AGRICULTURE, LANDSCAPE ARCHITECTURE, & ECOLOGICAL DESIGN:

A FOUNDATION FOR COLLABORATION BETWEEN ECOLOGISTS AND

LANDSCAPE ARCHITECTS

by

EMILY L. PATTERSON

(Under the direction of Marianne Cramer)

ABSTRACT

This thesis asserts that agriculture represents a promising venue for collaboration between landscape architects and ecologists. It focuses on defining the relationship between landscape architecture, agriculture, and ecology through historical analysis and an exploration of ecological design models employed by both landscape architects and ecologists. These ecological design models are then used as a foundation for exploring how landscape architects and ecologists might collaborate in order to design sustainable ecological agricultural systems.

INDEX WORDS: landscape architecture, agriculture, ecology, ecological design, sustainable agriculture, alternative agriculture, history

AGRICULTURE, LANDSCAPE ARCHITECTURE, & ECOLOGICAL DESIGN: A FOUNDATION FOR COLLABORATION BETWEEN ECOLOGISTS AND LANDSCAPE ARCHITECTS

by

EMILY L. PATTERSON

A.B., The University of Georgia, 2001

A Thesis Submitted to the Graduate Faculty of The University of Georgia in Partial Fulfillment of the Requirements for the Degree

MASTER OF LANDSCAPE ARCHITECTURE

ATHENS, GEORGIA

2004

AGRICULTURE, LANDSCAPE ARCHITECTURE, & ECOLOGICAL DESIGN:

A FOUNDATION FOR COLLABORATION BETWEEN ECOLOGISTS AND

LANDSCAPE ARCHITECTS

by

EMILY L. PATTERSON

Major Professor: Marianne Cramer

Committee: Alfie Vick
Carl Jordan
Shelley Cannady

Electronic Version Approval:

Maureen Grasso
Dean of the Graduate School
The University of Georgia
August 2004

ACKNOWLEDGEMENTS

The writing of this thesis was truly an educational experience. I have to thank Marianne Cramer for her amazing enthusiasm and energy. She provided wonderful support as I tackled this somewhat obscure and overwhelming topic. When I felt lost or hit a wall, Marianne had a knack for bringing me back to task and keeping me focused. I would also like to thank the teachers I have encountered in the Department of Landscape Architecture at UGA who push this profession forward, question the status quo, and demand that landscape architecture can and should shape a new and better world. I would like to thank my family, especially my parents and my sister Katie for all their support over the years and in the completion of this thesis. Finally, I would like to thank Jeffrey. Your passion for life and for the environment has been an inspiration to me. Thanks for your friendship and support over the past two years.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

This thesis asserts that agriculture represents a promising venue for collaboration between landscape architects and ecologists. The following chapters focus on defining the relationship between landscape architecture, agriculture, and ecology through historical analysis and an exploration of the ecological design models that are currently at work within landscape architecture and agriculture. It attempts to enlighten both ecologists and landscape architects about the possibilities for collaboration that exist through their mutual application of ecological design strategies.

This newly emerging theory of design is defined by Sim Van der Ryn and Stuart Cowan in their book *Ecological Design* (1996) as "any form of design that minimizes environmentally destructive impacts by integrating itself with living processes". It is characterized by a respect for ecosystem health, including human, animal, and plant diversity. Ecological design emphasizes minimal depletion of natural resources, the preservation of nutrient and water cycles, and the maintenance of habitat quality. Conservation, regeneration, and stewardship are the three principles at work within this design philosophy. Stated simply, ecological design solutions are inspired by and adapted to the ecosystem and human culture in which the design problem exists.

A fundamental element of ecological design is collaboration among disciplines. Collaboration among landscape architects and other disciplines has been central to the development of an ecological paradigm within landscape architecture. The collaborative nature of ecological design has manifested itself at the University of Georgia with the formation of the College of Environment and Design, uniting the School of Environmental Design with the Institute of Ecology. Despite the union that this merger represents, there is still a lack of interdisciplinary understanding and a lack of collaboration between the students and faculty of both institutions. Agriculture represents an intriguing venue for such an interaction to take place.

Ecologists have already made significant contributions (via ecological design) to the development of agricultural systems which are ecologically sensitive to the earth and its resources. Landscape architects have developed theories and methodologies which represent a new, ecologically oriented approach to design, yet have not considered agriculture a meaningful or important venue for their skills. Collaboration between landscape architects and ecologists in the venue of agriculture has the potential to increase both disciplines' understanding of ecological design and of each other, while applying their skills and knowledge to one of the most pressing environmental problems facing humanity today.

It is important to state that collaboration in order to solve the problem of agriculture is not limited to landscape architects and ecologists. Many other disciplines can and should contribute to a solution to the complex issues surrounding agriculture. However, this thesis will focus on how landscape architects and ecologists at the University of Georgia might take advantage of the formation of the new College of Environment and Design and the opportunity it presents for interdisciplinary work. This union can and should direct research towards this complex social and environmental issue.

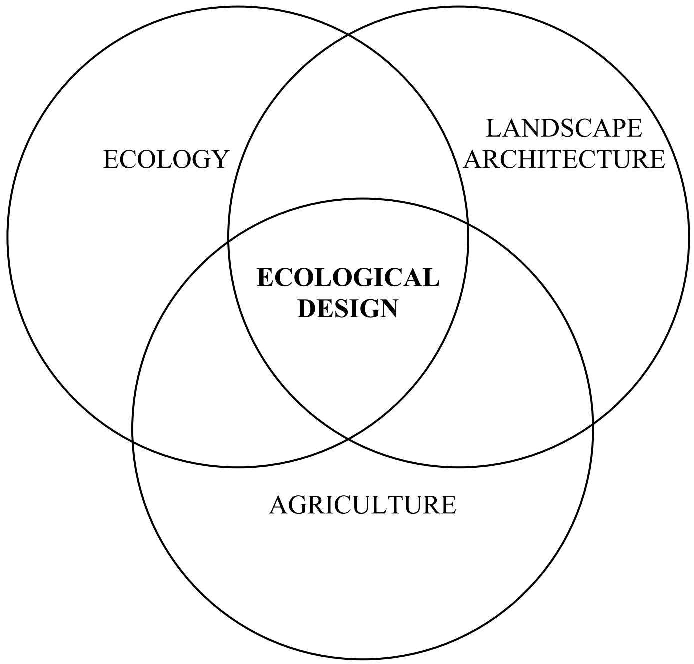
While direct farmer participation is not explicitly addressed by this union or in the body of this thesis, it must be acknowledged as an essential component to any solution. Any future application of research performed by the combined efforts of ecologists and landscape architects will have to take place farm by farm and address the issues presented by a particular farm property. It will also have to acknowledge the expertise of the person or persons responsible for the farm in question, the farmers, whose intimate knowledge of a particular place must be factored into any redesign or management decision. The goal of this thesis, therefore, is to generate ideas and to begin a discussion about how to best design farmland within an ecological framework. This discussion, while not excluding the knowledge and expertise of farmers and other disciplines, is particularly well suited to landscape architects and ecologists. Both disciplines have an understanding of ecological design, and within an academic setting, also have the ability to challenge conventional thought and propose new solutions.

The Problem of Agriculture

Like many areas of land planning, agriculture is facing increased criticism for the negative environmental impacts which accepted practices cause. Increasingly the appearance of the agricultural landscape is dictated by large chemical and seed companies that control the inputs required to produce crops and ultimately the structure, function, and management of agricultural systems. Agriculture as it is practiced in America today is far removed from the agrarian tradition on which our nation and culture was founded. Industrial agriculture is the largest single threat to the earth's biodiversity and represents "the most destructive land use in the nation" (Wuerthner 2002). The following is a short list of the negative ecological effects of current practices associated with industrial agriculture: devastation of wild species caused by chemical use, loss of wildlife habitat, fragmentation of habitat, irreversible soil loss, reduction in soil and water quality, proliferation of non-native species that choke out indigenous varieties, pollution of surface and ground water, loss of genetic resources, and the extirpation of large mammals (Altieri 2002). Miguel Altieri, an expert on the design of self-sustaining farming systems which use biodiversity as a tool for implementing design decisions calls this list of "ecological diseases" symptoms of a poorly designed and poorly functioning system (2002).

A contributing factor in the ecological devastation caused by industrial agriculture is our cultural perception that agriculture is still practiced as it once was—by the small family farmer tending dutifully to the land. American agriculture has ventured far from the Jeffersonian ideal of a nation composed of small family farms forming the foundation of a moral and ethically correct society. The rural and pastoral images which accompany this myth are far removed from the reality of where and how food is produced. Indeed, "no one sector of the 20th century American experience has been more spuriously romanticized while simultaneously being abused economically, politically, and socially than our nation's family farm system" (Krebs 2002). The result of the disintegration of this system upon which our society and country was founded has been a disassociation of people from the land which supports them. This increased distance between food production and food consumption "has resulted in a breakdown of environmental accountability and responsibility, and a lost connection between farmers and the public at large" (Spector 2002).

Thesis Structure



The diagram above illustrates the relationships which must be examined in order to answer the question of whether landscape architects and ecologists can collaborate in the design of agricultural systems. It respects each discipline's identity as a distinct entity with its own body of theory and methodology. Ecological design is represented as the logical outcome of such a merger. Using this diagram as a guide, this thesis will explore the relationships which underlie the three part union of landscape architecture, ecology, and agriculture. Exploring these relationships will help us answer the following questions:

1. Is there a relationship between landscape architecture and agriculture?

2. How does ecological science impact the practice of landscape architecture and agriculture?

3. How do ecologists use ecological design to shape agricultural systems?

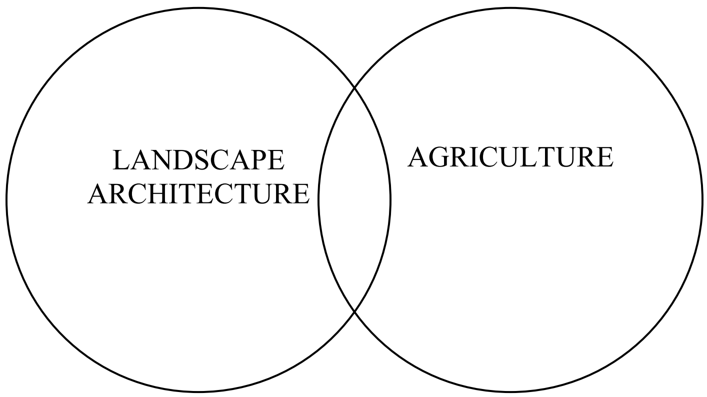
4. How do landscape architects use ecological design?

5. How can ecological design be used as a means of collaboration between ecologists and landscape architects within the framework of sustainable ecological agriculture?

Chapter 1 examines the first question through historical analysis of the ties which landscape architecture claims with agriculture. Chapter 2 answers the second question via historical analysis of the development of an ecological paradigm within landscape architecture and agriculture. In Chapter 3 and 4 I will answer questions three and four by investigating four models of ecological design currently at work within agriculture and landscape architecture. Finally, in Chapter 5 I will use the ecological design models established in Chapters 4 and 5 to answer the last question and propose some models for how landscape architects and ecologists might collaborate in the design of sustainable agricultural systems.

CHAPTER 1

THE HISTORICAL INFLUENCE OF AGRICULTURE ON THE PROFESSION OF LANDSCAPE ARCHITECTURE



This chapter focuses on the historical ties which landscape architecture and agriculture claim. Understanding these ties will help ground the landscape architect who works within a region where rural landscapes are an important cultural and visual component, as well as those who might collaborate with ecologists on the design of sustainable agricultural systems. From the very beginning of the profession, the rural landscape and the practice of farming have played important roles in the design theory and methodology of landscape architects. Today's landscape architects can look to this historical relationship as a foundation for the profession's involvement in the realm of sustainable agriculture.

I begin this discussion with the work of British landscape designer John Claudius Loudon. Loudon's combined interest in scientific agriculture and landscape design informed the work of landscape designers in the 19th century. The next section concerns the impact of the industrial revolution in America and the work of Andrew Jackson Downing, a seminal figure in the history of landscape design whose varied interests included scientific agriculture and a desire to preserve America's rural-agrarian heritage. His theories and philosophies mirror those of Loudon and he, in turn, influenced Frederick Law Olmsted. Lastly, I will explore Olmsted's time as both a farmer and landscape architect and explain the agricultural origins of his earliest work.

Agriculture by Design: Scientific Farming and the Ferme Ornee

The commercial spirit of this nation has led [men] so totally to overlook the value and management of land that to a person coming from a country where the soil is so highly valued, and so assiduously cultivated, this neglect appears like madness.

- John Claudius Loudon

Scientific agriculture and the *ferme ornee* (ornamental farm) together represent an example of landscape architecture's early agricultural heritage. Scientific agriculture originated in England and sought to "[increase] food supply through new methods of planting, the use of new fertilizers developed by chemists…and innovations in cattle and sheep breeding" (McLaughlin 2002). It was also concerned with the engineering required for proper and efficient land drainage, an important concern in England where cultivatable land was scarce and growing urban populations placed an increasing demand on farmers for food. The *ferme ornee* was a practice which endeavored to arrange agricultural estates into aesthetically pleasing compositions. Techniques included enhancing hedgerows with shrubs, vines, and flowers as well as careful attention to road and building placement in order to create the desired picturesque result (Rogers 2001). These combined practices represent a form of agriculture that applied science, horticultural knowledge, and aesthetic understanding of the rural landscape to the practical needs of food production. Together they represent an important example of how agriculture and landscape design were practiced as one discipline in the early 19th century.

An influential practitioner of the science and art of this combined practice was John Claudius Loudon (1783-1843). As a designer, theorist, farmer, and horticulturalist, Loudon addressed many of the ideas which continue to concern the profession of landscape architecture today, including “the expansion of metropolitan regions, the design and siting of buildings, [and] conservation of the landscape” (Simo 1988). His design philosophy reflected a concern for the human condition as England became increasingly industrialized. Among his social concerns were “the quality of education and housing, wages and unemployment, the dignity of the individual, and a ‘right to a fair chance in life’” (1988). Loudon’s professional accomplishments included the invention of a wrought iron sash bar (allowing for the design and construction of curved glasshouses) and the design of England’s first public park, the Derby Arboretum. He also conceived of the idea of urban greenbelts, devising a plan in 1829 that would incorporate concentric rings of greenspace as the city expanded into the countryside.

From 1807-1811, he was a tenant farmer, managing farms in Middlesex, Oxfordshire, and Wiltshire. Raised on his father’s farm in Scotland, Loudon campaigned to improve the efficiency and productivity of the English agricultural system by applying many of the principles of the Scottish system. These Scottish principles included land consolidation and a greater division of labor. Agricultural reform was an important subject in England due to a steady increase in the population, industrialization, and the Napoleanic Wars. Loudon was an important and vocal advocate of reform. England’s limited amount of cultivatable land demanded that agriculture be as productive and efficient as possible. Land consolidation, labor division, and the principles and methods of scientific agriculture were all part of a solution to this problem of production.

It is important to recognize that agricultural reform during this era (specifically land consolidation and labor division) represent a shift away from traditional peasant agriculture and led to the displacement of England's rural population. Likewise, scientific agriculture may be considered a precursor to industrial agriculture that in the next century would transform agriculture by relying heavily on the application of technology and chemicals to improve production. However, Loudon's advocacy for land consolidation was somewhat conservative. Although in favor of enclosures, he recognized the value of keeping land which was not suitable for cultivation as open space and he advocated for better management of prime agricultural land before less appropriate land was cultivated (Simo 1988). He was also aware of the cultural costs of reform and hoped that "small farmers who were able and willing to adapt to changing conditions might channel their energies in new directions and become overseers, managers, or bailiffs on the new larger farms". He believed that reform would put an end to bad farming and benefit "the more energetic and progressive farmers" who would become tenants on newly enclosed lands (1988). However, the result of reforms was culturally devastating and reflected the changing needs of an industrializing nation.

As the farm manager of Tew Lodge Farm in Oxfordshire, Loudon hoped to create England's "premiere ferme ornee" by uniting "landscape as nature, art, and science" (Rogers 2001). He wished to educate young farmers on the principles of scientific farming, the science of horticulture, and the art of landscape design. He did so by establishing an agricultural college at Tew Lodge and by writing extensively on the subject. In 1812, two of his books were published: *Designs for Laying Out Farms* and an *Encyclopedia of Agriculture*.

His improvements at Tew Lodge are described below:

> He removed some hedgerows in order to plant new ones as shelter against prevailing winds, had rough fields regraded and installed with drains, and built a farmhouse in an innovative design that emphasized practicality, comfort, and technology over ornament and style…His farm roads followed the contours of the land in a Picturesque manner, and around his new house he planted shrubs and trees in irregular masses…incorporating exotic species into his landscape design and displaying all plants, whether foreign or native, in such a way that each could reveal itself to advantage (Rogers 2001).

This description illustrates the diversity of concerns addressed by Loudon in his practice of scientific farming combined with landscape design. It emphasizes his concern with both the practical needs of an operating farm and the aesthetic sensibilities of a designed landscape.

Figure 1.1 East Front of Tew Lodge (Rogers 2001)

As a landscape designer, Loudon pioneered the Gardenesque Style, coining the term in 1832 to describe his method of displaying plants as individual specimens by providing them with the appropriate horticultural conditions. In her book *Loudon and the Landscape*, Melanie Simo states that

> Loudon's aesthetic ideals of landscape design were founded in a deep love of Britain's naturally wild, picturesque, and pastoral landscapes. At the same time, his economic arguments for reforms in agricultural land management had to be founded in a thorough understanding of the scientific and technical problems of husbandry.

This description could also be applied to Andrew Jackson Downing and Frederick Law Olmsted, men who pioneered the art of landscape design and the profession of landscape architecture in America. Loudon's works and writings, like those of Downing and Olmsted, reflect a desire to benefit his fellow man and a "primary concern for the great mass of society" (Simo 1988).

Although scientific agriculture can be viewed as a precursor to industrialized agriculture, to Loudon and his contemporaries it was an attempt to solve the problem of food supply and represented their desire to manage agricultural lands in a more enlightened way. The idea of increasing production while improving the aesthetics of the agricultural landscape, combining scientific farming with landscape design, was part of this new approach. The influence which industrialization had upon this practice cannot be overstated. Industrialization demanded that agriculture become more productive while at the same time promoting the growth of cities, resulting in the loss of agricultural land. Early landscape architecture in America and its adoration and celebration of the rural landscape, as well as its concern for the distance which was growing between rising urban populations and the rural landscape, was very much a result of industrialization's social and environmental consequences. As in England, great thinkers in America saw scientific farming and landscape design as part of an enlightened solution.

Industrialization, Scientific Agriculture and the Roots of Landscape Architecture in America

Man, who even now finds scarce breathing room on this vast globe, cannot retire from the Old World to some yet undiscovered continent, and wait for the slow action of such causes to replace, by a new creation, the Eden he has wasted.

-George Perkins Marsh, 1864

The 19th Century represents one of the most important time periods in history due to the immense social, cultural, and technological changes that took place. In America, this time-period is fractured by the Civil War (1861-1865), marking the second half of the century with a four year fight which shook the nation socially and economically. Ethical questions involving religion, social justice, and America's national identity were debated by some of the most influential thinkers ever to appear on the nation's stage. During this period, landscape architecture would be born and farming would be revolutionized by new technology and a growing market economy. The ideal of the self-reliant family farm would be obsolete by the end of the century and the urbanization of America well underway.

