Herman A. Karl · Lynn Scarlett
Juan Carlos Vargas-Moreno
Michael Flaxman *Editors*

Restoring Lands - Coordinating Science, Politics and Action

Complexities of Climate and Governance

Springer

Restoring Lands - Coordinating Science, Politics and Action

Herman A. Karl • Lynn Scarlett
Juan Carlos Vargas-Moreno • Michael Flaxman
Editors

Restoring Lands - Coordinating Science, Politics and Action

Complexities of Climate and Governance

Springer

Editors
Herman A. Karl
University of New Hampshire
Durham, New Hampshire
USA
hkarl@comcast.net

Lynn Scarlett
Resources for the Future
Washington, DC
USA
lynnscarlett@comcast.net

Juan Carlos Vargas-Moreno
Massachusetts Institute of Technology
Cambridge, Massachusetts
USA
jcvargas@mit.edu

Michael Flaxman
Massachusetts Institute of Technology
Cambridge, Massachusetts
USA
mflaxman@mit.edu

ISBN 978-94-007-2548-5 e-ISBN 978-94-007-2549-2
DOI 10.1007/978-94-007-2549-2
Springer Dordrecht Heidelberg London New York

Library of Congress Control Number: 2012930835

Preface

Our book is intended to inspire dialogue on new and creative ways to achieve harmony among ecological, social, and economic systems. We would urge you to read William Isaac's book, *Dialogue and the Art of Thinking Together*, either before or after reading this book to relate better to our message.[1] Out of these dialogues, perhaps, will evolve a new *ethos* and *ethic* with respect to the environment that will spur a movement for change and action:

> To affirm each person's dignity
>
> And to cherish the living earth

These two lines are simple yet incredibly powerful statements. They are the last two lines of the four-line Call to Ministry of the First Parish in Lincoln, Massachusetts the small New England town where Herman Karl lives.[2] Instilling a reverence for the living earth in people and respecting each other's dignity are the keys to sustaining a healthy environment for future generations. This is the foundation upon which regulations, economic coalitions, and stewardship needs to be built.

Our relationship with nature cannot be defined in technical terms; it is spiritual and aesthetic.

In writing this book we have reached back to some older works including those by Henry David Thoreau and especially Aldo Leopold. So that their message is not lost in the pages that follow and that you can reflect upon them as you read, we

[1] Other books that help to provide a good foundation for better understanding the underlying premise of this book include: *Frame Reflection* by D.A. Schon and M. Rein and *The Reflective Practitioner: How Professionals Think in Action* by D.A. Schon.

[2] Roger Paine, the minister, opened the service the Sunday morning that Herman Karl first heard these lines by telling about his vacation to Pt. Reyes National Seashore and the beauty of the emerald green hills filled with wild flowers brought to life by the recent rains. Pt. Reyes is part of the Tomales Bay watershed, which is described in Chapter 20. His sermon was on Moral Reasoning. He talked about people getting so caught up in doing "right" that they forget about doing "good."

presage a few key passages from subsequent chapters that particularly bear on humankind's relationship with nature and a new environmental ethos.

Thoreau states in Walden (Sayre 1985, 490):

> Fisherman, hunters, woodchoppers, and others, spending their lives in the fields and woods, in a peculiar sense a part of Nature themselves, are often a more favorable mood for observing her, in the intervals of their pursuits than philosophers or poets even, who approach her with expectation. She is not afraid to exhibit herself to them. … We are most interested when science reports what those men already know practically or instinctively, for that alone is a true humanity [emphasis original], or account of human experience.

With respect to scientific and technical solutions to restoring lands and the need to rethink approaches, Leopold made a sage observation decades ago (Meine 1988, 383):

> 'We end,' Leopold concluded, 'at what might be called the paradox of the twentieth century: our tools are better than we are, and grow better and faster than we do. They suffice to crack the atom, to command the tides. But they do not suffice for the oldest task in human history: to live on a piece of land without spoiling it.'

In *Thinking Like A Mountain*, he describes the killing of a pack of wolves and alludes to the spiritual relationship between humankind and nature (Leopold 1949, 130).

> We reached the old wolf in time to watch a fierce green fire dying in her eyes. I realized then, and have known ever since, that there was something new to me in those eyes—something known only to her and to the mountain.

