply outgrown our shoes. Because cities "appropriate" the ecological output and life support functions of distant regions, it is also critical to recognize that no urban region can achieve sustainability on its own (Rees & Wackernagel, 1996).

Determining the ecological footprint of a population level residing in the urban landscape facilitates this understanding by:

1. Estimating the annual per capita consumption of major consumptive items from aggregate regional data and dividing total consumption by population size.
2. Estimating the land area appropriated per capita for the production of each consumptive item by dividing average annual consumption of that item by its average annual productivity or yield.
3. Compiling the total average per capita ecological footprint (*EF*) by summing all the ecosystem areas appropriated by an individual.
4. Obtaining the ecological footprint (E_{fp}) of the planning area population by multiplying the average per capita footprint by population size ($E_{fp} = N \times EF$).

More complete details of this procedure can be found in Rees and Wackernagel (1994), Wackernagel and Rees (1995), and Rees (1996).

Although ecological footprint analysis is not a form of dynamic modeling and has no predictive capabilities, the method acts as an ecological camera that produces a snapshot of a population's current demand on nature. For the planner, such a snapshot can be a useful means to compare development proposals and evaluate growth policies with reference to the environmental support that will be required to accommodate a given alternative. However, perhaps the greatest obstacle to overcome when approaching the topic of sustainability is the negative expectations people have about what a sustainable society will look like (Beatley, 1995). Because a sustainable society would likely shift focus away from materialistic quantities and toward more abstract measures of quality, it conveys the image of a spartan and materially backward way of life. Because planners are visionaries, we must learn to describe sustainable futures in ways that effectively communicate alternative visions. Much of this begins with the plan, what it says, and how it communicates a future to those who stand to be affected by it. In the next chapter we will explore the nature of this plan, how it takes shape, and the important considerations that guide its formulation.

Summary

The nature of environmental planning served as the subject matter for this chapter. Set apart from other branches of the planning discipline, environmental planning was defined as the one approach to human landscape development uniquely devoted to achieving balance between human needs and environmental quality. From its philosophical roots and the ethical responsibilities that direct us at present, environmental planning, with its focus on integrating environmental ideals and information into the planning process, becomes an important step to ensure long-term sustainability. Achieving sustainable goals requires an understanding of how to plan environmentally. This chapter reviewed the ecological principles that guide environmental planning and pave the way for an integrative view of the planning problem based on synthesis and a conceptualization of human development as a physical feature of the landscape. By considering this perspective, and through the environmental planning process outlined, more sustainable landscape patterns can be realized.

Focusing questions

What do terms such as compatibility, suitability, susceptibility, and sustainability communicate when placed into the environmental planning process?

To what extent can natural laws provide guidance in the design of environmental plans and policies?

Explain the value of looking at human development through the lens of anthropogenic landscape.

How can the conceptualization of stress in a system be used to structure environmental planning problems?