Scientific farming gained popularity here for the same reasons as in England. Cities and their populations were expanding rapidly and industry was booming, resulting in new markets and more demand for agricultural products. In America, scientific agriculture appealed to gentlemen farmers who sought not only profit but an intellectually and physically rewarding lifestyle. Their interest lay in a belief that farming represented an honorable and spiritually beneficial endeavor. The unprecedented growth and rapid industrialization which occurred during this century also led to a growing environmental awareness. George Perkins Marsh (1801-1882), considered America's first environmentalist, wrote a groundbreaking book which was published in 1864 entitled *Man and Nature*; *or, Physical Geography as Modified by Human Action*. It was the first book to raise concerns about the destructive impact of human activities on the environment.

Before the publication of Marsh's book, the conventional idea of the day was that the physical aspect and geography of the earth was entirely the result of natural phenomena. Marsh was the first to suggest that human beings were agents of change, or "disturbing agents" (Marsh 1965). He was also the first to describe the idea of interdependence of environmental and social relationships and was one of the first to express concern over the decline of agriculture and the threat of soil erosion (Beeman 2001). Ultimately, Marsh's book raised public understanding of humanity's negative impact on the environment and argued for an "enlightened husbandry" of the earth and its resources (Rogers 2001).

Although it was changing rapidly as technology and science advanced upon it, farming was still an essential part of America's cultural identity. American practitioners of scientific farming, like their British counterparts, believed that by applying scientific principles and new technology to the farm, one could provide for the burgeoning urban population and improve the productivity and management of farmed land. The belief that progress was linked to scientific and technological advancement underlies American agricultural reform at this time. To men like Andrew Jackson Downing (1815-1852), scientific agriculture represented an opportunity to apply the best principles of scientific land management with notions of rural improvement and an aesthetic understanding of the designed landscape that heeded Marsh's call for an enlightened husbandry.

Andrew Jackson Downing was one of the most influential men of this generation. Downing's various interests included scientific farming, landscape design, architecture, and horticulture. Underlying all of these interests was a deep appreciation for the rural landscape and the cultural qualities that it reflected. As editor of one of the most popular journal of the day, *The Horticulturalist,* Downing advocated the principles of scientific farming and extolled the virtues of rural living and the practice of landscape design to a large middle-class audience. Among this audience was a young Frederick Law Olmsted who sought out Downing's advice when he decided to take up farming. Downing advised Olmsted on points related to scientific farming, horticulture, and design. He also introduced him to one of the most successful agriculturalists of the day, George Geddes, for whom Olmsted would later work. Olmsted was not yet a designer, and the profession of landscape architecture did not yet exist. His friendship or mentorship with Downing would directly influence Olmsted's future career.

Downing's design aesthetic was born out of a love for the picturesque rural landscape. The pastoral ideal advocated by Downing was in sharp contrast to America's growing cities. The popularity of this rural aesthetic was no doubt linked to the rapid changes resulting from industrialization's social and environmental consequences. In her history of landscape design, Elizabeth Bartow Rogers' surmises that Downing "may have shared with others of his generation a sense of anxiety as the machinery of capitalism focused its energies on enterprises that would eventually destroy much of the picturesque character of aspiring rural towns, elm-canopied village greens, well tended fields, [and] rich pastures fringed with woods" (2001). Downing believed that design could contribute to a more harmonious relationship between mankind and the earth.

Advocating for the construction of a large public park for the rapidly growing New York City, Downing argued that such a place might help create in the city a means to connect people with nature. The loss of this connection was a primary concern of Downing who believed, like many other thinkers of the day, that mankind's relationship with nature (embodied by the rural landscape and farming) was responsible for American democracy. The rise of industrialization threatened America's agrarian heritage and with it the nation's moral and cultural foundation. Downing was also concerned with the poor living conditions that most of the urban population faced, as well as with the vast numbers of foreign immigrants who had no experience with American democracy. He believed that a public park would not only provide a place for newcomers to breath healthy air, but also an opportunity to observe American democracy first hand.

Like Loudon before him, Downing was concerned with the complex social, cultural, and environmental consequences of industrialization. His tragic death at age 36, a result of a steamboat accident on the Hudson River, led to Frederick Law Olmsted's first project as a landscape architect—the design of Central Park in New York City. Olmsted is known as the "Father of Landscape Architecture", but he spent the first part of his adult life as a farmer. The importance of this previous career should not be dismissed. Farming introduced Olmsted to many of the design principles and land management techniques which he would use in his new profession and the picturesque agricultural landscape was the aesthetic inspiration for the majority of his work as a landscape architect.

Walks Like a Farmer, Talks Like a Farmer, Designs Like a Farmer: Farming and Frederick Law Olmsted

I began life as a farmer, and although for forty years I have had no time to give to agricultural affairs, I still feel myself to belong to the farming community, and that all else that I am has grown from the agricultural trunk.

-Frederick Law Olmsted

Frederick Law Olmsted (1822-1903) was many things before becoming a landscape architect, the profession which he pioneered and which made him famous. As a young man he worked as a clerk, a sailor, a journalist, and magazine editor. He was a visionary whose true gift was his ability to think in a large-scale and long-term way. Olmsted did not design for immediate satisfaction, but with an understanding that a landscape matured over time. He was "one of the first people to recognize the necessity for planning in a large, industrializing country" and "foresaw the need for national parks….and devised one of the country's first regional plans"(Rybczynski 1999). What prepared him for such groundbreaking work? Which of his previous endeavors laid the foundation for a new profession? Before designing Central Park, Olmsted's design experience was limited to the work he had done as a farmer. Today's landscape architects rightly attribute Olmsted with laying the groundwork for many aspects of the profession (from landscape design, regional planning, to ecological design), yet they are largely unaware of this fact: Olmsted became a landscape architect because Olmsted was first a farmer.

Farming introduced Olmsted to landscape design, horticulture, and land management. His farming experience led to an education that would benefit him in his career as a landscape architect and influence the practice and principles of the new profession. Olmsted chose to farm. He was the son of a wealthy man who could afford to fund his son's various interests, yet Olmsted's farming experience should not be dismissed as the hobby of an indulged young man. Olmsted was in search of a profession which would "combine economics, aesthetics, landscaping, nature, moral and intellectual improvement, and salvation" (Rybczynski 1999). Farming fulfilled his intellectual, physical, and spiritual needs. He took the profession seriously and spent over a year studying under more experienced and knowledgeable men.

Olmsted began his education on his uncle's farm, spending five months there before moving on to the farm of Joseph Welton for another three months. Welton was a scientific farmer and ran his farm and nursery business according to the latest scientific principles. Olmsted's interest in farming also led him to the door of one of the most respected scientific farmers of the day, George Geddes, whose Fairmount Farm in Camillus, New York was considered a model scientific farm. He worked for Geddes for six months before buying his own farm, with his father's financial support, at Sachem's Head on the shore of Long Island Sound. At his father's urging he would sell the property in 1847 and buy another farm on Staten Island which was closer to the important commercial market of New York City. He named this new endeavor Tosomock Farm.

At Tosomock Olmsted endeavored to create a profitable and beautiful farm. He grew corn, cabbages, hay, turnips, and potatoes. After a difficult first year spent improving the fields and not earning enough money to cover the cost with these crops, Olmsted decided to switch to fruit trees. Witold Rybczynski, author of a biography of Olmsted entitled *A Clearing in the Distance* (1999) suggests that this change to cultivating trees on a commercial scale "appealed to his interest in scientific farming and satisfied his sense of planning and organization". The farm and the aesthetic improvements that Olmsted made to the grounds are described in the following passage:

> The farm stretched about a mile from the shore to the Main Road….The back part of the farm, near the road was heavily wooded. Olmsted created some scenic effects. He moved the barns and outbuildings away from the house to a more discreet location behind a knoll and rerouted the approach road to the utilitarian barnyard pond at the rear of the house and added water plants to further enhance the scenic effect (1999).

Olmsted found this first effort in landscape design a very rewarding experience, awakening in him “a desire to understand exactly how natural elements could be manipulated to create an effect of picturesqueness or sublimity” (1999). Shortly after establishing the farm, Olmsted was presented with an opportunity to travel to England with his brother and a family friend. Olmsted convinced his father to fund his journey, arguing that the trip would allow him to study British techniques of scientific farming firsthand “in order to practice his profession to best advantage” (McLaughlin 2002). This trip proved to be a formative experience, exposing Olmsted to not only new farming methods, but introducing him to the English landscape—an experience which would shape his future design aesthetic.

After returning to America, he wrote a book describing many of the farming practices which he observed, as well as the beauty and culture of England’s rural landscape, entitled *Walks and Talks of an American Farmer in England* (1850). Olmsted was deeply affected by the English countryside and returned with a new appreciation and understanding of the spiritual benefit which the rural landscape could inspire in the observer. It was his visit to England which instilled in Olmsted an appreciation for long-term management and the beauty of a matured landscape. He understood that the rural landscape which he observed there was a result of centuries of human intervention and manipulation. America's rural landscape lacked this history, but in his park designs Olmsted would attempt to recreate this aesthetic by setting the stage for such a landscape to develop and mature.

Olmsted became a landscape architect by accident. The success of his book led to several other opportunities to travel and write. He dabbled as a magazine editor and publisher. He still ran the farm, but he increasingly neglected farm business in favor of these new endeavors. Finding himself in debt, Olmsted accepted a steady job as the superintendent for the new "peoples park" in New York City. It is likely that Downing would have been chosen to design the park had he not died. His partner, British architect Calvert Vaux, asked Olmsted to join him in the design competition for the park. Vaux knew that Olmsted, a Downing disciple, understood the true purpose of the park and that he had a grasp of Downing's principles, as well as knowledge of horticulture and land management. As park superintendent, Olmsted also had an intimate knowledge of the land that had been chosen for the park, not to mention a political edge in the competition.

Olmsted and Vaux's design for Central Park was a social and aesthetic experiment and represents the union of aesthetic intent with scientific land management. The two would repeat the experiment with the design of Prospect Park in Brooklyn, New York (1871). The Long Meadow in Prospect Park is considered by many to be the "quintessential Olmstedian Landscape" and exemplifies his desire to ameliorate with design the "deprivation of contact with nature as the countryside became increasingly distant from the city" (Rogers 2001). Both Central Park and Prospect Park's agricultural inspiration go beyond aesthetics. It can also be seen in Olmsted's management decisions, from draining land using the same techniques he had studied and observed in England, to grazing sheep to maintain the pastoral landscape.

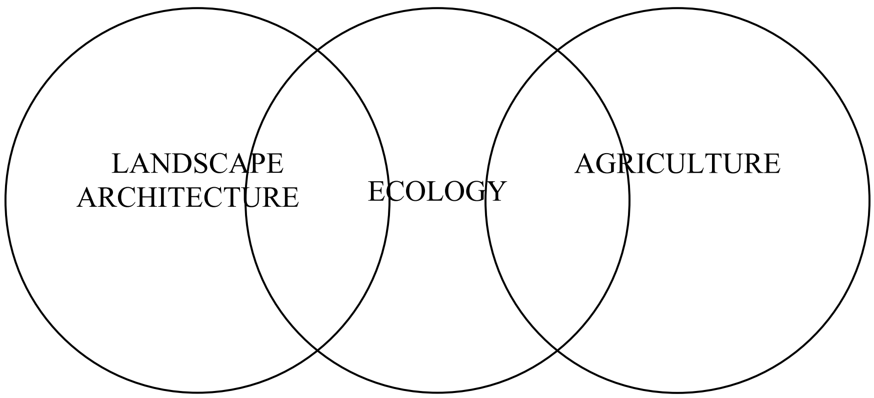
Figure 1.2 Sheep Meadow, Central Park, New York City (Rogers 2001)

Figure 1.3 Long Meadow, Prospect Park, Brooklyn, NY (Rogers 2001)

Olmsted established a landscape architecture firm in New York City and went on to design parks in many American cities. Olmsted's firm pioneered ideas such as design to mimic natural systems, environmental inventory and analysis, and regional planning. As the profession matured in the early twentieth century, this legacy would be challenged by a reverence for design which celebrated only the art of landscape architecture. Despite this split within the profession, landscape architecture continued to profit from its roots in agriculture. For example, several landscape architecture departments were established within Agricultural Colleges at major universities. The "agricultural trunk" from which landscape architecture emerged can provide new sources of inspiration and professional development to today's landscape architect. The next chapter will explore one of the most important branches of thought to emerge in recent decades.

CHAPTER 2

THE ECOLOGICAL PARADIGM IN LANDSCAPE ARCHITECTURE AND AGRICULTURE



An explanation of the historical development of an ecological paradigm within both landscape architecture and agriculture is essential in understanding how landscape architecture and ecology might work together to improve sustainability in agricultural systems. Landscape architecture and agriculture share many of the same cultural and environmental catalysts which led to new practices reflecting an understanding of ecology. Often they claim the same source of inspiration and were influenced by the theories and opinions of the same scientific, political, and cultural figures. It is an intriguing history with many surprising parallels. This chapter does not compromise a detailed history of landscape architecture and sustainable agriculture. Rather, it concentrates on how landscape architecture and sustainable agriculture have been influenced by many of the same events, ideas, and people and seeks to establish a shared history of ecological thought and practice.

I have identified two main periods in which environmental and cultural concerns served as a catalyst for ecological developments in both landscape architecture and agriculture. The first of these is from 1930-1940. In this section I focus on the cultural and environmental events surrounding the Great Depression and the soil crisis which led to more environmentally aware practices in both landscape architecture and agriculture. The second "catalyst" period involves the advent of the Green Revolution and the beginning of the Environmental Movement in the United States, from 1960 to 1980. In this section I will discuss the significant effect these movements had on the development of sustainable agriculture and ecological design in landscape architecture.

The 1930's: The Great Depression, the Soil Crisis, and the New Deal

Nature still offers her bounty and human efforts have multiplied it. Plenty is at our doorstep, but a generous use of it languishes in the very sight of the supply.

-Franklin Delano Roosevelt, "First Inaugural Address" in 1933

The social and economic changes begun in the nineteenth century continued in the twentieth. Industrial wealth and power continued to replace agrarian life as cities expanded and the cultural traditions associated with agrarianism were replaced with a radical modernity. Two distinct paths now existed in landscape architecture. Although Olmsted's practice greatly influenced the direction of the new profession towards an emphasis on conservation and regional planning, the practice of landscape architecture and the design curriculum at schools like Harvard became oriented to the Beaux-Arts, a design philosophy which was primarily concerned with aesthetics and the creation of formal gardens and estates. By the beginning of the century, the shift to commercial agriculture was nearly complete and farming practices had changed dramatically to keep up with market demands. From 1909-1914 American agriculture would experience a "Golden Age" as commodity prices rose faster than farm expenses. With the beginning of World War I (1914-1918), the government encouraged farmers to increase production to serve new European markets. Farmers responded by increasing the amount of land under cultivation and by borrowing money on credit. Following the war, this brief prosperity would ultimately lead to an economic downturn. An increasing reliance on the federal government's agricultural policies, as well as the use of scientific and technological advancements, defines this period. The industrialized commercial agriculture which resulted contributed to the economic and environmental problems which define the period.

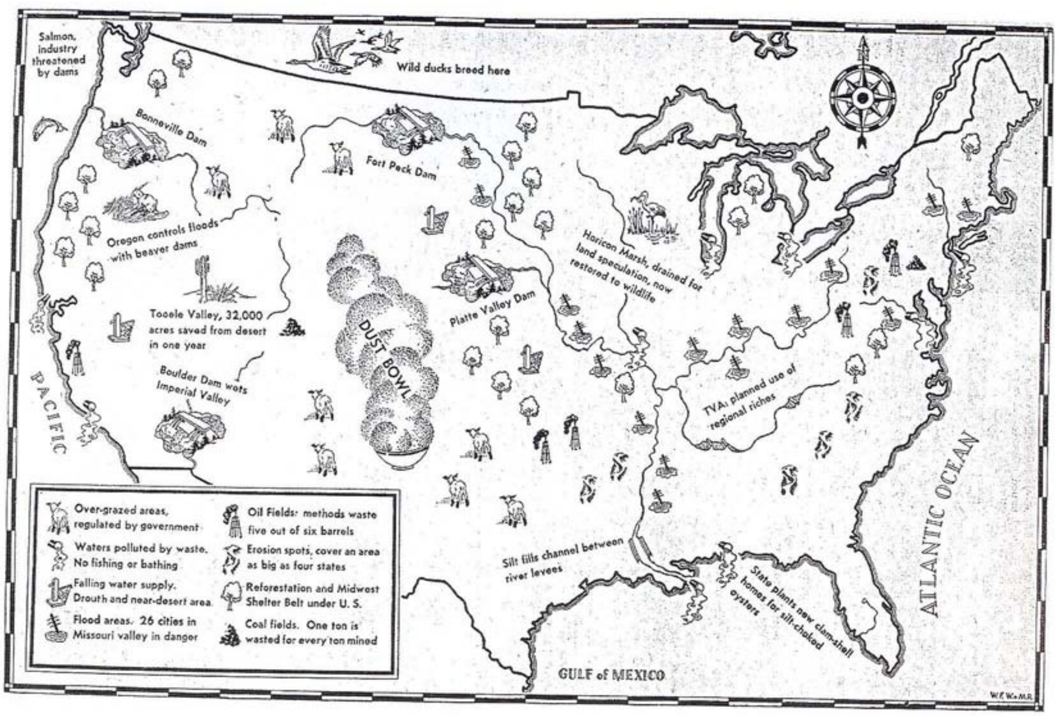


Figure 2.1 Conservation Map of the United States, 1936 (Black 2000)

With the beginning of the Great Depression in 1929, the country experienced profound social upheaval as millions of Americans lost their jobs. The overwhelming sense of crisis which developed as a result was made worse by the occurrence of major ecological disasters. These disasters, combined with the nation's economic worries, shook America's confidence in the "new era of mass culture and mass consumption" that "challenged many things once held dear" and resulted in "an increasingly complex and intertwined world" (Beeman and Pritchard 2001). The Dust Bowl resulted in the loss of 300 million tons of soil from the Great Plains. An agricultural system which concentrated on production rather than longevity and stewardship were to blame for the devastation. Drought and flooding added to the hardship. President Franklin Delano Roosevelt responded to the economic, environmental, and social crises of this period with the New Deal (1932-1941). This recovery plan represents an unprecedented attempt by the federal government to reorganize American society with sweeping economic reform and implementation of new programs which attempted to regulate man's impact on natural resources. New Deal planning implemented a national ethic of conservation through an environmental agenda that would have important ramifications for landscape architecture and agriculture.

Landscape Architecture and the New Deal

The Great Depression and the New Deal played a critical role in the history of landscape architecture, sounding "a deathknell for 'single-track eclecticism' and reorienting landscape architecture towards an environmental conscience" (Miller 1999). By 1934, 90% of all landscape architects were employed by the federal government through New Deal Programs including the Civilian Conservation Corp, the Tennessee Valley Authority, the Works Progress Administration, as well as the pre-existing National Park Service and Forest Service. This is a significant number, considering that only ten landscape architects were employed by the National Park Service (just three by the Forest Service) prior to the New Deal and that in 1933, 90% of landscape architects were unemployed (Olin 1990). During this period landscape architects "shaped essential aspects of many recreation and conservation programs, an experience that permanently altered their profession" (Carr 1999). Prominent New Dealers, such as Harold Ickes (Director of the Public Works Administration and Civilian Conservation Corp) and landscape architects like Earle Draper, Elbert Peets, and Stanley Abbot advanced the profession's environmental scope and orientation with projects ranging from dam construction to town and parkway design. As landscape architects became engaged in the design of these public landscapes, they were charged with addressing the social, economic, and environmental concerns of the American public. The landscapes that resulted remain an important part of America's national identity and continue to serve as models for the profession.