With regard to restoring and preserving lands (224–225),

> A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise.

And humankind's relationship to the land (203–224),

> All ethics so far evolved rest upon a single premise: that the individual is a member of a community of interdependent parts. … The land ethic simply enlarges the boundaries of that community to include soils, waters, plants, and animals, or collectively: the land.

Holling and Chambers (1973) in a seminal paper help us to transition into the modern era of social-ecological systems thinking, resilience, and new forms of governance and institutional arrangements.

In the past, ecosystems and communities have been sufficiently resilient to absorb the impacts of natural disturbances and human activity.

> "… resilience is not infinite" and "…three hundred years of ignoring these limits has left us with a baggage of approaches and solutions that are only admirable as instruments for resolving fragments of problems. Wherever we look there are gaps – gaps between methods, disciplines, and institutions."

This book identifies the gaps and offers approaches to bridge them. American political institutions are reasonably adept at dealing with crises. They are not suited well at all for the ongoing, flexible, and adaptive policy formulation and decision-making required for balancing the dynamics of coupled natural and human systems

for sustainability, which pose wicked problems. We show how what we already know and practice can be framed, structured, and integrated into a holistic approach to tackle the wicked problem of sustainability. We suggest the creation of new institutions and spaces for adaptive policy formulation and decision-making, because it is not the problem that is wicked so much as the response to it. Whereas these need to be a collaborative effort between government and citizens, the impetus will come from grass roots movements that are emerging organically across the nation and the globe.

Like living organisms, and the earth itself, these new institutions ought to constantly evolve – they must, as wicked problems constantly morph and have no discrete solution only better or worse outcomes.

> We shall never achieve harmony with the land, anymore than we shall achieve absolute justice or liberty for people. In these higher aspirations the important thing is not to achieve but to strive (Aldo Leopold).

Acknowledgements

Herman Karl Many people, too many to name individually, contributed to shaping the evolution of my thinking about restoring and sustaining lands. I am indebted to several visionary leaders that took a risk and supported me to pursue what was an unconventional path of research in the U.S. Geological Survey as my interests evolved from basic marine geological research to the use of science in policy formulation and natural resource management. Gordon Eaton, 12th Director of the USGS, appointed me to the bureau Strategic Planning Team in 1994–1995. This provided an opportunity to learn about USGS as an institution and to help shape its future. P. Patrick Leahy, first as Chief Scientist of the Geologic Division and subsequently as Associate Director for Geology and Acting Director, provided both moral and financial support. I will never forget Pat's remarks to me when I called to discuss the unusual line of research I proposed to undertake. After about 2 min, he said, "Stop, I understand exactly what you want to do and the great risk it entails. I also understand the great potential pay-off to this organization, and I will fund you for 3 years." Charles "Chip" Groat, the 13th Director of the USGS, continued additional venture capital funding as part of the Science Impact Program and encouraged me to expand my research. Alan Mikuni, Chief of the Western Geographic Science Center, provided a space for me to experiment and a safety net to fail when I transferred from the Geology Discipline to the Geography Discipline.

Robert Barrett, an environmental mediator, in California introduced me to the field of collaboration and consensus building. Through Bob, I met Prof. Lawrence Susskind of the Massachusetts Institute of Technology. Larry invited me to MIT on a sabbatical. USGS approved a 1-year temporary assignment that turned into a permanent change of duty station and a 7-year stay at MIT as a Visiting Lecturer in the Department of Urban Studies and Planning. Larry and I co-founded and co-directed the MIT-USGS Science Impact Collaborative (MUSIC). Carl Shapiro, my good friend and colleague in USGS, persevered with me through the bureaucratic morass to move the MUSIC experiment forward; we faced many trials and tribulations together.

During my transition from physical scientist to social scientist (at least that's what I've been told I am now), Gary McVicker and Charles Pregler invited me to be

an instructor in the Bureau of Land Management's Community Based Ecosystem Stewardship course. More than anything else, this singular event changed my outlook on the role of science and scientists in ecosystem restoration and introduced me to citizen stewardship. The many hard working people that came together despite their differences because they cared about the land taught me more than I could possibly teach them.

During this period of transition in my career, I met Michael Mery, then chair of the Tomales Bay Watershed Association. He and the dedicated people that confronted their conflicts, turning them into creative solutions to preserve the character and qualities of the place they loved further inspired me to help develop participatory, collaborative approaches to harmonize the ecological, social, and economic systems.

Throughout all, working quietly and sometimes not so quietly in the background, Lynn Scarlett, my co-editor and friend, supported my efforts through her position first as Assistant Secretary for Policy, Management, and Budget and later as Deputy Secretary in the Interior Department.

Most of all it is through the ongoing support and encouragement of my wife, Suzanne that I have been able to continue to move forward. She has always had faith in me. My daughter, Chantelle, has been an inspiration for me to search for ways to achieve sustainability. As one of her elementary school teachers commented, "Chantelle has a reverence for all life."

Finally, I dedicate this book to the memory of my deceased parents. They instilled in me a moral compass, integrity, inquisitiveness, initiative, responsibility, and ensured that my education came first and foremost. Mostly they encouraged me to be myself.

Lynn Scarlett There is an Apache blessing that closes with these words: "May you walk gently through the world and know its beauty all the days of your life." Behind the analysis and narratives of this book lies, for me, fundamentally, the beauty of this world – a beauty of both people and places. I thank my mother for opening my heart to this beauty. I thank my daughter for lighting my days with laughter and learning to laugh at myself. I thank so many, many colleagues at the Department of the Interior for connecting me to so many people and places laying caring hands across America's landscapes. I thank them, too, for sharing their wisdom. I thank Steven, John, and Maryanne for sharing with me the delights of dragonflies, butterflies, birds, and all things wild.

Michael Flaxman My love of nature comes from my mother, who made sure that I was educated about natural history, even though it was clear at a young age that I didn't share her green thumb. My love of planning comes from my father, who helped start the planned community of Reston, Virginia, where I grew up. Neither of them have much patience for computers, so I'm not sure what sparked my interest there. Combining these three things took awhile, since geographic information systems hadn't been invented when I went to school. I am grateful to ecologist Michael Hamilton, landscape architect David Hulse, and planner Carl Steinitz for showing

me that useful and interesting things can be done in this area. They taught me that when you start with love of place, and respect for its people, flora and fauna, you can always find your way to the knowledge and methods needed. Along the way, you often get to meet some exceptional people.

The work presented here represents passion, dedication, and commitment to doing things better, often against trying odds. As a starting professor at MIT, I particularly appreciate the role of Herman Karl in providing what I found to be a vital bridge between theory and practice, and the communities of science and planning. Although the road was frequently rocky, he stuck true to a vision about what was important, even when it might be hard.

Along a similar vein, my research colleague Juan Carlos Vargas-Moreno has suffered through more bureaucracy, contracting battles and even office-space shuffling in the last 3 years than anyone should have to deal with over a lifetime. So I am thankful to him for his persistence in getting the work done well, even under the most challenging circumstances. Looking back, I am proud of what we have accomplished, despite working on a shoestring with incredibly limited resources.

The students and volunteers working under our supervision, often for long hours and doing something far outside their professional training largely accomplished the Everglades research project. This included undergraduate research assistants, Masters in Community Planning (MCP) graduate students, a Ph.D. student and a visiting researcher. They are individually credited in our chapters, but I want to thank them here again, since none of this could have been done without them.

The project itself would not have been possible without the visionary leadership provided by three exceptional public servants. Ronnie Best, of USGS, had the original vision, which led to the study. Dr. Best is a model to me of what I would most hope for from our nation's scientific leadership. He is a scientist's scientist who thinks outside of the box. In our project and others, he continues to invest significant resources into the challenging and often thankless task of making sure good science leads to better planning. Paul Souza, from the U.S. Fish and Wildlife Service, was the rare manager willing to take a risk, granting us the resources and precious staff time to address a long-term problem while short-term fires raged around him. Steve Traxler was our main FWS liaison, champion, and interagency cultural translator. It is hard to overstate the importance of his support in holding things together and allowing us to move forward. All three of these folks went far outside of their job descriptions to ensure project success.

Finally, thanks to my very patient wife, who endured Boston winters while I was off working in Florida, and frequent cold dinners even when I was at home, all so that I could work overtime on this project and book.