Agriculture and the New Deal

From an agricultural perspective, the New Deal put the weight of the federal government behind agricultural reform and supported America's first movement towards sustainable agricultural practices. Just as in landscape architecture, newly created federal programs and agencies (including the Agricultural Adjustment Administration, Soil Conservation Service, and Ressettlement Administration) helped implement a new ethic of conservation in agriculture. Randall S. Beeman and James A. Pritchard document the Permanent Agriculture Movement in their book *A Green and Permanent Land: Ecology and Agriculture in the Twentieth Century*. In it, they describe two essential messages of the Permanent Agriculture Movement which are based on planned ecological harmony. The first was the need to "recognize the independent reality of the modern world that meant agriculture must be viewed as part of an interconnected set of components" and the second was a call for an American "society based on permanence as opposed to the past conditions that included a short-term, exploitive and unplanned land management system" (2001).

As both a social reform movement and an agricultural reform movement, Permanent Agriculture represents an important historical reference for landscape architects, agriculturalists, and ecologists who are seeking a sustainable alternative in agriculture. Its methods were based in the empirical study of ecology as well as the more philosophical and spiritual hope that it would create a better society (see Table 2.1). The techniques of Permanent Agriculture were an outgrowth of research performed in organic agriculture in England in the 1920's and 1930's by Sir Albert Howard who "extensively developed the idea of emulating nature" in agricultural systems (2001). Permanent Agriculture also hinged on the idea of regional planning, the practices of biodynamic agriculture and observations of Chinese peasant agriculture.

The movement was supported by two prominent New Dealers—Hugh H. Bennett (Director of the Soil Conservation Service) and Rexford G. Tugwell (Undersecretary of Agriculture at the USDA and Director of the Resettlement Administration). Although permanent agriculture was just one component of sweeping New Deal agricultural reforms, these two men championed the principles upon which it rested and "helped bring some changes in theory, practice and policy of agriculture… [and] converted many to the idea that 'farms must be treated as organic, integrated units,' interdependent with the greater physical, social, and economic environment" (Beeman and Pritchard 2001). This government support for a sustainable and ecologically based agriculture during the thirties was a direct result of the environmental crisis of the dust bowl and was part of a larger picture of social and cultural reform which gripped the nation. Permanent Agriculture and landscape architecture were both influenced by two important components of this era of reform: regional planning and the science of ecology.

Table 2.1 Permanent Agriculture

3 Essential Components of Permanent Agriculture: • The building of humus through the incorporation of organic material into the topsoil • Maximum crop diversity or mixed farming • Provide a permanent cover of vegetation as a protective skin for the soil
The Benefits of Permanent Agriculture: • Restore ecological harmony between people and the land • The salvation of rural life and the revitalization of the Jeffersonian ideal • Economic Prosperity to support revitalization of rural life • Produces health benefits for humans • Creates the conditions necessary for a peaceful world
From *A Green and Permanent Land* by Randall S. Beeman and James A. Pritchard, 2001

Regional Planning & Ecology in the 1930's

In order to appreciate the sea-change which this time period represents, it is important to explore the development of two influential disciplines that impacted both landscape architecture and agriculture during a decade of reform: regional planning and ecology. By the 1930's, industrialization and urbanization threatened the rural landscape and rural communities. Technology, employed by the industrialist and farmer alike, became an increasingly dominant force in America. However, critics of this machine mentality and unchecked growth did exist, and they voiced the opinion that development must be tempered by planning and an understanding of the environmental cost of land management decisions. The regional planning movement and the rise of ecological science were a result of the social and environmental costs of industrialization. Both had important ramifications for how landscape architecture and agriculture were practiced in America.

An important leader in the regional planning movement in the 1920's and 1930's was Lewis Mumford. Believing that technology robbed us of our humanity, Mumford advocated for a utopian form of technological application and "held the conviction that humans must apply their mind and technology to environmental problems" (Black 2000). He believed that people could form "a respectful marriage between human technology and the natural environment" and that regional planning could create a rural-urban and agricultural-industrial balance (2000). Mumford also contributed to the cause for sustainability in agriculture by advocating for a form of planning which envisioned "a new framework of farms and villages and cities and regions, which will make industrial organization subordinate to the demands of nature and education and living" (Beeman and Pritchard 2001). The planning ideals of Mumford informed New Deal programs and manifested itself in plans for new towns and in the application of technology towards conservation.

Mumford's idea of a balance between the rural and the urban landscape was echoed in The emerging theory of ecosystems became the foundation of America's new conservation ethic. During this time, the climax concept dominated ecological theory and held that all communities (plant, animal, and human) evolved from simple to complex and achieved "climax" when they reached a stable state characterized by harmony and equilibrium. The idea of interdependence of human and natural resources was at the core of ecology's influence and was "fundamental to understanding the social and biological dimensions of the soil crisis" (Beeman and Pritchard 2001). This understanding informed a new ethic of resource management away from the Pinchot Era of wise use, implemented in early Forest Service management policies, towards "a new era of seeing life as a vast web of interconnections, with human beings simply one of many delicate strands" (2001). Ecological theory outlined by ecologists such as Frederick Clements introduced planners and designers to the idea that "nature should be used as a guide and that the indigenous flora should be respected instead of altered" (Black 2000). Ecology also informed the early ideas of city planners during this period, who advanced the notion of urban ecology and "contributed to the more holistic, social, reformist, and political aspects of ecological thought" (Beeman and Pritchard 2001). In agriculture, ecologists began to conduct research that would help deter unsound practices and validate the argument for permanent agriculture, forming the foundation of the methods and techniques that it advocated. Regional planning and the science of ecology, together, offered a rational scientific approach to decision making that would help guide the country out of its present crisis.

Achieving Balance through Conservation during the New Deal

It is helpful to discuss how the concepts of regional planning and ecology, as they were applied during the New Deal Era, contributed to the evolution of sustainability and ecological design in landscape architecture and agriculture. The ideal of conservation is at the core of this discussion. Before this period, conservation was not a philosophy which Americans had broadly considered important or necessary for their day to day survival. The New Deal brought conservation home, broadcasting its ethic through a variety of media and educating the public on the principles and practice of environmental awareness. In landscape architecture and agriculture, professionals rose to the challenge, producing a new vision of America by implementing ideas which fostered growth, social stability, and conservation.

An important early advocate of conservation was Rexford G. Tugwell. Tugwell's advocacy for both permanent agriculture and urban design exemplifies the argument for better integration and communication between the disciplines of landscape architecture and farming. Tugwell was part of President Roosevelt's braintrust, helping to conceive the New Deal in its early days. He would serve as Assistant Secretary and then Undersecretary of Agriculture at the USDA from 1933 to 1939. He was a controversial figure who "preached a gospel of planning cooperation, and societal permanence, laced with increasing portions of interdependence and ecological ideas" (Beeman and Pritchard 2001). He was opposed to monoculture and cash crop farming, believing that it was responsible for the devastation witnessed by the dust bowl and the economic fallout of the depression years. He was a firm believer in the principles and practices of permanent agriculture (see Table 2.1) and he

> envisioned a system of rural-urban balance, arising from new, smaller scale manufacturing technologies and better transportation, and predicated on semi-agricultural 'rurban' villages where part-time employment in industry or forestry would be supplemented by five-acre family subsistence plots. He fiercely advocated highly effective soil conservation and a switch in land use from regional monocultures to regionally designated tree, fruit, or grassland agriculture (2001).

This vision found application in his leadership of the Resettlement Administration (RA). Described by Elizabeth Barlow Rogers in *Landscape Design: A Cultural and Architectural History* (2001) as "an ardent disciple of Ebenezer Howard", Tugwell led the RA in the design and planning of new model communities which would be better able to balance the conflicting demands of America's rural-agricultural and urban-industrial landscapes. The Greenbelt Cities Program was operated under the RA and was responsible for the creation of new towns like Greendale, Wisconsin.

Greendale was designed by Elbert Peets, a landscape architect who worked under Tugwell at the RA. In 1999, Landscape Architecture Magazine identified Peets as an important influence on twentieth century urbanism, remarking on his "unique ability to appreciate historic cities and to adapt their precedents to modern planning" (Martin 1999). The design for Greendale embodied Tugwell's "notion that the soil crisis and the human crisis could be countered through education, planning, and creating an ideal rural-urban balance" (Beeman and Pritchard 2001). Greendale was designed for a population of 12,000 and was composed of three main housing clusters, totaling 3000 houses. The town plan also included a 2000 acre greenbelt that preserved the agricultural landscape and the working farms which occupied it. The picture below (Figure 2.2) is a bird's eye view of Greendale that shows house lots, kitchen gardens, and agricultural fields beyond the town perimeter. The design of Greendale and other Greenbelt Cities under the New Deal represents an important union of landscape architecture, agriculture, and conservation.

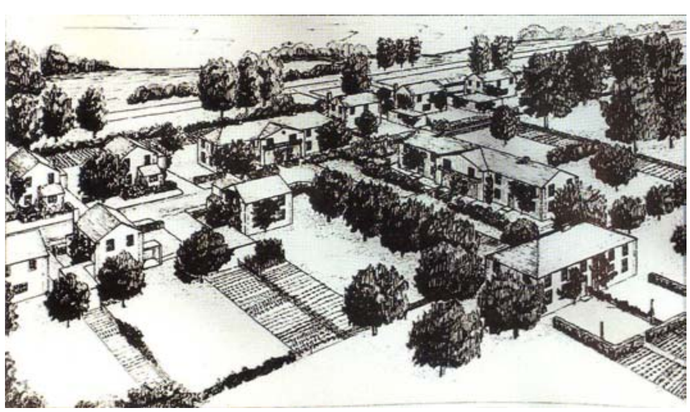


Figure 2.2 Greendale, Wisconsin (Rogers 2001)

Reformers of the New Deal Era understood that the success of the Permanent Agriculture Movement and regional and urban planning efforts hinged on broad social and cultural changes away from the urban-industrial model towards one which better balanced industry with agrarianism. Unfortunately, America's involvement in World War II would put an end to these hopes as New Deal projects and programs shut down and the country prepared for war. During the war, acreage under production would increase by 5% and advances in science and technology would increase by 11% (Hurt 2002). After the war, American agriculture "became further integrated into a vast technological and marketing system, even more dependent on capital, agribusiness, and experts in the agricultural colleges" (Beeman and Pritchard 2001). Support for Permanent Agriculture dissipated as federal programs encouraged excess production. By 1960, America would begin another era of agricultural reform with the beginning of the Green Revolution.

<u>The 1960's-1980's: The Green Revolution and the Environmental Movement Make their Mark on Landscape Architecture and Agriculture</u>

The most alarming of all man's assaults upon the environment is the contamination of air, earth, rivers, and sea with dangerous and even lethal materials. This pollution is for the most part irrecoverable; the chain of evil it initiates not only in the world that must support life but in living tissues is for the most part irreversible. In this now universal contamination of the environment, chemicals are the sinister and little recognized partners of radiation in changing the very nature of the world—the very nature of its life.

-Rachel Carson, *Silent Spring,* 1962

The Green Revolution is the term used to describe the scientific and technological advancements made in agriculture after World War II that forever changed the scale, method, and culture of farming. The advances in agricultural technology which the Green Revolution brought to farming worldwide and the changes that these advancements brought to rural life represents for its critics “Western scientific hubris, anthropocentricism, and ecological blindness” (Beeman and Pritchard 2001). American reliance on machine technology, such as tractors and mechanical harvesters, led to an increase in the amount of land each farmer had under production and crop specialization (monoculture). This new technology “aided large-scale, capital-intensive rather than small-scale agriculturalists, the latter most often associated with the family farm” (Hurt 2002). By the end of the twentieth century the agricultural population had dropped to less than 2% of the total population, yet each American farmer provided agricultural products for 93 people (2002). The Green Revolution also included the use of chemical and genetic technology, including the widespread use of chemical fertilizers, pesticides and herbicides, and expensive hybrid seeds. This linear systems approach to farming combined the talents of agricultural engineers, horticulturalists, and agronomists. Oriented toward the large-scale grower, it resulted in “bankruptcy and flight” as thousands of farmers were forced to leave their land when they could not meet expenses. The net result of the Green Revolution was an increase in the amount of acreage under production, a decrease in the number of farmers, widespread pollution caused by agricultural chemicals, and what Wendell Berry referred to as a “crisis of the spirit” in America.

In landscape architecture, technology was similarly celebrated. Modernism emerged after World War II and advanced a philosophy that expressed through design the idea that machine technology would solve all of humanity’s problems. Implicit in modernism’s affinity with technology was a separation from nature in the pursuit of a universal design approach that could be applied to all people regardless of class, culture, or location. The public life of landscape architecture epitomized by pre-war America would give way to a new post-war clientele composed of the suburban homeowner and the corporate campus. Yet, as early as 1954, opposing voices began to emerge to confront what many landscape architects regarded as a "dangerous ideology" (Conan 2000). Inspired by the environmental fallout of the Green Revolution, landscape architects and ecologists began to advocate for better management of earth's finite resources through an ecological approach to development and agriculture.

The publication of Rachael Carson's *Silent Spring* in 1962 was central to the development of a new ecological paradigm in both landscape architecture and agriculture. In this groundbreaking book, Carson detailed the devastating impact of agricultural and industrial pollution on America's water, air, plants, animals, and people. The book's "well reasoned, meticulously researched arguments forced the American public to seriously consider the wide environmental effects of mechanized, chemically intensive production-oriented agriculture" (Beeman and Pritchard 2001) and "turned [landscape architects] toward the fundamental issues of environmental management" (Olin 1990). In agriculture and landscape architecture, ecology became a guiding force by providing an ethical holistic perspective which informed new techniques for both disciplines.

Establishing an Ecological Paradigm in Landscape Architecture

In landscape architecture Ian McHarg and Lawrence Halprin provided the theory, methodologies, and models for designers who wished to advance an ecological approach. Ian McHarg is widely recognized as the central figure in the redefinition of landscape architecture in the United States. With the publication of his book *Design with Nature* in 1969, his methods of inventory and site analysis soon became mandatory in landscape design curriculums across the country. McHarg's method "dictated that any site must be seen as part of the larger organism and must be treated with respect to problems faced by the organism as a whole" (Conan 2000).

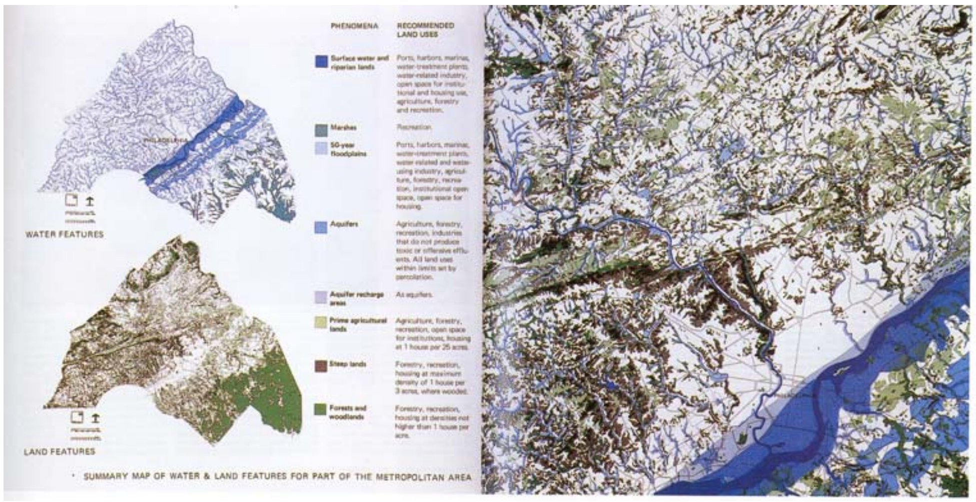


Figure 2.3 Environmental Analysis by Ian McHarg (Rogers 2001)

His use of ecological principles provided a scientific legitimacy to his methods as well as a social and moralist point of advocacy for landscape architects struggling to redirect the profession toward environmental concerns. McHarg believed that landscape architects were uniquely poised to guide society through the environmental crisis at hand. The profession's tradition of pooling knowledge from multiple disciplines and it's direct relationship as mediator between man and the earth, imbued landscape architecture with a relevance missing since the demise of New Deal environmentalism. McHarg argued that

> What the world needs from landscape architecture is an enlarged vision, greater knowledge, and commensurate skill. Landscape architects are engaged in the

> challenge of adaptation. They must acquire the accomplishments that can make a significant contribution to preserving, managing, planning, and restoring the biosphere, to designing human environments (McHarg 1997).

McHarg's technique assigns levels of density and development along with categories of land use and is based on extensive ecological, geological, hydrological, and cultural inventories. This technique has become a standard part of the curriculum at landscape architecture programs world-wide, including the University of Georgia. It has, however, been criticized by many designers as lacking form due to its strict application of scientific methodology. Landscape architecture, as a design profession, must strike a balance between art and ecology. Today, McHarg's techniques are viewed as a tool used to guide design decisions rather than dictate them. During this period, another important designer rose to the challenge of ecological sensitivity in landscape architecture. Unlike McHarg, his design technique was rooted in an emotional experience of place.

Like McHarg, Lawrence Halprin published a groundbreaking book in 1969, *RSVP Cycles*, in which he described the idea of scoring. Inspired by both dance and ecology, Halprin describes a design process in which spatial frameworks are created "that allow for change over time and within each other can play participatory riffs" (Rogers 2001). Halprin's work "represented a first step toward creating a design vocabulary predicated on landforms created by natural processes, such as erosion and deposition due to water and wind" and "represented a type of critical practice that gave form to ecological environmental values through the construction of experience" (Meyers 2000). A seminal project of this era in landscape architecture is Halprin's *Sea Ranch*, a community near Gualala, California.

Described as a “a striated landscape of open meadows framed by monumental hedgerows” Sea Ranch gave a form to the ecological methodology of McHarg (2000).

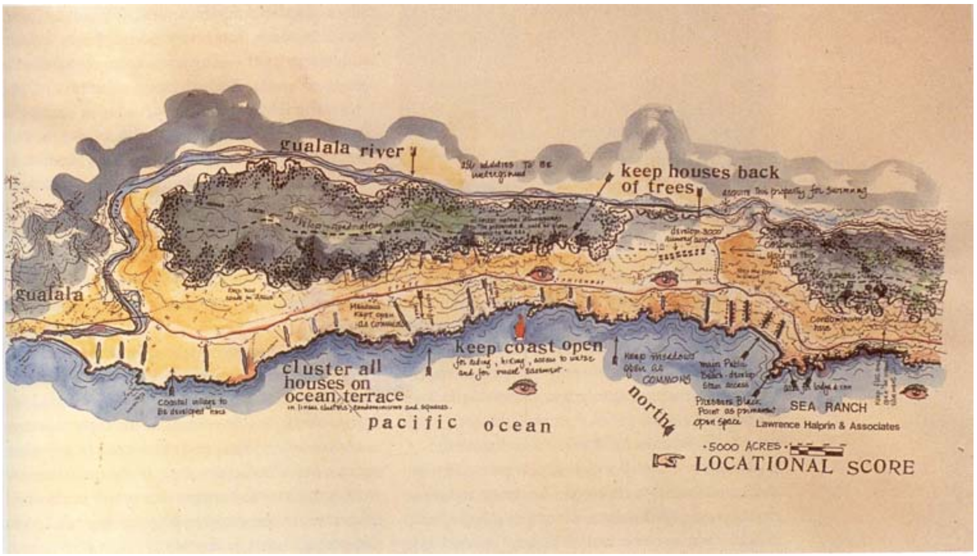


Fig. 2.4 Sea Ranch by Lawrence Halprin (Rogers 2001)

Sea Ranch was considered a prototype of how landscape architects could plan development with nature and do so in a creative and artistic way. The project represented a year of intensive site study by Halprin and a team of landscape architects, scientists, and architects. The process of design and intensive environmental analysis included,

> [Qualitative] observations about the experience of the place, an ecoscore graphically depicting the forces of change over an expanse of geological time, and a synthesis of their site interpretations in the form of landscape and architectural design guidelines. The resulting master plan reinforced the shaping processes of the landscape—grazing, the directionality of the wind, and the erosive power of the water—by clustering buildings and the streets along the hedgerows and by leaving the meadows open (Meyer 2000).

Lawrence Halprin's successful merging of ecology and design is an important model for landscape architects. While Halprin and McHarg worked to apply ecology to design, others worked to apply ecological principles to technology in the hopes of creating a more sustainable agriculture.

Establishing an Ecological Paradigm in Agriculture

The 1960's marked the beginning of the second movement in sustainable agriculture in the United States. The social and ecological failures of the Green Revolution were central to this movement and would result in a number of different ideologies based on the principles and techniques of organic farming and "scientific and ethical imperatives provided by ecological theory" (Beeman and Pritchard 2001). In this section I will discuss three different individuals who helped to shape this movement. Unlike the Permanent Agriculture Movement before it, this movement did not enjoy government support. Its leaders were outsiders and idealists who believed that agriculture could be practiced in a more harmonious way. Some were scientists, others were political activists, and some were traditional farmers. All were concerned with creating a sustainable ecologically sensitive agriculture and with improving humanity's relationship with the earth through farming.

John Todd was trained as a marine biologist, but in 1969 he left this field of study to devote his life and energies to sustainable ecological design. The negative public sentiment concerning science, technology, and its disastrous ecological and social results led Todd to explore the possibility of an alternative. Todd believed that through ecological design, science and technology could be developed in such a way as to "be seen in a much more exquisitely whole light, as a science of assembly, where knowledge could be reintegrated around a whole theme of reverse stewardship" (Todd 2000). In 1970, he and his wife founded the New Alchemy Institute in Falmouth, Massachusetts with a principle goal of uniting ecology and agriculture through "the development of new world skills and technologies" (Beeman and Pritchard 2001). Todd and others at the institute attacked Green Revolution technology and its environmental consequences and advocated for "small and innocuous technology" that would be "autonomous, human scale, low energy, low pollution alternative to 'supertechnology'" (Green 1976). Such technology included solar energy, microcomputer application, aquaculture, composting, small high-yield gardens, the biosphere concept, and living machines©. According to Todd, the principle question which he and others at the institute were asking was, "Is the way we raise food—shuttling food several thousand miles before it ever reaches the table—does it make sense?" and they posed the following design problem (Todd 2000):

> Is it possible to grow the food needs of a small group of people in a small space without harming the environment and without enormous recourse to external sources of energy and materials on a continuing basis? ...Could we design a system that is self-sustainable and capable of functioning as a system (2000)?

Table 2.2 Sustainable Agriculture

Ecology in Sustainable Agriculture (1960-1985)

1. *Employed ecology to create new environmental ethics.*
   "agricultural sustainability required a cultural change entailing a new devotion to ecological stewardship and responsibility."

2. *Ecology informed a revived holistic perspective on environmental problems.*
   "agriculture had to be refashioned in order to promote better health for all life but especially for human life, and to find less disruptive technologies that would preserve the planets overall ecological community."

3. *Ecology informed technique.*
   "In proposing systems such as agroecology, organic farming, permaculture, and perennial polyculture, advocates of the new farming sought to reharmonize agriculture with the natural environment, creating long term productivity and ecosystem health."

From *A Green and Permanent Land* by Randall S. Beeman and James A. Pritchard, 2001

The New Alchemy Institute worked throughout the 1970's to develop living machines© that could provide food, waste treatment, fuels, climate, heating and cooling, and architectural integration. Their systems were designed to integrate into urban settings and they began to address through ecological design a breadth of social and environmental issues including housing and village design. The work continues today at Todd's Ocean Arks International, founded in 1981.

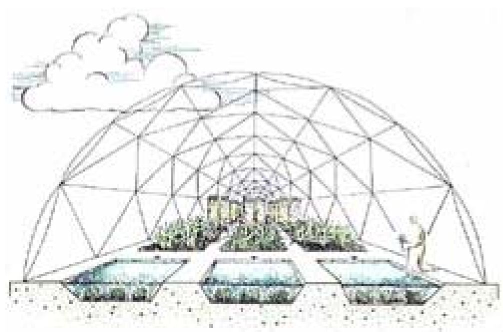


Figure 2.5 Todd's Living Machine© (Todd 2000)

Interestingly, the words which John Todd chose to describe the process of design which he and his colleagues used to tackle their first project in the 1970's echo the concepts and methods of McHarg and Halprin, who had by this time both published their books. Although he does not mention them by name, their ideas were clearly present in Todd's work. When describing the institute's first project, a design for a community in the Tecate Mountains of California that wished to be completely self-reliant for all their energy and food needs, Todd describes a process that incorporates McHargian analysis and Halprin's design process. He writes:

> Our response to that experience was to learn all we could about that place, its microclimates, geology, its botany, its zoology. As we studied it, it began to tell us what the latent potential of the area was. Working in that particular spot, we

> began immediately to move into bodies of knowledge…and, all of a sudden, this site just simply opened up the whole idea of an earthly science that had to encompass the most advanced ideas and material engineering…But it had to be recast in a new light, this dream of balance…this concept of all kinds of strange things that technologists don't think about, pulses—day and night, seasons, cold, warm—how to design all these things so that they dance with each other to create a whole system that self-designs, that becomes intelligent. All of a sudden you are talking about a technology that is alive, a living machine (Todd 2000).

The dance that Todd describes is exactly what most interested Halprin and the process of site inventory and analysis which he writes of could very well be modeled after McHarg. John Todd continues to develop systems of food production which function as living machines. His theories are an important example of the dynamic crossover which can occur between scientists, landscape architects, and farmers.

Another voice in the sustainable agriculture movement of the 1970's was a husband and wife who began their advocacy for an organic lifestyle in the 1950's. Scott and Helen Nearing espoused "simple, non-consumptive living, vigorous physical and mental exertion, and the use of composts, natural fertilizers, and pest fighters in their greenhouse and gardens" (Beeman and Pritchard 2001). They first published their book in 1954, but their philosophy became renowned when it was republished in 1970. *Living the Good Life* not only detailed the organic techniques employed by the Nearings on their farm, but offered an alternative to the mass-culture, consumerism, and corporate capitalism which typified America, a mentality many young people of the time were revolting against. The Nearings played an important role in the sustainable agriculture movement by preserving the culture of organic farming and many of the principles of the permanent agriculture movement established in the 1930's. They also represented a model for a different way of life and were important symbols of the counter-culture of the 1960's and 1970's. The ideas espoused by the counter-culture movement, especially the back to the land movement, also played an critical role in reviving the idea of permanence and sustainability in American agriculture.

Another important voice in sustainable agriculture was Robert Steffen who, as a "college-trained production agriculturalist", rejected conventional wisdom and managed a 2000 plus acre farm in Omaha, Nebraska on a completely organic regimen (Beeman and Pritchard 2001). Steffen was a follower of the biodynamic school of organic farming and managed the farm on a regime that used zero chemicals, and instead made use of composts, green manures, and crop rotations. In 1970, Steffen wrote that agriculture was "'deeply involved with the religion of production and the god of efficiency, which of course are the basic tenets of any successful industry. Until we realize that more is not always better and that quality is not always something that inevitably follows quantity we will never solve the current environmental problems'" (2001). The biodynamic method will be explored in more detail in the following chapter. Steffen's advocacy of an alternative to production agriculture and his successful application of its organic methods on a large scale is an important example of the possibilities of sustainable agriculture. The rise of sustainable farming during the 1970's is a story of individuals and groups of individuals who desired an alternative and challenged the agricultural establishment and its unchecked use of chemicals. Public awareness grew as these alternative voices rang out and people began to demand change.

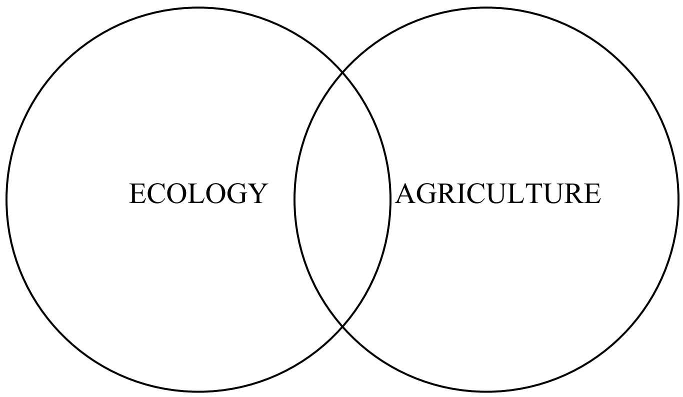
As organic foods became popular, even fashionable in the 1970's and 80's, the agricultural establishment took note. The American public began to demand safer food and production systems that did not pollute the water and land, and with it, human and animal populations. A market for organic produce emerged, made evident with the establishment of

> a growing number of organic producers' associations with links to large food processors and distributors, to the burgeoning supply business for organic farmers, and to the formation of such groups as the International Federation of Organic Agriculture Movements in 1972 as signatory of the successful infiltration of the new holism into American agriculture (Beeman and Pritchard 2001).

The popularity of organic foods has grown in the decades since. The USDA established its own guidelines for regulating organic food production with the Organic Foods Production Act of 1990, helping organic products to enter the mainstream and increasing their availability to the consumer. However, organic production represents just one model of ecologically based agriculture. Three other models have also developed which employ ecological design in order to create more sustainable agricultural systems. In the next chapter I will explore all four of these models and some of the techniques which represent them.

CHAPTER 3

FOUR MODELS OF ECOLOGICAL DESIGN IN AGRICULTURE



Several ecological design strategies have emerged in agriculture which seek to produce food for human populations in ways which are sustainable in that they do not cause adverse environmental impacts, allow for growth in yield, and are reliable and consistently productive. The focus of these strategies varies and therefore their design strategies vary. For instance not all approaches make biodiversity an objective. Instead, they may focus on creating a system which integrates ecosystem functions at the field level in order to eliminate the need for chemical inputs. The approach might indirectly contribute to biodiversity, but the model is not constructed with this objective in mind.

In order to ascertain the different focus areas illustrated by ecological design strategies within agriculture I have identified four models which describe different approaches to increasing sustainability within agriculture. The four models are the process model, the structural model, the cultural model, and the biodiversity model. The *process model* and *structural model* were first identified and described by Judith D. Soule and Jon K. Piper in their book *Farming in Nature's Image: An Ecological Approach to Agriculture.* The last two models, the *cultural model* and *landscape model*, I have identified to describe two other important avenues of ecological design within agriculture. Each of these models has a particular type of agriculture associated with its objectives. Together they illustrate the diversity of approaches existing within the current movement towards a more ecologically sound agricultural system. It is important to note that these four models (*Process*, *Structural*, *Cultural*, & *Landscape*) are not mutually exclusive. Elements of each model can be found in the others. However, the focus of each model is distinctively different and categorization will help the reader understand the similarities and differences between the four approaches.

The purpose of this chapter, therefore, is to briefly describe the objectives of these four models and to give the reader an introduction to the principles at work through the different design strategies. While many of the details of these approaches have been developed by ecologists and other scientists, working farmers are also at the heart of these approaches. It is important to keep in mind that farmers, while not mentioned explicitly in the following definitions, represent a critical step in applying these methods to working farmland. Likewise, this chapter does not attempt a detailed analysis of the ecological, economic, or cultural implications or realities of these models. It is intended to provide a brief review of the ecological design strategies which are currently active within agriculture. Table 3.1 on the following page provides a brief explanation of these four models and their associated agricultural approaches.

Table 3.1 Ecological Design Models in Agriculture

MODEL	APPROACH	OBJECTIVE	SCALE
PROCESS	Organic Agriculture	Uses natural ecosystem processes to replace the use of chemicals and other inputs.	Small Farms & Large Farms
STRUCTURAL	Natural Systems Agriculture	Uses nature as a model for agricultural systems by mimicking the vegetation of regional plant communities.	Small Farms, Large Farms, Region, & Communities
CULTURAL	Permaculture	Landscape planning in order to design sustainable agricultural systems within human settlements.	Small Farms & Communities
LANDSCAPE	Ecoagriculture	The management of landscapes for both the production of food and the conservation of ecosystem services, in particular wild biodiversity.	Small Farms, Large Farms, & Region

The Process Model: Conventional & Organic Agriculture

The Process Model, as described by Soule and Piper "attempts to employ some ecological processes that occur in nature without imitating the vegetation structure of a natural community"(1991). This model involves transplanting one or a few ecological processes into conventional systems of agriculture. Organic agriculture and its associated practices also fall under the Process Model. Organic agriculture has developed several practices which replace the use of chemicals with ecological processes. However, organic agriculture does not necessarily seek to increase biodiversity by creating habitat for native plants and animals on the farm. Its principle aim is to produce food without contributing to environmental or human health concerns through the use of conventional pesticides, fertilizers made with synthetic ingredients or sewage sludge, bioengineering, or ionizing radiation (USDA Organics). Organic production emphasizes the use of renewable resources and the conservation of soil and water, but it is not directly concerned with issues of biodiversity and cultural sustainability. However, many practitioners of organic agriculture are indeed concerned with such questions and do address these issues on a small scale, in ways which vary from farm to farm.

It is important to note that organic operations may be quite large and incorporate elements of the industrial model, such as mono-cropping and mechanized harvesting. Likewise, organic agricultural operations may incorporate socially unsustainable practices, such as unhealthy working conditions and the use of cheap migrant labor. The co-option of organic agriculture by the larger agribusiness complex is of concern to many ecologists and agriculturalists who believe that biodiversity and social justice continue to suffer as a result of large scale organic farming operations. Therefore, it is important to keep in mind that organic operations may be run as part of the industrialized agricultural complex, using non-renewable resources for production, transportation, and marketing purposes and contributing to the continuation of a socially and ecologically unsustainable agricultural system. The following examples of techniques at work within the Process Model are applied to both conventional and organic agricultural operations. Two of the examples, Integrated Pest Management and conservation tillage, may require chemical inputs and therefore contribute to environmental damages associated with pesticide use.

3 Examples of Ecological Processes Used in Conventional & Organic Agriculture:

Integrated Pest Management (IPM)

Figure 3.1 *C. septempunctata*

IPM is a form of biological control of pests based on an understanding of predator-prey and host-parasite interactions and insect life-history patterns in nature (Soule and Piper 1991). This technique, when practiced wisely, emphasizes "*proactive* measures to redesign the agricultural ecosystem to the disadvantage of a pest and to the advantage of its parasite and predator complex" (1991). The technique also includes *reactive* methods that are more commonly used in a conventional agricultural setting (ie. on non-organic operations) without the benefit of proactive measures. It is this lack of emphasis on proactive measures which has earned IPM critics who believe that the technique lacks a more holistic approach. Its acceptance of chemical use, such as synthetic pesticides and fungicides, when biological controls fail has also been criticized.

Proactive measures within IPM permanently lower the farm's carrying capacity for pests, which is determined by factors such as food availability, shelter, the presence of natural enemies, and weather. Proactive measures include crop rotation and the creation of habitat for beneficial organisms. Reactive measures of IPM are commonly utilized when pest problems do not respond to proactive measures or when such measures are nor undertaken. Reactive measures include inundative releases of biological controls (example: lady bugs for the biological control of aphids), mechanical and physical controls (examples: tillage, flaming, flooding, soil solarization, and plastic mulches to kill or prevent weeds), and chemical controls (includes both synthetic and botanical pesticides).

Intercropping

Figure 3.2

Intercropping is the practice of raising two or more crops in the same field. The technique has many advantages. As mentioned above, it acts as a form of IPM. Intercropping increases the diversity of the field and acts to confuse pests interested in a particular crop. The use of trapcrops which lure pests away from the principle crop is another popular technique. Likewise, overall field diversity reduces the likelihood and spread of some crop diseases. Intercropping may also increase the efficient use of soil and water resources on the farm, as well as overall land use. By taking advantage of the "complimentary aspects of species' niches" some species demonstrate a tendency to yield more when grown together (Soule and Piper 1991). According to Soule and Piper, intercropped fields "typically yield more per unit area than do equivalent areas planted to monoculture" (1991). Figure 3.2 shows an intercropping of French beans with cilantro.

Conservation Tillage

Figure 3.3 Cotton & Wheat (Boquet 2003)

Conservation tillage encompasses practices that range from no tillage at all, to a reduction in the frequency and the depth of plowing. Systems employing this technique usually allow crop residues to remain on the soil surface rather than being turned under with the plow. Surface litter not only protects the soil from erosion, but allows soil mycorrhizal associations to develop. Reducing tillage also enables soil strata to be maintained which further enhances populations of beneficial soil organisms such as earthworms, insects, fungi, and microbes. Conservation tillage may work to "improve crop vigor, lower levels of diseases and pests, [produce] favorable soil structure, and [retain] nutrients" (Soule and Piper 1991). Despite these benefits, a major draw back of no till agriculture or conservation tillage is the need to apply high levels of herbicides for initial weed removal. This makes it a difficult practice to adopt in an organic setting. However an organic approach to conservation tillage has been explored and some methods developed which eliminate the need to use herbicides. Mulch tillage and ridge tillage are two examples of conservation tillage techniques used within organic agriculture. Figure 3.3 illustrates the use of conservation tillage in conjunction with crop rotation and shows a cotton field surrounded by the residue of the field's previous crop of wheat.

<u>The Structural Model: Natural Systems Agriculture</u>

The structural model of ecological design in agriculture uses nature as a model for agricultural systems by imitating the vegetation of regional plant communities. This model is embodied by Natural Systems Agriculture (NSA), an alternative form of agriculture which is inspired by the vegetative *structure* of natural plant communities. The theory behind Natural Systems Agriculture is that conventional forms of agriculture are unsustainable due to their tendency to decline in productivity and require an increasing amount of inputs in order to maintain productivity. In contrast, native plant communities have the ability to persist through time because they perform the necessary ecosystem functions which allow them to do so. Therefore, Natural Systems Agriculture looks to the structure of local biotic communities as a guide in order to design synthetic communities for agriculture which perform the same ecosystem functions of their wild counterpart. The "ecological capital" of wild ecosystems (including deep rich soil, the ability to fix and hold nutrients, the ability to adapt to periodic stress caused by drought and fire, and the ability to manage weed and pest pathogen populations) also are present in Natural Systems Agriculture (The Land Institute).

Although the structure of Natural System Agriculture varies from region to region based on the ecology and plant communities of its location, the following five characteristics of stable natural ecosystems should be present in NSA's regardless of location (Soule and Piper 1991):

1. Vegetation adapted to seasonal precipitation patterns.

2. Tight nutrient cycles.
3. Compatibility in resource use among species.
4. Soil preservation
5. Biological methods of crop rotation

The first question to ask when designing an NSA is whether agriculture is an appropriate activity for that region. Resiliency of the ecosystem native to that region will supply the necessary answer. Fragile ecosystems should never be farmed. If it is determined that the agriculture is indeed an acceptable use, the NSA approach would then:

> [Look] to native ecosystems to see what types of agriculture will work. It is necessary to understand what makes those ecosystems work sustainably in that particular landscape. Researchers might ask: Why is the landscape here covered with trees? Why is this ecosystem dominated by drought tolerant succulents? Why do C4 grasses predominate here and why are trees scarce
> (Soule and Piper 1991)?