Juan Carlos Vargas-Moreno "This is a place for hope Juan Carlos, as well as place for meditating about the miracle of life," my father said, as I started my first hike in the deepest of the rain forest…I was only 6, my father a young biology professor; the place was my home country Costa Rica. That is my recollection of an appreciation for nature and the land around land.

I need to first and foremost acknowledge my father Gerardo and my mother Maria Teresa for teaching me to appreciate life through the beauty of our land and our relationship with it. To my father who was successful in imbedding in the deepest place of my heart the appreciation and love for nature. To my mother for supporting me and making me aware of life choices and disciplines that eventually allowed me to help conserve that land. I own them my academic and scholar interest. Thanks for a lifetime of ongoing and unconditional support. To my home country Costa Rica for letting me enjoy nature in a very special way as a child.

I also to thank Carl Steinitz my academic mentor for an education beyond the Harvard classrooms and for countless hours of work and discussion together about land, nature and how to plan for their future. Similarly I want to thank Richard Forman at the Harvard Design School for teaching me to see the natural world through the lenses of the landscape itself; and to Bill Clark at the Harvard Kennedy School for teaching me to see land conservation not only as a planning and scientific problem but also as a societal one.

Many people have contributed in the elaboration of this book. First I want to thank my colleagues Herman Karl, Lynn Scarlett and Michael Flaxman, for their patience and incredible discussions lading to this book. To our chapter contributors for pouring their souls and years of experience into these pages, as well as tolerating our edits and sharing a vision for what this book should explored. Thank you all for an incredible job.

My special gratitude goes to Ronnie Best (USGS), Paul Souza and Steve Traxler (USFWS) three outstanding leaders at these federal institutions, for believing and supporting our research vision. Several of these book chapters would not be possible without them. Your leadership and professionalism is a source of insipiration for all of us.

I want to thank the Department of Urban Studies and Planning at MIT for the continued support and especially to our department chair Amy Glasmeier, and those colleagues at the Environmental and Policy Planning Group. I specially want to thank my colleague Michael Flaxman, for the endless support, advice and friendship for the last 10 years. Our intellectual exchanges have always nurtured my work. Also to Herman Karl, for his energy, unbreakable ethics and persistence from which I have learned a great deal. Thanks for believing in our work. Great appreciation goes to our students at MIT, thanks for your patience and valuable work.

Finally, I want to thank my soon to be wife Karelys for her unconditional support, endless patience and most importantly for believing in me. Te amo mi amor. Nothing would mean the same with you.

Contents

Part I
Introduction

Chapter 1
Restoring and Sustaining Lands—Coordinating Science, Politics, and Community for Action

Herman A. Karl, Lynn Scarlett, Juan Carlos Vargas-Moreno, and Michael Flaxman

Abstract We propose that a new conceptual framework is needed for conservation and land restoration to achieve sustainability. We present two conceptual models—Static Productive Harmony and Dynamic Productive Harmony—for formulating environmental policy and making natural resource management decisions. The static model seeks a balance among ecological, social, and economic systems through compromises that require trade-offs that often end up satisfying no one. The dynamic model represents a fundamentally different approach to restoring and sustaining lands. In this model, healthy ecosystems are the foundation for thriving communities and dynamic economies. The dynamic model aims to generate resource management approaches that add value to each of the systems for a mutual gains outcome. Restoring and sustaining lands is a wicked problem. New institutions need to be shaped that support ongoing collaborative and participatory processes to achieve durable and equitable environmental policy.

Keywords Ecosystem health • Land restoration • Collaboration • Land ethic • Wicked problems • Trust • Relationships • Productive harmony

H.A. Karl (✉)
University of New Hampshire, Durham, NH, USA
e-mail: hkarl@comcast.net

L. Scarlett
Resources for the Future, Washington, DC, USA
e-mail: lynnscarlett@comcast.net

J.C. Vargas-Moreno • M. Flaxman
Massachusetts Institute of Technology, Cambridge, MA, USA
e-mail: jcvargas@geoadaptive.com; mflaxman@mit.edu