With these questions answered, an agricultural system which mimics the native ecosystem can begin to be explored. The following two examples illustrate how Natural Systems Agriculture might be explored in different regions of the United States.

Agriculture Modeled on the Deciduous Forest

Deciduous forests are characterized by four distinct plant layers: the high canopy, a sub-canopy, shrub layer, and herb layer. This forest type covers a diverse geographic and climatic range along the Atlantic coast of North America from Canada to the Southern United States. Annual precipitation and soil type vary widely, as do the plant communities which dominate in the different regions where this ecosystem structure is present. An important component of the deciduous forest is the periodic disturbance of the forest structure due to falling trees. Tree-fall gaps allow light and precipitation to reach the forest floor and allow understory plants to "increase in vigor, flower, and fruit before the canopy closes once again" (Soule and Piper 1991) These gaps are especially beneficial to birds and browsing animals who use such gaps as sources of food and cover.

Soule and Piper (1991) identified the features of this system which make it an appealing model for agriculture. They include the following:

- A fine and fibrous root system produced by woody understory plants hold the soil and retain nutrients.
- Species which occupy different niches and vertical and spacial diversity favors natural pest control and offers habitat to many animal species.
- Leaching of critical nutrients is prevented by the understory layer which helps retain nutrients by preventing downslope loss.
- Decomposing litter on the soil surface enhances beneficial mycorrhizal relationships.

Two examples exist which provide insight on how to use these naturally occurring features of sustainability present in the deciduous forest. The first example is represented by the agricultural practices of indigenous people living in this ecosystem type prior to European colonization. The small-scale agriculture practiced by indigenous people occurred in patches in the forest which were cleared of trees for a period of eight to ten years. Crops supplemented hunting and gathering and included corn, tobacco, beans, and squash.   After the soil declined in fertility, these nomadic peoples would move on and farm another area of forest. Farmed patches, once abandoned, were allowed to lay fallow for a period of ten to twenty years before being farmed again, a process which allowed the soil to recover its nutrients and fertility. This shifting agriculture "mimicked the natural forest dynamism by creating small patches that were allowed to revert to forest" (1991).

The second example of an agriculture which made use of the sustainability inherent in the structure of the deciduous forest was developed by J. Russel Smith in 1953. His system was based on the cultivation of nut and fruit bearing trees and "included a perennial understory that would fix nitrogen, hold the soil, and be suitable for grazing and haying"(Soule and Piper 1991). This structural model was practiced on hillsides in Alabama and was composed of honey locust trees planted with an understory of Chinese bush clover. According to Soule and Piper, "this system demonstrated effective soil protection, produced both hay and seed crops, supported grazing, involved low management costs, provided good weed control, and required relatively low labor inputs"(1991). Any agriculture which might effectively mimic the deciduous forest would also draw extensively from research conducted into agroforestry (another example of the structural model of ecological design in agriculture) which seeks to combine tree and shrub crops into crop and livestock production systems.

Agriculture Modeled on the Prairie: Perennial Polyculture

Perennial Polyculture, and Natural Systems Agriculture in general, was pioneered by ecologist Wes Jackson at The Land Institute in Salinas, Kansas. For the past twenty years, The Land Institute has worked to develop an agricultural system which mimics the native tall grass prairie of the Midwest. In The Land Institute's 2003 Annual Report, the following statement was made concerning the progress and potential of research into perennial polyculture:

> Our hopeful message is that humanity can fashion an agriculture as sustainable as the nature we have destroyed, an agriculture that rewards the farmer and the landscape more than external suppliers of inputs. An agriculture in which irreparable soil erosion ceases. An agriculture not dependant on fossil fuels or alien chemicals, an agriculture that honors the reality of the ecological mosaic. It features perennial crops whose year-round roots hold the life giving soil and grows them in mixtures that function more like the native vegetation. It transforms conventional annual crop species by breeding them to be perennials (Land Institute).

In order to achieve this goal, research at the land institute has focused on the four major plant groups which make up the structure of this ecosystem: warm-season grasses, cool-season grasses, legumes, and composites. The structure of the tall grass prairie makes it an appealing model for agriculture because of the following ecological attributes (Soule and Piper 1991):

- Extensive and permanent root systems of perennials hold and build soil.
- Plant diversity increases ecosystem productivity through niche partitioning.
- Plant diversity increases the systems resilience to outside factors such as precipitation and natural disturbances such as fire.
- Plant diversity promotes micro-organisms that cycle nutrients.
- Plant diversity retards the spread of pathogens and pests.

By mimicking this structure, perennial polyculture will illiminate or greatly reduce the need for plowing, disking, chiseling and mechanized power weeding. It will also create a system in which there is only one harvest and the occasional replanting. Outside inputs will be greatly reduced once the system is established, amounting to some fertilizing and pest control measures. Genetic engineering will also play a key role in the establishment of a successful perennial agriculture, “either through some inter-generic crossing of our high producing annuals with some perennial relatives, or by selecting some wild perennial relatives which show promise of a high yield”(Jackson 1985). Current research at the Land Institute includes development of a perennial wheat variety, work with Illinois bundleflower (a perennial legume), and the development of a perennial grain producing sunflower (The Land Institute).

The Cultural Model: Permaculture

The Cultural Model of ecological design in agriculture encompasses strategies which advocate (as central to their design objective) a change in human culture as it relates to natural resource use and settlement patterns. Although other models and their associated agricultural “schools of thought” include a cultural component, it is not central to their design method and philosophy. The Cultural Model is well represented by the practice of Permaculture. Bill Mollison, one of the principle founders of the Permaculture movement, describes this approach to an ecologically based agriculture as “a whole human system” which combines architecture with biology, agriculture with forestry, and forestry with animal husbandry (Mollison 1990). Permaculture is defined by Mollison as

> The conscious design and maintenance of agriculturally productive ecosystems which have the diversity, stability, and resilience of natural ecosystems. It is the harmonious integration of landscape and people providing their food, energy, shelter, and other material and non-material needs in a sustainable way. Without permanent agriculture there is no possibility of a stable social order (1990).

As illustrated in the last line of this definition, the Cultural Model has a strong spiritual and ethical basis. Permaculture achieves this basis by looking to indigenous tribal cultures for inspiration on how best to live harmoniously with the land. It defines a moral basis for its practice by advocating three basic ethical principles: care of the Earth, care of people, and setting limits to population and consumption. It also defines a set of ethical principles for human interaction with natural systems. This set of principles includes the following(Mollison 1990):

- Implacable and uncompromising opposition to further disturbance of any remaining natural forests.
- Vigorous rehabilitation of degraded and damaged natural systems to a stable state.
- Establishment of plant systems for our own use on the *least* amount of land we can use for our existence.
- Establishment of plant and animal refuges for rare or threatened species.

Theses ethical principles are implemented through the design strategies outlined in figure 4.1 on the following page. These principles are informed by the methods of permaculture design which are outlined below(1990):

1. ANALYSIS: Design by listing the characteristics of components.
2. OBSERVATION: Design by expanding on direct observation of a site.
3. DEDUCTION FROM NATURE: Design by adopting the lessons learnt from nature.
4. OPTIONS AND DECISIONS: Design as a selection of options or pathways based on decisions.
5. DATA OVERLAY: Design by map overlays.
6. RANDOM ASSEMBLY: Design by assessing the results of random assemblies.
7. FLOW DIAGRAMS: Design for workplaces.

8. ZONE AND SECTOR ANALYSIS: Design by the application of a master pattern. Permaculture design textbooks outline these methods in detail. The main objective of the methods above is to design a system in which every component (both conceptual and material) is assembled in a pattern that benefits all life and in which every component may function in more

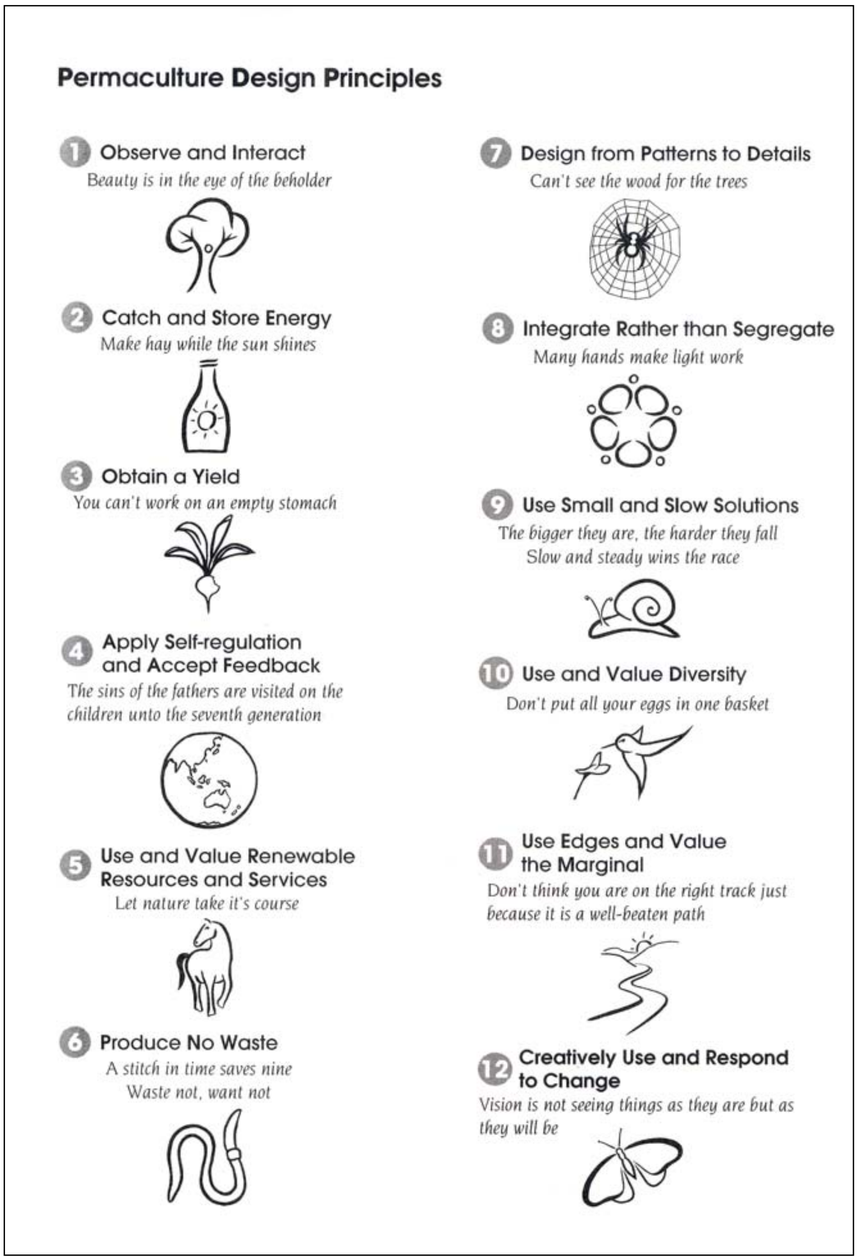


Figure 3.4 Permaculture Principles (Holmgren ,2002)

than one way. The challenge of Permaculture is to create an integrated system in which every piece of that system is designed to reflect and enhance all the other system components. This challenge is embodied by the Permaculture Principle of Self Regulation which states that "The purpose of a self-regulating design is to place elements or components in such a way that each serves the needs, and accepts the products, of other elements"(Mollison 1990).

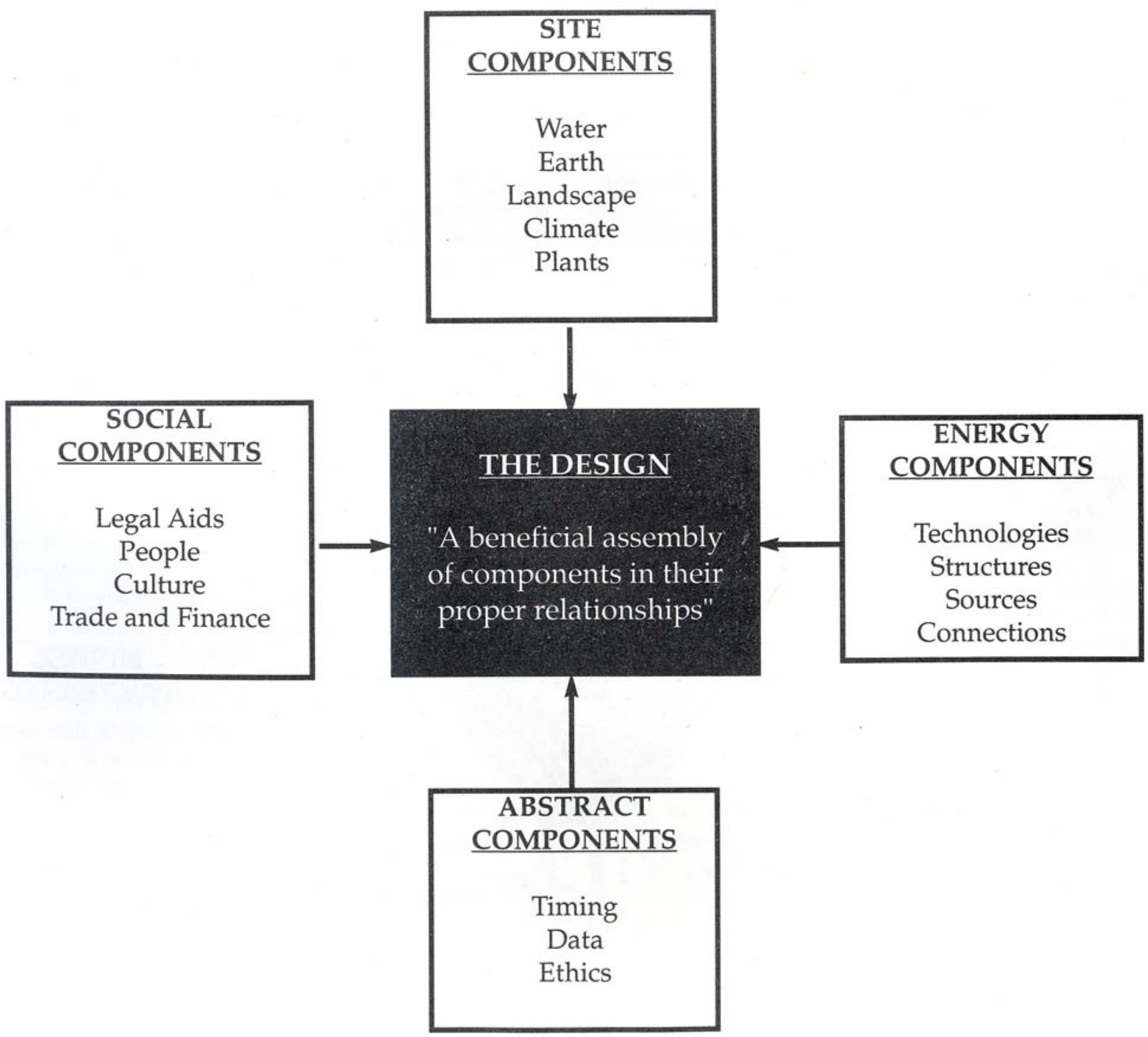


Figure 3.5 Permaculture "Elements of a Total Design" (Mollison 1990)

Permaculture's main message is that humans have the ability to design systems that support a healthy and vibrant human culture as well as a healthy and vibrant environment. Mollison refers to permaculture designers as pioneers. The nature of permaculture design is inherently small in scale and the practices and techniques it advocates are localized. It introduces "pioneers" to a new way of looking at the earth and its resources by providing them with a specific design approach that will enable them to coexist with the earth and its natural resources. Mollison's definition of design is useful in summing up the Cultural Model of ecological design in agriculture and its approach: *A design is a marriage of landscape, people, and skills in the context of a regional society* (Mollison 1990).

The Landscape Model: Ecoagriculture

The Landscape Model of ecological design in agriculture is centered on creating systems of food production that consider the broader regional implication of human land use decisions, the function of agriculture within that system (as it pertains to the overall environmental health), as well as a site scale approach to designing farms in order to enhance wildlife habitat. Ecoagriculture is a prime example of this model. It advocates systems of farming that accommodate the habitat needs of wild native species by developing an agriculture which is productive, but which also acts to conserve biodiversity and the ecosystem services which support healthy plant and animal communities.

Ecoagriculture is based in the knowledge that industrialized agriculture poses a very serious threat to wild biodiversity. Fragmented landscapes of monoculture do not provide the wildlife corridors and habitat patches needed by wildlife in order to sustain a healthy population. The chemical applications which are necessary to sustain such landscapes further impact wild populations. Conservationists interested in saving wildlands and the species inhabiting them have often overlooked agriculture and the potential which agricultural lands have to greatly increase the amount of habitat available for wild species. Thus, the object of ecoagriculture is threefold: 1. To protect and prevent the conversion of wildland into agricultural land, 2. To enhance existing agricultural lands through systems of farming which provide habitat to native plant and animal species and eliminate the use of dangerous chemicals, 3. To incorporate such systems into the larger fabric of land use and habitat surrounding agricultural land.

In *Ecoagriculture: Strategies to Feed the World and Save Wild Biodiversity* (2003), authors Jeffrey A. McNeely and Sara J. Scherr identify ecosystem management as a principle tool in developing a form of agriculture with biodiversity and conservation as a primary goal. According to the authors,

> Ecosystem management provides a comprehensive framework for bringing together different approaches to conservation, helping to integrate or coordinate the various sectors with an interest in biodiversity. The scope of ecosystem management efforts may include activities across the entire land and waterscape, crossing ownership, political, and even international boundaries. Conserving a species of rare or threatened plant involves conserving all parts of its ecosystem, including pollinators, seed dispersers, and other organisms that play significant roles in its life cycle. Ecosystem analysis can help decision-makers consider options for landscape-scale developments.

This statement illustrates the breadth of concern which one must consider when designing an ecoagricultural system.

McNeely and Scherr (2003) outline six key strategies of Ecoagriculture. Many of these strategies are discussed in the methods and design principles of the models previously described. Ecoagriculture does not have a set design process methodology. Rather, it applies the methods and strategies of several ecologically based agricultural practices along with land conservation strategies in order to achieve the goal of biodiversity. The following key strategies are applied to land with this goal in mind:

1. Create biodiversity reserves that also benefit local farming communities.
2. Develop habitat networks in non-farmed areas.
3. Reduce (or reverse) conversion of wild lands to agriculture by increasing farm productivity.
4. Minimize agricultural pollution.
5. Modify management of soil, water, and vegetation resources.
6. Modify farming systems to mimic natural ecosystems.

Depending on the location of the agricultural land and its context within the broader ecosystem management framework, these strategies would be applied in different ways and in different combinations. The key to the Ecoagriculture approach is the priority it places on looking at agricultural systems as part of a much larger landscape. The farm becomes much more than the property lines which define its borders. Instead, decisions made on the farm consider the land beyond property boundaries and envisions the farm as part of a larger more complex landscape matrix.