H.A. Karl et al. (eds.), *Restoring Lands - Coordinating Science, Politics and Action: Complexities of Climate and Governance*, DOI 10.1007/978-94-007-2549-2_1,

"For the first time, I understand the benefits to my family's welfare to manage my ranch for a healthy ecosystem. More importantly, I recognize the responsibility I have to all of society to restore my land and maintain it as a healthy ecosystem."[1] The rancher that made this statement experienced an epiphany. He gleaned an insight that is the underlying premise of this book—healthy ecosystems are the foundation for thriving communities and dynamic economies. He came to understand that his economic wellbeing and his family's quality of life depend upon restoring the natural environment of his ranch. That same link between economies and the environment applies broadly across communities. Sustainability is an illusion unless communities understand the importance of restoring lands to health and protecting the environment and *manifest their understanding through action*.[2]

This book gives voice to others like the Nevada rancher. It is not an academic tome, although some contributors are with academic institutions. And it is not a guide book or handbook by practitioners setting out procedures and methods for collaborative conservation. It is a narrative of diverse voices that collectively talk about coordinating science, politics, and communities to manage ecosystems in harmony[3] with social and economic systems. The common thread through each of the chapters is the belief in the effectiveness of *people acting together* to achieve durable solutions for restoring lands. Each of the authors, who generically might be classed as "scholar practitioners," has a very different background, set of experiences, and career path—engineer, social scientist, political scientist, physical scientist, biologist, ecologist, natural resource manager, policy maker, activist citizen, federal government scientist, urban planner, landscape architect, computer modeler—yet their paths led each of them to embrace the promise and power of collaboration and the ability of people to express their diverse values in grappling with complex and contentious environmental and land use issues.

These chapters provide some insights as to why and how the individual paths of participating authors converged. Although each chapter stands alone and can be read independently of the others, a greater understanding will come through reading the book in its entirety. We will help the reader in that understanding by linking each chapter in each section, linking each section, and concluding with a synthesis and recommendation for a more effective process that coordinates science, politics and communities to restore and sustain lands. In this regard, the appendix will help you understand how these concepts translate into action on the ground.

---

[1] A rancher in eastern Nevada said this to Herman Karl about in 2004 when Karl was visiting two privately held ranches that practiced holistic ranch management.

[2] The challenge is not only that of action; it is how to develop institutions that provide the incentives, feedback, and accountability that help people understand the results of their decisions, be accountable for them, and adjust to changing circumstances.

[3] Thoreau provided a view of harmony in Walden published in 1854 that is as true today as it was then: "Our notions of law and harmony are commonly confined to those instances which we detect; but the harmony which results from a far greater number of seemingly conflicting, but really concurring, laws which we have never detected is still more wonderful" (Sayre 1985). Has he anticipated the field of ecology and Leopold's land ethic?

Since the environmental crises of the 1960s, societies have endeavored to find ways to manage natural systems and the services they provide in harmony with social and economic systems. Enacted in 1969, the foundational modern U.S. environmental law, the National Environmental Policy Act (NEPA), sets forth this aspiration and outlines the decision processes that are intended to help federal agencies better achieve "productive" harmony among ecological systems, economic systems, and social systems. At least two decades of sustainability initiatives, likewise, have aimed for this harmony. Yet these efforts continue to fall short of their aspirational promise. One increasingly apparent barrier pertains to governance processes and institutions, which this book addresses in several chapters. Another fundamental barrier is the tension between the environment and the economy[4] (Layzer 2006).

Productive harmony is most often interpreted to imply an equal status among the three systems. However, one worldview puts economic systems and societies they support on a higher plane than ecological systems, whereas another worldview elevates ecological systems. These opposing worldviews generate conflict, which often results in dysfunction, because the antagonists on one side presume robust economies are attained at the expense of ecosystem health (despoiling the environment) and those on the other side believe aggressive environmental protection and ecosystem restoration are not compatible with strong (profitable) economies. Some actions to reduce environmental impacts do carry costs, and most production and consumption activities have some environmental impacts. However, pursuit of economic and environmental benefits need not be a zero-sum contest. Such a framework presents an unnecessary dichotomy. Adherence to it causes polarization and stalemate. The potential tensions between economic actions and environmental protection, when managed well, can transform into a creative tension that can lead to breakthrough solutions—the harmony among ecological, economic, and social systems envisioned in the National Environmental Policy Act. The chapters in this book illustrate various ways for turning potentially bitter and deadlocked disputes into *actionable, productive, and durable outcomes that address environmental, economic, and social goals*.