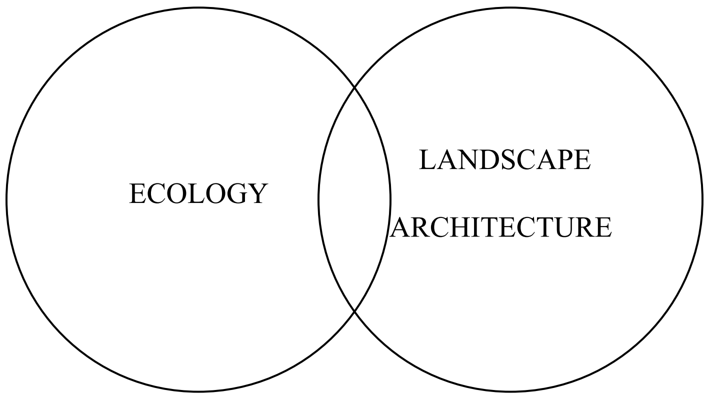
Summary

These four models of ecological design demonstrate a diverse approach to the problem of agriculture. The Process Model utilizes ecosystem processes in order to solve specific management goals. The Structural Model mimics the natural plant community of the area in order to embed the agricultural system within naturally occurring ecosystem processes and thus restoring proper ecosystem function to a site. The Cultural Model emphasizes the human/cultural relationship and designs agricultural systems in order to increase both its cultural and ecological value. Finally, the Landscape Model uses landscape ecological principles in order to reconnect the matrix of habitat by integrating that habitat within agricultural systems, and thus providing for human land use needs and the needs of wild biodiversity.

It is important to note that the realities of the world we live in make most of these models economically unfeasible. This is true because of our government's endorsement and support of the agribusiness complex which favors large industrial operations rather than smaller independent family farmers. While this is an extremely important issue, the models described in this chapter do not address it in a substantive way. Rather, they describe design alternatives to a system which is failing on many levels, but has not yet collapsed. If our present system experiences a crisis on par with the Dust Bowl of the 1930's (described in Chapter 1) we may see a shift towards one or more of these alternative designs. The government support of the Permanent Agriculture Movement in response to the Dust Bowl and Great Depression illustrates that such an event can result in reform. The design models described may then be viewed as economically (as well as culturally and ecologically) valid solutions. If such a restructuring occurs, landscape architects may have an important role to play in the redesign of our nation's agricultural lands. The next chapter will explore the Process, Structural, Cultural, and Landscape Models of Ecological Design as they are expressed in landscape architecture.

CHAPTER 4

FOUR MODELS OF ECOLOGICAL DESIGN IN LANDSCAPE ARCHITECTURE



Within landscape architecture, ecological design theory is not a "unified philosophy for which there is one accepted, rigorous method" (Franklin 1997). Although the profession's early consideration of environmental processes was demonstrated in Chapter 1 and 2, landscape architects have struggled over recent decades to define ecology's place within the profession. Several theories and methodologies have arisen which address the principals and practice of ecological design within the profession. The four models of ecological design which were established for agriculture in Chapter 4 may also be applied to landscape architecture. Exploring the practice of ecological design in landscape architecture through the Process, Structural, Cultural, and Landscape Model will allow the reader to understand the different approaches which have evolved within the ecological paradigm in landscape architecture. Some of the examples provided in this chapter reflect a direct application of landscape architectural principles to agricultural or rural settings. Others are not directly related to agriculture, but do present significant opportunities for application within agricultural systems.

As with their application in agriculture, these models describe certain approaches to ecological design within landscape architecture, but elements of each model can be found within others. Once again, it is the focus of each model that is key to understanding the differences between them. The following examples of practices which represent the Process, Structural, Cultural, and Landscape Models of ecological design in landscape architecture do not represent a detailed analysis of technique. Rather, these examples are intended to provide the reader with a brief definition of a method or theory at work within the ecological paradigm of landscape architecture and hence an understanding of the varied approaches represented by the four models. This exercise will help set the stage for the final chapter which will discuss the opportunities for collaboration between ecologists and landscape architects within the framework of sustainable ecological agriculture.

Table 4.1 Ecological Design Models in Landscape Architecture

MODEL	APPROACH	OBJECTIVE	SCALE
PROCESS	Hydrologic Restoration	Ecosystem processes replace the need for piping stormwater to streams by returning runoff to the water cycle via on-site infiltration.	site
STRUCTURAL	Landscape Restoration	Landscape design which mimics native plant communities.	site
CULTURAL	Eco-Revelatory Design	Landscape architecture which reveals and interprets the human relationship with ecological phenomena and processes.	site, region
LANDSCAPE	Design For Human Ecosystems	The design of ecologically based landscapes (operating at multiple scales) which are managed in a responsive and holistic way in order to provide for the needs of human, animal, and plant communities.	site, region, subcontinent, global

The Process Model: Hydrologic Restoration

As in agriculture, the Process Model of Ecological Design within landscape architecture employs techniques which mimic naturally occurring ecological processes in order to achieve a management goal. Hydrologic restoration is an excellent example of the Process Model in landscape architecture because it involves a management decision relevant to the design of every site. The purpose of hydrologic restoration is the return of stormwater to the water cycle through infiltration, rather than the more typical management practices of conveyance (through a series of pipes to a water body or engineered retention area). It is especially important and applicable in urban areas where large amounts of impervious surfaces prevent infiltration and cut off rainfall from the natural water cycle. In his book *Introduction to Stormwater: Concept, Purpose, Design* (1998), Bruce Ferguson explains that infiltration "constitutes the restoration of a site's hydrologic process" because it "restores groundwater to the earth and balanced flow regimes to streams". Infiltration also mitigates flooding and erosion on a site and increases the water quality of local water bodies—improving and protecting habitat of aquatic ecosystems as well as the water supply for human populations. A technique of hydrologic restoration commonly used by landscape architects in order to achieve infiltration on site is the design of infiltration basins.

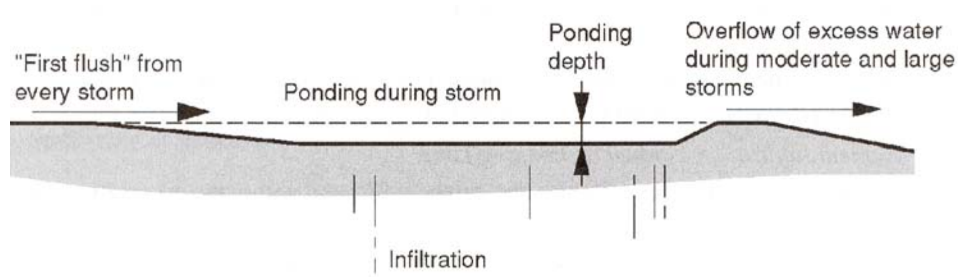


Figure 4.1 Diagram of an infiltration basin (Ferguson 1998)

Infiltration basins offer landscape architects a number of design possibilities for on-site stormwater management. Basins may be excavated to different depths. Some may simply sculpt a low area into the earth where runoff is directed and quickly absorbed. Others may be excavated to a greater depth, intersecting the water table and offering a permanent pool. The water level of the resulting pond would then fluctuate with the level of the groundwater table (Ferguson 1998). Both shallow and deep basins are usually augmented with vegetation. This vegetative cover might be as simple as grass or, depending on water level and duration of ponding, wet-tolerant plant species which serve as a decorative or ornamental element in the landscape. Elaborate infiltration basins, called stormwater wetlands or rain gardens help to filter and remove dangerous pollutants such as fertilizers, pesticides, and other toxic chemicals associated with stormwater runoff. The details of infrastructure and size of such a system depends upon its location and the amount of runoff it is designed to treat. Figure 4.2 illustrates a typical design and how it works. Rain gardens in residential settings are typically planted with an array of wet-tolerant native species and are considered a visual amenity by neighborhood residents.

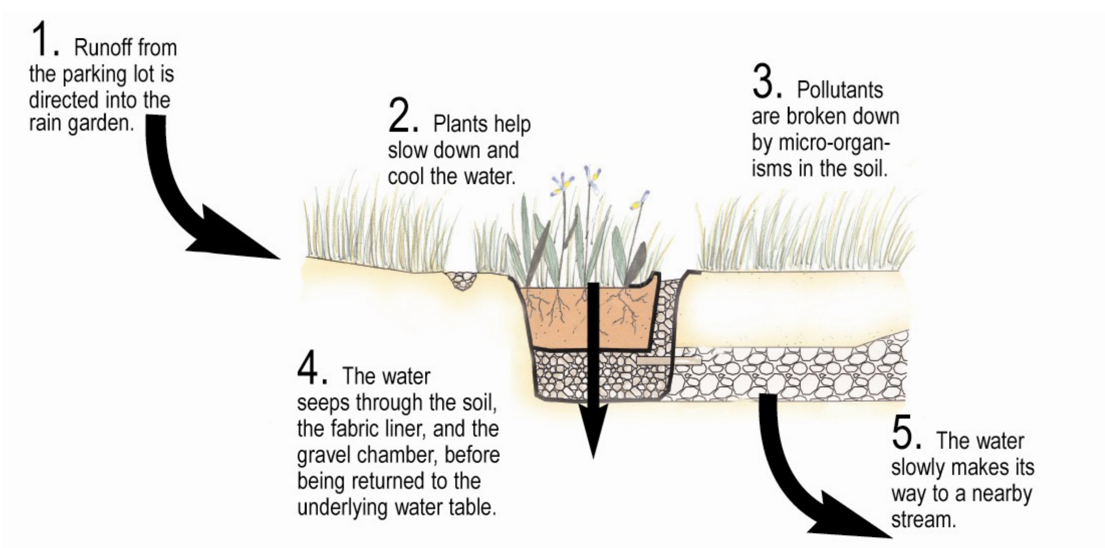


Figure 4.2 Diagram of How a Raingarden Works (author's rendering)

The Structural Model: Landscape Restoration

The Structural Model of Ecological Design in landscape architecture emphasizes techniques which mimic ecosystem structure in order to achieve a more diverse and dynamic landscape. This model is represented by the practice of planting design using native plants as well as landscape restoration. Darrel Morrison, professor emeritus of landscape architecture at the University of Georgia, is a leader in the field of planting design utilizing native plants. Beyond simply incorporating native plants into an otherwise typical planting design, Morrison mimics the natural plant communities associated with a site's geographic location. This involves replicating the patterns which particular plant species display in natural ecosystems as well as plant associations typical of native communities. Resulting designs offer a natural aesthetic and are also typically managed without the use of fertilizer, pesticides, or intensive irrigation because they are adapted to the particular environment in which they are placed.

Landscape restoration takes this technique a step forward because it tends to address larger areas and is often created in a less controlled way, emphasizing restoration of native plant communities which once in place exhibit variations in plant composition and pattern which reflect shifting weather conditions and other environmental factors. Landscape restoration is defined by Darrel Morrison as "The reintroduction and reestablishment of community-like groupings of native species to sites that can reasonably be expected to sustain them, with the resultant vegetation demonstrating aesthetic and dynamic characteristics of the natural communities on which they are based"(1987). Morrison has implemented large scale restorations of native plant communities for Lady Bird Johnson Wildflower Center in Austin, Texas; the Utah Botanical Center at Kaysville, Utah; and the native Wisconsin Garden at the University of Wisconsin Arboretum. Another landscape architect actively practicing landscape restoration is Ron Bowen of Prairie Restoration Inc. His company focuses on designing native prairie landscapes and has reintroduced these native landscapes into the urban and suburban landscapes where development had previously eradicated them. Bowen emphasizes the potential of landscape restoration in such settings stating that fifty to seventy-five percent of residential sites could "be restored with native grasses, open woodland, dry prairie, or wetlands ringed with riparian species". Bowen and his company are described by Landscape Architecture Magazine as "committed to ecological authenticity", relying on local genotypes and limiting sales to within a 200-mile radius of its four production sites (Martin 2004). His company—composed of designers, botanists, wetland ecologists, and landscape management technicians (they mimic the fire regime of native prairie for clients in residential settings)—represents the multidisciplinary approach which is necessary for successful ecological design.

Figure 4.3 Prairie restoration by Ron Bowen in a suburban setting (Martin 2004)

Figure 4.4 Ron Bowen's own home in a typical subdivision with prairie inspired Landscape (Martin 2004)

The Cultural Model: Eco-Revelatory Design

The Cultural Model of Ecological Design in landscape architecture encompasses design which has (as its primary focus) the desire to integrate ecology with culture. Design within this model is not only ecologically sensitive, but culturally sensitive and seeks to enlighten and educate people about the ecological processes which surround us. Eco-revelatory design is an example of the Cultural Model at work within landscape architecture. The term Eco-revelatory Design was coined in 1998 for an exhibit of work documenting fifteen landscape architecture projects which attempted to solve ecological problems and integrate ecological processes into landscape designs. In poorly designed landscapes, ecological processes have been designed out—hidden or eliminated by designs which do not incorporate or reflect the ecology of a site. In Eco-revelatory Design these processes are revealed, sometimes highlighted, and a dialogue between culture and nature encouraged. According to the exhibit catalogue Eco-revelatory design can be understood as:

> [Design] strategies [which] have to do with *how* we see and experience as well as with *what* we see and experience. Designers envision and plan *new uses* of landscapes, out of which arise *deeper caring* for the interactive life and processes within them. They preserve, restore and introduce *signifying features* in landscapes that speak for natural and cultural processes that might otherwise remain invisible. They *expose infrastructure processes* customarily hidden. They *reclaim* landscapes so that the past is *remembered*, even as nature, culture and their interactions are recast and *revived* for present and future. They *change perspectives* by structuring the forms and processes of landscapes themselves. *In these landscapes, both nature and how we see nature are dynamic*(National Building Museum).

Although the exhibit documents a range of approaches which encompass all four of the design models, the main purpose or intent of Eco-revelatory design is to strengthen the bond between cultural and ecological systems by enhancing understanding of how theses two systems relate and interact. A good example of the theory behind Eco-revelatory Design is illustrated in the work of Joan Iverson Nassauer.

Joan Iverson Nassauer, Perception Studies

Joan Nassauer, a professor of landscape architecture at the University of Michigan's School of Natural Resources and Environment, has focused her research on how people perceive their environment through culturally imposed standards which reflect care for the landscape. The core idea of her work is that our culturally imposed standards of care are both a hindrance to the design of ecologically based landscapes as well as an opportunity for such landscapes to be crafted in a more culturally acceptable way, and hence become more popular. This concept of the aesthetic of care and its influence on human action as it relates to landscape management was summed up by Nassauer in the following passage:

> People see the larger landscape through the instruments of their daily experience. The way people contact the landscape, farming, gardening, recreating, through scientific investigations, and, importantly, through pictures, greatly influences what they know and notice about all the landscapes they see. The aesthetic of care is the beauty we notice in everyday experience….In caring for the garden we are involved, not only by our understanding, but by the familiarity with place that maintenance creates (1988).

Nassaeur has applied this concept of "neatness as a form of care" to a variety of suburban and rural landscapes. As part of the Eco-revelatory Design exhibit, she explored the possibilities which exist in the suburban landscape for more ecologically based site design.

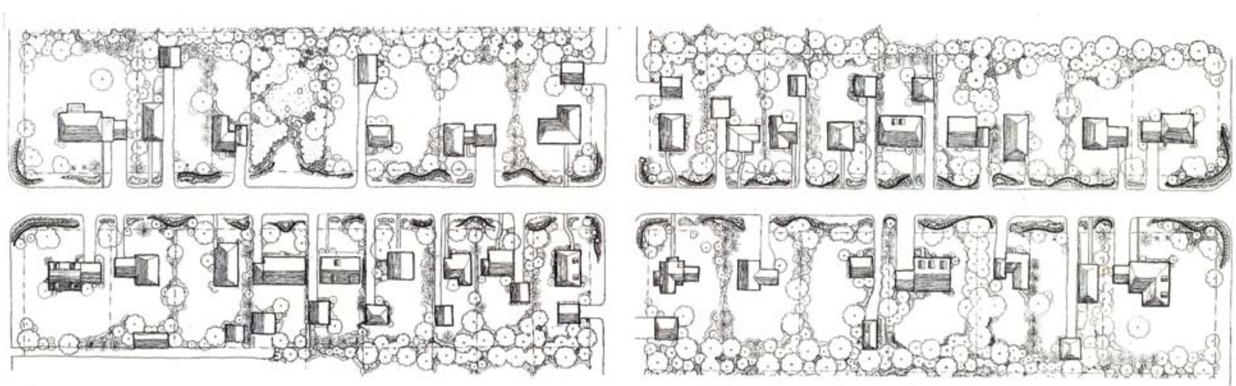


Fig. 4.5 Plan for "Urban Ecological Retrofit", Joan Iverson Nassauer (1998)

The exhibit piece, entitled "Urban Ecological Retofit", focused on stormwater infiltration in a Minnesota neighborhood. The city engineer saw the opportunity presented by a standard street-resurfacing project in the neighborhood as a chance to redesign the traditional stormwater system towards a more ecologically sensitive management solution which included retrofitting the neighborhood with raingardens to infiltrate stormwater runoff. The design also included plans to enhance the neighborhood's ecological structure in order to enhance biodiversity. The success of the project depended on the community's participation. Nassauer led a research team which investigated the aesthetic values of the residents. According to Nassauer, it was necessary to understand the aesthetic values of the community in order to design a system which would function successfully on both an ecological and cultural level. Changes reflecting a healthier ecosystem must also be appreciated by the people who live and interact with the landscape on a day to day basis because the ultimate success of the design depends on the community's care and maintenance of it. To that end, the design

> situates the disorder of change and the apparent disorder of biodiversity in an orderly pattern of native plant gardens recognizable by their relationship to the house, their conventional shapes and structural materials, and turf frames….The finely meshed landscape structure of native wetland and prairie plant gardens up and down the street connects to gardens and fences along the edges of each property. The stormwater retention area on the site of a tax forfeiture lot has become the neighborhood nature garden. None of these gardens camouflages the ecological function of the landscape. Instead, each of them portrays ecological function in the cultural landscape language of the place, presenting nature to be seen through the eyes of Birmingham Street (Nassauer 1998).

Nassaeur has also applied these principles towards the design of more ecologically sensitive agricultural landscapes. She has published a number of articles which explore the cultural importance and ecological meaning behind the landscape patterns represented by agricultural production systems and the rural landscape.

In the perception studies she has undertaken with farmers, Nassauer has learned that "farmers may be reluctant to adopt conservation practices that contradict aesthetic norms for attractive agricultural land" (1989). An example which she provided was the practice of conservation tillage which was advocated by the USDA's Conservation Reserve Program (CRP). This practice (described in Chapter 3) met with some initial resistance from farmers in the program who perceived the messy appearance of a perennial cover crop as an indication of their lack of care. Straight neat rows of corn with no weeds is the standard to which most farmers adhere because it indicates, in their minds, a certain standard of care which indicates good farming. Nassauer conducted research for the CRP which looked into how to best integrate conservation measures aiming to increase the biodiversity of farms in the program. Her perception studies with farmers indicated that the "aesthetic value of good stewardship depends on whether people can tell that they are looking at planned conservation practices" (Nassauer 1989). By incorporating land cover patterns which make conservation noticeable or readable within the pattern language of agriculture, Nassauer argues that conservation measures and efforts to increase biodiversity will become more popular among farmers.

One of her suggestions reflecting this theory advocates "extensive, connected network of linear patches of perennial cover made from parts of fields" which provide for greater species movement between fields, rather than planting a whole field or a series of disconnected fields to perennial cover (1989). Another suggestion addresses vegetative buffers advocated by the CRP. These buffers were often regarded as unattractive to farmers and rural residents because the tall native grasses and forbs composing them appeared wild and unmanaged. The simple act of a mowed strip delineating such native plantings communicated the idea of care and translated the messy disorder of the buffer plantings into an understandable language of stewardship and conservation. Likewise, planting native grasses and forbs in strips which mimicked the pattern of row crops also established an acceptable method of incorporating these important habitat structures into agricultural systems.

The Landscape Model: Human Ecosystems Design

The Landscape Model of ecological design in landscape architecture includes practices which focus at the site level as well as those concerned with larger scale regional planning initiatives. The primary concern of the Landscape Model within landscape architecture is the protection or enhancement of ecosystem function through design which is responsive to site constraints and the needs of plant, animal, and human populations. The practice of site inventory and analysis as well as practices associated with regional planning (such as alternative futures analysis) are examples of techniques at work within this model. John Tillman Lyle's *Design for Human Ecosystems* is also representative of this model.

First published in 1985, Lyle's book, *Design for Human Ecosystems*, advocated an approach to design which was predicated on an understanding of multiple scales and ecological order. His design approach sought to unite science with the more intuitive process of design in order to create human ecosystems which were reflective of both the ecology and culture of a particular place. Central to his design theory was the notion that human beings were a part of every natural ecosystem. Likewise, people were responsible for creating unnatural or unplanned ecosystems when they constructed built landscapes. The health and function of an ecosystem depended on the knowledge, understanding, and sensitivity of the people who were responsible for it. He believed that in order for landscape architects to design within the ecosystem concept they must recognize that

> no ecosystem stands alone….ecosystems are connected by flows of energy and materials. Each system draws in energy and materials from the systems around it and in turn exports to them. In drawing the boundaries of an ecosystem, therefore, we need to consider the flows that link it with its neighbors. Ignoring these connections—these imports and exports of energy—has caused a great many of the disasters of unintentional ecosystem design (Lyle 1999).

Lyle's system for shaping ecosystems includes three organizational concepts: scale, design process, and order. The goal of this system of human ecosystem design was to create ecosystems which merged human and natural processes into an organic whole.

SCALE

The scale of a landscape must be considered beyond the political and legal boundaries of property lines. For any project, boundaries should be determined by topographic features because "there is no natural reason why we should be shaping the land on one side of the imaginary line and not on the other" (Lyle 1999). Lyle, therefore, advocates a form of design which does not restrict solutions to property lines. Instead, it suggests that designers contemplate the impact that their choices will have on the land outside traditional boundaries, the region where the site is located, the subcontinent surrounding that region, and finally a global awareness of how their design decisions might impact the world at large. This broadened vision of design scale and context will allow local design choices to contribute to a much larger goal of integrating human needs (settlement, agriculture, production forests, et.) with the needs of wild biodiversity, creating “an intricately patterned fabric that has to be woven with enormous sensitivity and skill”(1999).

DESIGN PROCESS

Lyle’s design process acknowledges the need for design to utilize scientific understanding but he cautions against the idea of design as a science. Whereas science seeks to clarify uncertainty and uncover truths, design (especially ecosystem design) must operate under the assumption that nothing is absolutely certain. Lyle advocates a systems approach to design which “emphasizes interrelatedness, the notion that if we alter one part of the system we inevitably alter other parts, and ultimately the whole” (Lyle 1999). The design process is malleable and changes based on the specifics of the site. The stages of design outlined in the box to the right do not necessarily have to follow the order shown. However, the fourth step, management, is considered by Lyle to be extremely important for the success of any design. According to Lyle, “The design of ecosystems is probabilistic

Table 4.2 Design for Human Ecosystems

Design Process for Human Ecosystems (Lyle 1999):

1. *Stage of Romance*

Inception: This stage represents the groundwork for all the work that follows. During inception designers describe their methods, identify participants, and get to know the land and the issues surrounding it.

2. *Stage of Precision*

Information: The gathering and assembling of needed facts including research (information gathering) and analysis (finding out what this information means for the designs purpose).

Models: Analyzing the facts and organizing them into useful abstract representations of reality.

3. *Stage of Generalization*

Possibilities: the development of alternatives

Prediction: Analytical evaluation of the possibilities in order to find the best course of action based on the prediction of their performance.

Plan: The plan may take any number of forms and is formulated based on the needs and requirements of the chosen direction.

4. *Management*

This is the process of continuous redesign based on feedback.

in that we cannot say what will definitely happen. Management deals with this uncertainty….by observing what actually does happen and redesigning as necessary"(1999). This focus on management, along with Lyle's decision to focus at multiple scales of concern, is an integral part of designing human ecosystems.

ORDER

Ecological order is the final component to Lyle's design strategy for human ecosystems. Recognizing that we are unable to fully understand the details and complexity of an ecosystem, Lyle points to three modes of order in ecology which serve as guides to the order which underlies an ecosystem. These modes of order are as follows:

1. Structure: *Describes all the elements of an ecosystem and the relationship between these elements.* It is concerned with the biotic and abiotic tangibles of a site like rocks, plants, animals, and soil. The components and their composition reflect a community and within this community certain associations between components exist. An understanding of structure reflected in these communities and association has "practical importance because of the influence on stability and on what we have called the sustainability of human ecosystems. They also give us a conceptual basis for designing into human systems the conditions required by plants and animal species"(Lyle 1999).

2. Function: *Describes the flow of energy and materials in an ecosystem.* Along with structure, function gives us access to an understanding of the inner workings of an ecosystem. An understanding of function aides in decision-making when designing human ecosystems because

it helps us to “design the energy flow of a human ecosystem in ways that will improve efficiency, make rational choices among energy uses possible, and permit work within limited inputs”(Lyle 1999).

3. Location: *Describe the landscapes effect on species organization based upon the uniqueness of the climate, land forms, and living community which it supports.* This uniqueness represents “the current expression of millions of years of development”. According to Lyle “it is entirely possible for human ecosystems to fit harmoniously into evolved patterns of location, but it requires a careful mapping of the particular place and an understanding of the characteristics that combine to create it”(Lyle 1999).

<u>Summary</u>

These four models of ecological design demonstrate a diversity of approaches to ecological problem solving by landscape architects. As in agriculture, each model demonstrates a particular interest or area of focus in which a design solution is constructed. The Process Model emphasizes the use of an ecosystem process to achieve a management goal which must be addressed on a particular site. The water cycle is the ecological process which hydrologic restoration uses in order to manage stormwater in an ecologically sound way. The Structural Model, demonstrated by landscape restoration, mimics the plant communities associated with the location of a particular landscape in order to restore proper ecosystem function to a site. The Cultural Model emphasizes the human/cultural relationship. Through Eco-revelatory Design it emphasizes revealing ecosystem process and integrating ecological design within a culturally acceptable framework. Finally, John Lyle’s Design for Human Ecosystems represents the landscape model and its emphasis on the use of landscape ecological principles in order to design human ecosystems which merge with naturally occurring ecosystems by functioning as healthy ecosystems themselves. As with ecoagriculture, this model emphasizes ecological design of the landscape at the regional and even global scale in order to merge human land use needs with the needs of wild biodiversity. The next and last chapter will examine how these four models of Ecological Design might serve as a foundation for collaboration and understanding between ecologists and landscape architects.

CHAPTER 5

OBSERVATIONS & CONCLUSIONS

Agriculture represents a complex set of issues which involve human land use decisions and our relationship to the earth at the fundamental level of food production. It encompasses an array of environmental and cultural issues which should be of great interest to landscape architects who have developed a number of skills that address how people live and interact with the world around them. Therefore, the lack of collaboration between landscape architects and ecologists in crafting a solution to the problem of agriculture is extremely unfortunate.

Agriculture is perhaps the most important design problem facing the earth and humanity. Based on the research and analysis of this thesis, I believe that landscape architects can play a role in its solution. This thesis has uncovered the historical involvement of landscape architecture and agriculture and has explored the shared discipline of ecological design, which unites landscape architects and ecologists. As a profession, landscape architecture should consider agriculture worthy of consideration. Ecological science has already developed several design solutions which landscape architecture can expand upon by helping to improve agriculture's structure, function, and location. However, only through partnership and collaboration with other disciplines will the landscape architect's role find meaning.

Collaboration will afford our profession the insight and expertise which complex environmental problems demand. If our profession is to continue to explore outside the parameters of traditional design and find meaning and relevance through environmental problem solving we must seek out the relationships which will foster the best solution to complex problems—we must collaborate in order to grow. The problems facing agriculture are numerous and a solution will be multifaceted and complex. Collaboration with ecologists and others to solve this problem will not only provide insight into how our profession might contribute to solving other complex social and environmental problems, but also will provide a venue in which to study ecological design in a structured way. At the University of Georgia, the new College of Environment and Design is well poised to take up such a challenge, propose and implement solutions, and study the results.

The Next Agricultural Crisis & the Landscape Architect

It may not be a question of if our country faces another agricultural crisis on par with the Dust Bowl of the 1930's, but when. In fact, most scientists and ecologists would argue that the crisis has already begun and that industrial agriculture has already failed on a number of levels. On the inside cover of the book *Fatal Harvest: The Tragedy of Industrial Agriculture* (2002), a quote appears from Wendell Berry which sounds this warning. It reads:

> A healthy farm culture can be based only upon familiarity and can grow only among a people soundly established upon the land; it nourishes and safeguards human intelligence of the earth that no amount of technology can satisfactorily replace. The growth of such a culture was once a strong possibility in the farm communities of this country. We now have only the sad remnants of those communities. If we allow another generation to pass without doing what is necessary to enhance and embolden the possibility now perishing with them, we

will lose it altogether. And then we will not only invoke calamity—we will deserve it.

When we face a restructuring of the current industrial agriculture because of its cultural and environmental failures, landscape architects and ecologists could play a critical role in replacing it with a sustainable and productive alternative. The research contained in this thesis has attempted to establish a foundation for this collaboration so that landscape architects and ecologists might take a proactive role in a solution and "enhance and embolden" the possibility of an alternative to industrial agriculture.

The historical tie between landscape architecture and agriculture was established in Chapter 1. From this discussion we learned that agriculture played a significant role in shaping the profession of landscape architecture. We learned that during the industrial revolution, landscape design combined with scientific agriculture was conceived as a solution to the new pressures being placed upon agriculture and the rural countryside. Loudon, Downing, and Olmsted all participated in an agricultural movement which sought to combine nature, art, and science through the design of scientifically managed, aesthetically pleasing agriculture estates. This endeavor—representing the very beginning of landscape architecture in America—can be viewed as the historical foundation of the continued involvement of landscape architects in the design of sustainable agricultural systems.

In Chapter 2 we acknowledged a co-evolution of the ecological paradigm within agriculture and landscape architecture—two separate disciplines using ecology as a guide for human interaction with the environment. By tracing the historical roots of this paradigm, we learned that both landscape architecture and agriculture were responding to the same cultural and scientific catalysts. Just as landscape design and agricultural improvements were conceived as a combined solution to the needs of an industrializing world in the nineteenth century, so too in the twentieth century were these two combined in order to conceive of enlightened solutions to the problems caused by the Great Depression and the Dust Bowl. The work of Mumford and Tugwell and the development of regional planning and permanent agriculture represent a second historical instance when design and scientific understanding were combined in an attempt to solve the agricultural problem facing America.

Later, in the twentieth century, as fallout from the Green Revolution hit America during the sixties and seventies, landscape architecture and agriculture were again dramatically influenced by the same cultural and scientific events. The birth of the ecological paradigm in landscape architecture and agriculture during this period introduced new ideas and a new direction in both disciplines towards ecological design. It is remarkable that despite landscape architecture's historical involvement and the value which agriculture represents in a rapidly changing world, that landscape architects have not done more to shape a solution to one of the most fundamental environmental questions facing our world today—How do we design ecologically and culturally sound agricultural systems?

Four Collaborative Models for Agriculture

In recent decades, landscape architects have been involved on the periphery of this question, tackling issues of the cultural value of rural landscapes and leading discussions surrounding rural landscape preservation and the preservation of farmland as open-space. Few landscape architects have tackled the core of this issue which resides in the devastating effects of industrial agriculture on the environment and culture of our rural landscapes. The ecological design models explored in Chapters 3 & 4 provide insight into how landscape architects might contribute to this work and the problem of agriculture in a more profound way, by partnering with ecologists in order to design sustainable agriculture systems. The following pages will begin the dialogue between these disciplines by exploring the possibilities for collaboration that exist within the Process, Structural, Cultural, and Landscape Models of Ecological Design.

Tables 5.1 and 5.2 summarize the details of the ecological design models explored in Chapters 3 and 4. Utilizing Miguel Altieri's list of "ecological diseases" associated with industrialized agriculture (listed on page two of this thesis), Table 5.3 identifies which of these issues are potentially addressed by the ecological design strategies discussed in previous chapters. The four collaborative models explored in Tables 5.4-5.7 discuss the possibilities and potential of each of these four models and makes suggestions for further involvement between landscape architects and ecologists via the design of sustainable agricultural systems.

<u>Questions for Future Study & Research</u>

As landscape architects and ecologists, the common perception of our relationship must change if we are to make a contribution towards furthering our understanding of ecological design and its inherent possibilities. In her essay *Ecological Design Strategies for Environmental Problem Solving* (1998), Susan M. Galatowitsch states that

> The typical relationship of designer and scientist presumes that most of what can be known is known. The designer is the creative partner; the scientist is the interactive book. Since the scientific base for ecological design is nascent, the nature of this relationship is flawed. Science and design are complimentary ways to generate knowledge (and therefore both are creative endeavors).

Table 5.1 Four Models of Ecological Design in Agriculture and Landscape Architecture

OBJECTIVE	AGRICULTURE	MODEL	LANDSCAPE ARCHITECTURE	OBJECTIVE
Ecosystem processes replace or decrease dependence on chemicals.	ORGANIC AGRICULTURE	**PROCESS** **Use of ecosystem processes to achieve a management goal.** ⇔	HYDROLOGIC RESTORATION	Ecosystem processes replace the need for piping stormwater to streams by returning runoff to the water cycle via on-site infiltration.
Agricultural systems which mimic native plant communities.	NATURAL SYSTEMS AGRICULTURE	**STRUCTURAL** **Mimics the natural plant community structure in order to restore proper ecosystem function to a site.** ⇔	LANDSCAPE RESTORATION	Landscape design which mimics native plant communities.
Landscape planning in order to design sustainable agricultural systems within human settlements.	PERMACULTURE	**CULTURAL** **Designing the details of a site in order to increase the cultural and ecological value for human inhabitants.** ⇔	ECO-REVELATORY DESIGN	Landscape Architecture which reveals and interprets the human relationship with ecological phenomena and processes.
The management of landscapes for both the production of food and the conservation of ecosystem services, in particular wild biodiversity.	ECOAGRICULTURE	**LANDSCAPE** **The use of ecological principles to reconnect the matrix of habitat and integrate that habitat with human land use needs.** ⇔	HUMAN ECOSYSTEM DESIGN	The design of ecologically based landscapes (operating at multiple scales) which are managed in a responsive and holistic way in order to provide for the needs of human, animal, and plant communities.

Table 5.2 Scales of Application for Ecological Design Models in Landscape Architecture and Agriculture

MODEL:	STRUCTURAL		PROCESS		CULTURAL		LANDSCAPE	
SCALE ⇓	*Organic Agriculture*	*Hydrologic Restoration*	*Natural Systems Agriculture*	*Landscape Restoration*	*Permaculture*	*Eco-revelatory Design*	*Ecoagriculture*	*Human Ecosystem Design*
SITE SCALE/ SMALL FARM (under 50 acres)	Y	Y	Y	Y	Y	Y	Y	Y
SITE SCALE/ LARGE FARM (over 50 acres)	Y	Y	Y	Y	Y	Y	Y	Y
REGIONAL SCALE	N	N	N	N	Y	Y	Y	Y
GLOBAL SCALE	N	N	N	N	N	N	Y	Y

Y = The design model addresses problems at this scale.
N = The design model does not address problems at this scale.

Table 5.3 Problems Associated with Industrial Agriculture & the Ecological Design Models in Landscape Architecture and Agriculture that address them.

MODEL:	PROCESS		STRUCTURAL		CULTURAL		LANDSCAPE	
Ecological Diseases ⇓	*Organic Agriculture*	*Hydrologic Restoration*	*Natural Systems Agriculture*	*Landscape Restoration*	*Permaculture*	*Eco-revelatory Design*	*Ecoagriculture*	*Human Ecosystem Design*
devastation of wild species caused by chemical use	Y	Y	Y	Y	Y	Y	Y	Y
loss of wildlife habitat, fragmentation of habitat	N	N	Y	Y	Y	Y	Y	Y
irreversible soil loss	Y	Y	Y	Y	Y	Y	Y	Y
Reduction in soil and water quality	Y	Y	Y	Y	Y	Y	Y	Y
proliferation of non-native species that choke out indigenous varieties	N	N	Y	Y	Y	Y	Y	Y
Pollution of surface and ground water	Y	Y	Y	Y	Y	Y	Y	Y
loss of genetic resources	N	N	Y	Y	Y	Y	Y	Y
the extirpation of large mammals	N	N	N	N	N	Y	Y	Y
loss of a cultural connection to the earth	Y	N	Y	Y	Y	Y	Y	Y

Y = The design model addresses (or has the ability to address) this problem.
N = The design model does not address this problem.

Table 5.4 Collaborative Model 1: The Process Model of Ecological Design

Organic Agriculture & Hydrologic Restoration

This model is applicable at the site scale/farm level and can address specific management goals associated with a particular property. This is a model in which the skills of landscape architects might find immediate application because many of the techniques used on farms to improve soil and water quality, reduce soil loss, and prevent the pollution of soil and ground water are also used in some form by landscape architects working in urban and suburban settings. For instance, hydrologic restoration via infiltration basins, rain gardens, and constructed wetlands are all techniques in which landscape architects are well versed. All are applicable to farm landscapes. In fact, these techniques are already in use on farms in the form of grassed waterways and filter strips, practices which are advocated by the USDA's Conservation Reserve Program. This program also actively encourages farmers to preserve and restore wetlands on their farms in order to provide habitat for wildlife—another area in which landscape architects are already well suited.

However, the Process Model of Ecological Design is a limited model for collaboration because it does not addresses design problems in a holistic way. Rather, it asks what piece of an ecosystem's natural processes can be borrowed in order to develop less harmful management techniques. In agriculture, the core goal of this approach is to eliminate the need for chemicals. While organic farming techniques may enhance environmental quality, they do not address issues of culture or biodiversity by examining the scale and organization of agriculture. While the techniques provided by organic agriculture and hydrologic restoration may be part of design solutions at the site scale and can play a role in the details of the design of sustainable agricultural systems, this model does not offer a broad enough context for meaningful collaboration between landscape architects and ecologists.

Potential for Collaboration: *Limited*

Table 5.5 Collaborative Model 2: The Structural Model of Ecological Design

Natural Systems Agriculture & Landscape Restoration

This model offers an interesting juncture or intersection when we consider how the two techniques operating under this model might meet. Landscape architects who design with native plant materials and practice landscape restoration and ecologists who are mimicking native plants and ecosystems for agriculture at the field level are essentially designing (or mimicking) the same system towards a different purpose. How these two might meet literally and figuratively poses an interesting question for designers working in both fields to consider.

Consider the diagram below, what happens at the intersection of these two techniques?

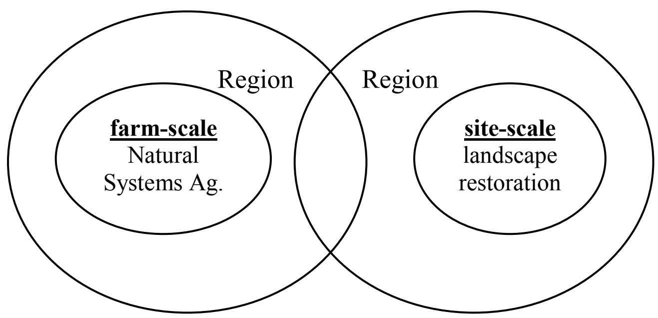


Figure 5.1 Merging Techniques, Increasing Scale & Impact

This model, while being applied by ecologists and landscape architects at the site scale/farm level, has the potential to address issues of habitat loss and fragmentation at broader levels as well. As the matrix of urban and suburban areas, farmland, and natural areas becomes increasingly intertwined, these two techniques might be able to address habitat loss and fragmentation at a regional level by using the structure of native ecosystems as a palette for design—integrating a matrix of native plant communities within agricultural, residential, and even urban landscapes. For instance, the native prairie landscapes of Ron Bowen and the perennial polyculture of Wes Jackson together have the potential of restoring the prairie region's native landscape and ecosystem while maintaining agricultural production and creating beautiful landscapes for human inhabitants.

Potential for Collaboration: *Good*

Table 5.6 Collaborative Model 3: The Cultural Model of Ecological Design

Permaculture & Ecorevelatory Design

The Cultural Model has a very important role to play in the collaboration of landscape architects and ecologists because it deals with how human culture interacts with the environment and it addresses this relationship through designs which are human-scaled and culture-oriented. If we are faced with restructuring our current agricultural system, the solution will have to integrate a strong culturally-oriented approach. The solution will not only lie in redesigning the system—but in educating the human participants of that system. The fact that almost every human being on this planet is a participant (on some level) in the dominant agricultural system of industrialized agriculture and is therefore directly or indirectly involved in its destructive impacts—is a fact which is not understood or recognized by most, yet it is a fact which enables this system's dominance of our world and our resources.

Eco-revelatory design applied to this problem of cultural ignorance has the potential to help educate the public now on the issues which surround industrialized agriculture. In designing new systems, this design approach is also key to identifying and resolving the cultural impediments to sustainable ecological agriculture. The success of any designed landscape is rooted in how people view, connect, and relate to that landscape. The success of ecological design in agriculture will hinge on how well these systems respond to the culture in which they are embedded. Permaculture represents a model of sustainable agriculture which attempts to unite the landscape with the people who inhabit it. It is small in scale, but operates within the context of a regional subsistence-based society. While its approach might be limited in our urban-industrial culture, its design philosophy and techniques offer an important point of reference in small-scale farm design. Smaller farms integrated within human settlements, like the typical suburban neighborhood or a community garden in an urban area, may play an important role in restructuring agricultural production. Smaller units of production dispersed throughout a community and integrated with the daily habits and routines of human inhabitants can be viewed as a form of eco-revelatory design operating within an agricultural context. Ecologists and landscape architects should consider exploring the ecological and cultural effects which such systems may hold.

Potential for Collaboration: *Excellent*

Table 5.7 Collaborative Model 4: The Landscape Model of Ecological Design

Ecoagriculture & Human Ecosystem Design

This model has the most potential for collaboration between landscape architects and ecologists because it attempts a solution to the problem of agriculture in the most holistic and profound way. It incorporates elements of the other 3 models at the site and regional scale, but it does not restrict a solution to agriculture to these scales. It asks the larger question of how our local and regional landscapes can be designed to not only celebrate and enhance the ecosystems they inhabit, but to connect at larger landscape scales (sub-continent—continent—global) in order to create a matrix of human land use and habitat which is sensitive to the earth and supportive of biodiversity. This is the model which holds the most potential for reshaping and reorganizing human life at the planetary level. It is the big picture approach to ecological design in which landscape architects and ecologist have the most freedom to influence a renewed human relationship to the Earth.

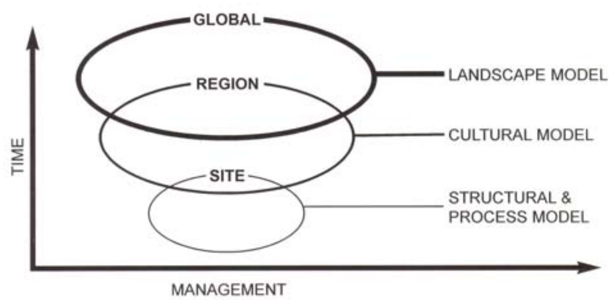


Figure 5.2 Nested Systems

Ecoagriculture and Human Ecosystem Design are particularly well suited to this approach. Both advocate a form of design without borders, disregarding property lines in order to frame human land use needs within ecological systems. Human Ecosystem Design has already tackled questions related to the design of agricultural systems at multiple scales. Three such designs are included as case studies in John Lyle's book Design for Human Ecosystems and can serve as models for landscape architects and ecologists who choose to collaborate on the problem of agriculture. Most important when considering this model is the importance which is placed on a form of management which is responsive to change over time and accepting of new knowledge and the changing needs of humanity as well as wild biodiversity.

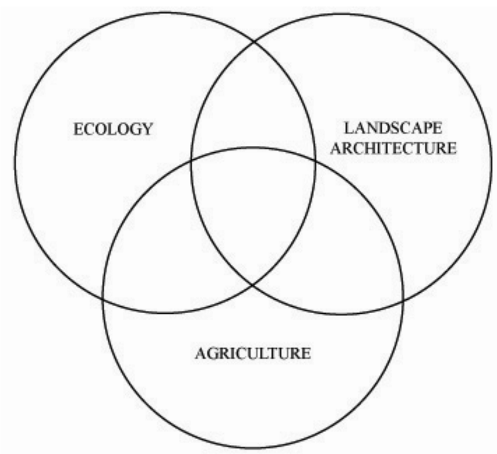
Potential for Collaboration: *Unlimited*

Galatowitsch's statement is important because it points out an often overlooked and undervalued truth that both ecologists and landscape architects are designers. This statement is also useful because it acknowledges the informal nature of ecological design, still in the very dawn of its existence and not well studied or understood by either discipline. Agriculture represents a venue in which ecological design and the relationship between landscape architects and ecologists can and should be explored. This thesis represents the tip of the proverbial iceberg. There is much to study and much to learn from such collaboration. Some questions for further research and direction on this topic include:

- How might the new College of Environment and Design develop courses and design curriculum that stress heuristics or "learning by doing" in the venue of sustainable ecological agriculture? (Research could include the development of multi-disciplinary courses which implement projects from the four collaborative models to land operated by CED and the College of Agriculture and Environmental Sciences at UGA.)
- How might we develop and monitor long term projects which apply ecological design strategies to agricultural systems?
- What are the visual implications of sustainable agriculture and how might landscape architects impact the cultural perception of ecologically based systems?
- How can landscape architects imbed agricultural systems within new human developments in ways which enhance our culture's diminished relationship and understanding of agriculture (and the environment in general)?
- What sort of management structures might be developed in order to enhance agricultural sustainability?

- What are the economic consequences of alternative agricultural systems and how does ecological design impact the farmer on a financial level?
- How can landscape architects and ecologists work with farmers or farm communities to make the transition to ecological agriculture?

Conclusions



The challenge of this thesis has been in finding and understanding the relationships which I knew must be present in the diagram to the left. I began with a question: Can landscape architects contribute to the design of sustainable agricultural systems? I believe that the contents of this thesis will meet this question with a resounding yes. The historical significance which agriculture holds for landscape architects was my first discovery. With every piece of information I uncovered about the role which agriculture played in the profession's early beginnings, the more confident I became about the question which I was asking. I approached this portion of my research as a timeline. Beginning with Olmsted and working my way forward decade by decade. As I researched Olmsted's genesis as a landscape architect, I understood how important cultural and environmental events were to the development of his design ethics and approach. The impact industrialization had upon his work (and on Loudon and Downing before him) cannot be understated. The fact that we continue to attempt to resolve conflicts surrounding industrialization and its environmental and cultural problems, speaks to the foresight and wisdom men like Olmsted, Downing, and Loudon exhibited.

The second moment of clarification came as I researched the development of the ecological paradigm in landscape architecture and agriculture. Once again, cultural and environmental events coincided to propel landscape architects forward. The public realm of landscape architecture flourished in the 1930's and agriculture benefited from a renewed understanding of man's impact on the earth and the need for conservation. It was planners like Mumford and Tugwell (implementing agricultural reform during this era) who laid the groundwork for McHarg and Halprin in the 1970's. Likewise, the idea of Permanent Agriculture was reborn, though without the government support it enjoyed in the past. Mavericks and pioneers like John Todd and the Nearings exemplify this period in the reawakening of agriculture's ecological paradigm.

As I researched the development of ecological design which resulted from the advent of this new paradigm, I was excited by the similarities I found in the approaches of ecologists and landscape architects. Understanding that ecological design is a dynamic and evolving arena for both disciplines was an important part of the development of this thesis. There is much to learn about each other and ourselves through ecological design. There is much left to understand about how ecological design might be implemented and what the results of such implementation might be. I became aware that the question of "Could landscape architecture contribute to the design of sustainable agricultural systems?" was shortsighted and the question became "How can landscape architects collaborate with ecologists in the design of sustainable agricultural systems?". I knew that the short answer to this question was through ecological design.

The ecological design models which I established in Chapters 3 and 4 begin to structure the theory and approaches of both disciplines toward the design of agricultural systems. These chapters establish a common dialogue or language which landscape architects and ecologists can use in order to "enhance and embolden" the possibility of an alternative to our current industrialized system. The Collaboration Models contained in this final chapter explore how this dialogue might begin and the potential which each of the four Ecological Design Models hold. These models are only the beginning of a discussion which I hope might continue through collaboration between the School of Environmental Design and the Institute of Ecology. Courses, projects, and research could be focused on an agricultural agenda which would have implications for human settlement patterns, land-use decisions, biodiversity, and environmental literacy. Collaboration will be the key to crafting a design solution for agriculture which is both culturally relevant and ecologically sound. As stated by Sim Van der Ryn and Stuart Cowan in *Ecological Design* (1996), "Without a common gauge, a shared dialogue, we will continue to face the costs associated with rigidly segregated disciplines: mutual incomprehension and designs that work at cross purposes".

BIBLIOGRAPHY

Altieri, M. 2002. The Ecological Impacts of Industrial Agriculture. In *Fatal Harvest: The Tragedy of Industrial Agriculture*, edited by Andrew Kimbrell, 197-199. Washington DC: Island Press.

Beeman, R. and J. Pritchard. 2001. *A Green and Permanent Land.* Lawrence: University of Kansas Press.

Boquet, D., R. Hutchinson and K. Paxton. 2003. LSU Ag Center, "Conservation Tillage, Cover Crops BMP's for Cotton," LSU Ag Center, http://www.lsuagcenter.com/Communications/LouisianaAgriculture/agmag/

Black, B. 2000. Organic Planning: Ecology and Design in the Landscape of the Tennessee Valley Authority, 1933-1945. In *Environmentalism in Landscape Architecture*, edited by Michael Conan, 71-96. Washington DC: Dumbarton Oaks.

Byrd, W. 1990. *Hope & Prophecy*: How the New Deal Spurred the Rise of Public Practice. *Landscape Architecture Magazine* 80 (10): 84-89.

Carr, E. 1999. *1930-1939*: Timeline of American Landscape Architecture. *Landscape Architecture Magazine* 89 (4): 82-83.

Carson, R. 1962. *Silent Spring.* Boston: Horton Mifflin Company.

Clark University, "George Perkins Marsh: Renaissance Vermonter," Clark University, http://www.clarku.edu/departments/marsh/georgemarsh.shtml

Conan, M. 2000. Introduction: Contested Claims and Creative Tensions. In *Environmentalism in Landscape Architecture*, edited by Michael Conan, 1-22. Washington DC: Dumbarton Oaks.

Cornell University College of Agriculture and Life Sciences, "Biological Control: A Guide to Natural Enemies in North America," Cornell University College, http://www.nysaes.cornell.edu/ent/biocontrol/

Cowen, S. and S. Van der Ryn. 1996. *Ecological Design.* Washington DC: Island Press.

Dufour, R. 2001. ATTRA, "Biointensive Integrated Pest Management". ATTRA-National Sustainable Agriculture Information Service, http://attra.ncat.org/attra-pub/PDF/ipm.pdf

Franklin, C. 1997. Fostering Living Landscapes. In *Ecological Design and Planning*, edited by G. Thompson and F. Steiner, 263-292. New York: John Wiley & Sons, Inc.

Galatowitsch, S. 1998. Ecological Design for Environmental Problem Solving. *Landscape Journal, "Eco-Revelatory Design: Nature Constructed/Nature Revealed"* (Special Issue: Exhibit Catalog): 99-107.

Gebremedhin, T. and R. Christy. 1998. Sustainability and Agricultural Industrialization: Issues and Implications. In *Sustainability in Agricultural and Rural Development*, edited by G. D'Souza and T. Gebremedhin, 1. Aldershot: Ashgate.

Green, W. 1976. The New Alchemists. *New York Times Magazine*, 8 August.

Holmgren, D. 2002. *Permaculture Principles and Pathways Beyond Sustainability. Holmgren Design Services.* Hepburn: Holmgren Design Services.

Hurt, D. 2002. *American Agriculture: A Brief History*. West Lafayette: Purdue University Press.

Imhoff, D. 2003. *Farming with the Wild: Enhancing Wild Biodiversity on Farms and Ranches*. San Francisco: Sierra Club Books.

Jackson, W. 1985. *New Roots for Agriculture*. Lincoln: University of Nebraska Press.

Jackson, W. 1994. *Becoming Native to this Place*. Lexington: The University Press of Kentucky.

Johnson, J. 1999. *1960-1969*: Timeline of American Landscape Architecture. *Landscape Architecture Magazine* 89 (7): 74-75.

Johnson, J. 1999. *1970-1979*: Timeline of American Landscape Architecture. *Landscape Architecture Magazine* 89 (8): 80-81.

Johnson, Jory. 1999. *1980-1989*: Timeline of American Landscape Architecture. *Landscape Architecture Magazine* 89 (9): 76-77.

Krebs, A.V. 2002. Corporate Takeover of Agriculture. In *Fatal Harvest: The Tragedy of Industrial Agriculture*, edited by A. Kimbrell, 307-311. Washington DC: Island Press.

Kuepper, G. 2001. "Pursuing Conservation Tillage Systemsfor Organic Crop Production," ATTRA-National Sustainable Agriculture Information Service, http://attra.ncat.org/attra-pub/organicmatters/conservationtillage.html

The Land Institute, "Research Agenda: Natural Systems Agriculture," The Land Institute, http://www.landinstitute.org/vnews/display.v/ART/2000/12/01/37dffb033

The Land Institute, "Annual Report—June 2003," The Land Institute, ttp://www.landinstitute.org/vnews/display.v/ART/2003/08/05/3f2ed27e34eef?in_archive

National Building Museum, "Nature Constructed/Nature Revealed," National Building Museum, http://www.nbm.org/Exhibits/past/2000_1996/Eco_Revelatory.html

Lyle, J. 1999. *Design for Human Ecosystems: Landscape, Land Use, and Natural Resources*. Washington, DC: Island Press.

Marsh, George Perkins. 1965. *Man and Nature.* Cambridge: Belknap Press of Harvard University Press.

Martin, F. 1999. *American Civic Art*: How Landscape Architects Shaped Twentieth-Century Urbanism. *Landscape Architecture Magazine* 89 (10): 64-70.

Martin, F. 2004. *Bringing Land Ethics to Life*: Restorationist Ron Bowen reconnects Midwesterners with their native landscape. *Landscape Architecture Magazine* 94 (6): 118-121.

McHarg, I. 1997. Ecology and Design. In *Ecological Design and Planning*, edited by G. Thompson and F. Steiner, 321-332. New York: John Wiley & Sons, Inc.

McLaughlin, C. 2002. Introduction to the Reprint Edition. In *Walks and Talks of an American Farmer in England*. Frederick Law Olmsted, author. Amherst: Library of American Landscape History.

McNeely, J. and S. Scherr. 2003. *Ecoagriculture: Strategies to Feed the World and Save Wild Biodiversity*. Washington: Island Press.

Meyer, E. 2000. The Post-Earth Day Conundrum: Translating Environmental Values into Landscape Design. In *Environmentalism in Landscape Architecture*, edited by M. Conan, 187-244. Washington, DC: Dumbarton Oaks.

Miller, L. 1999. *Environmental Conscience Before Ian McHarg*: On the Importance of Ecology in Landscape Architecture Before 1970. *Landscape Architecture Magazine* 89 (10): 58-62.

Mollison, B. 1990. *Permaculture: A Practical Guide for a Sustainable Future*. Washington DC: Island Press.

Morrison, D. 1987. Landscape Restoration in Response to Previous Disturbance. In *Landscape Heterogeneity and Disturbance*, edited by M.G. Turner. New York: Springer-Verlag.

Nassauer, J.I. 1986. *Caring for the Countryside: A Guide to Seeing and Maintaining Rural Landscape Quality*. USDA Soil Conservation Service. Station Bulletin AD-SB-3017, Agricultural Experiment Station. University of Minnesota.

Nassauer, J.I. 1988. The Aesthetics of Horticulture: Neatness as a Form of Care. *HortScience* 23(6): 973-977.

Nassauer, J.I. 1989. Agriculture Policy and Aesthetic Objectives. *Journal of Soil and Water Conservation*, September-October: 384-387.

Nassauer, J.I. 1998. Urban Ecological Retrofit. *Landscape Journal, "Eco-Revelatory Design: Nature Constructed/Nature Revealed"* (Special Issue: Exhibit Catalog): 15-17.

Olin, Laurie. 1990. Wide Spaces and Widening Chaos. *Landscape Architecture Magazine.* 80 (10): 77-83.

Olmsted, F. 2002. *Walks and Talks of an American Farmer in England*. Amherst: Library of American Landscape History.

Prairie Restorations Inc., "Natural landscaping with native grasses and wildflowers", Prairie Restorations Inc., http://www.prairieresto.com/

Rogers, E. 2001. *Landscape Design: A Cultural and Architectural History*. New York: Harry N. Abrams, Inc.

Rybczynski, W. 1999. *A Clearing in the Distance: Frederick Law Olmsted and America in the 19th Century.* New York: Simon & Schuster.

Simo, M. 1988. *Loudon and the Landscape: From Country Seat to Metropolis 1783-1843.* London: Yale University Press.

Soule, J. and J. Piper. 1991. *Farming in Natures Image: An Ecological Approach to Agriculture.* Washington DC: Island Press.

Spector, R. 2002. Fully Integrating Food Systems: Regaining Connections between Farmers and Consumers. In *Fatal Harvest: The Tragedy of Industrial Agriculture*, edited by A. Kimbrell: 351-354. Washington, D.C.: Island Press.

Spirn, A. 2000. Ian McHarg, Landscape Architecture, and Environmentalism: Ideas and Methods in Context. In *Environmentalism in Landscape Architecture*, edited by M. Conan: 97-114. Washington, DC: Dumbarton Oaks.

Thompson, P. 1995. *The Spirit of the Soil: Agriculture and Environmental Ethics.* London: Routledge.

Todd, N. and J. Todd. 1994. *From Eco-Cities to Living Machines: Principles of Ecological Design*. Berkeley: North Atlantic Books.

Todd, J. 2000. The Galactic Explorer Perspective. In *Design Outlaws on the Ecological Frontier,* edited by C. Zelov: 164-175. Easton, PA: Knossus Publishing.

Wuerthner, G. 2002. The Destruction of Wildlife Habitat by Agriculture. In *Fatal Harvest: The Tragedy of Industrial Agriculture*, edited by A. Kimbrell: 277. Washington, DC: Island Press.