Implicit in this book is the belief that healthy lands are the foundation for thriving communities and dynamic economies,[5] as stated in the opening paragraph. The conventional conception of productive harmony among the three systems is that each system occupies the corner of a triangle or some other trilogy analogy (Fig. 1.1, Static Productive Harmony model). Productive harmony, or sustainability, is achieved at the center of the triangle, which seldom occurs in practice. There are various paths and combinations to reach the harmonious center, yet these paths often require trade-offs that can possibly (and often do) result in deadlock. Theoretically, productive harmony could be achieved at numerous

[4] "Civilization has so cluttered this elemental man-earth relationship with gadgets and middlemen that awareness of it is growing dim. We fancy that industry supports us, forgetting what supports industry."— Aldo Leopold

[5] "We abuse land because we see it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect."—Aldo Leopold

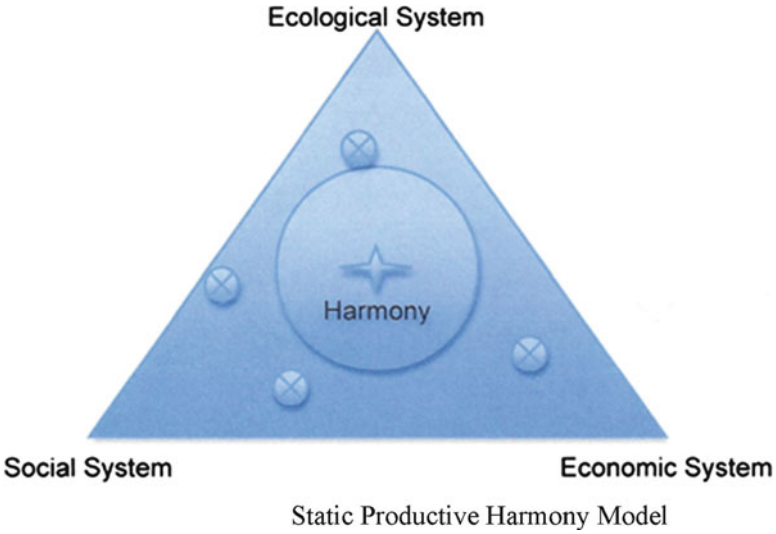

Fig. 1.1 This is a representation of the traditional way of thinking of harmony among ecological systems, social systems, and economic systems. The *dots* with crosses represent a few of the infinite combinations within the circle among the three systems. This is a static model, with movement only possible within the bounds of the triangle, with sustainability essentially conceived as a series of different tradeoffs

points along these paths through compromise. But compromise is difficult to achieve, particularly where mistrust flourishes and, where decision making remains framed within the triangle of competing systems, there is no way to think outside the "box."

Another way to visualize productive harmony is to look at sustainability as a house (Fig. 1.2). In this conceptual model, Dynamic Productive Harmony, ecological systems are the foundation of the house and the heating, plumbing, electrical, and water systems (infrastructure) of the house; social systems are the living spaces (superstructure); and economic systems are the flows of goods and services such as food and fuel into the house to service the living spaces.[6] The engines (ecosystem services) for the infrastructure are housed in the basement, the structural foundation of the house. The environment is the overall framework of the house that shelters all. A deteriorating framework exposes everything within the house to the weather, with degradation or even, ruination resulting. Similarly, if the foundation is faulty or allowed to deteriorate, the superstructure and flow of goods and services will eventually deteriorate. Indeed, if the foundation has been neglected, a nicely painted house may provide a

[6]Ecological systems are both foundations and infrastructure. Using ecosystems in an ecosystem services framework is often about replacing "gray" infrastructure—levees, wastewater treatment plants, etc.—with "green" infrastructure—coastal sea marshes, wetlands, etc. Economic systems are not really just matters of "static" infrastructure—bridges, roads, airports, etc. As systems, economies are highly dynamic contexts through which people exchange goods and services, allocate scarce resources, etc.

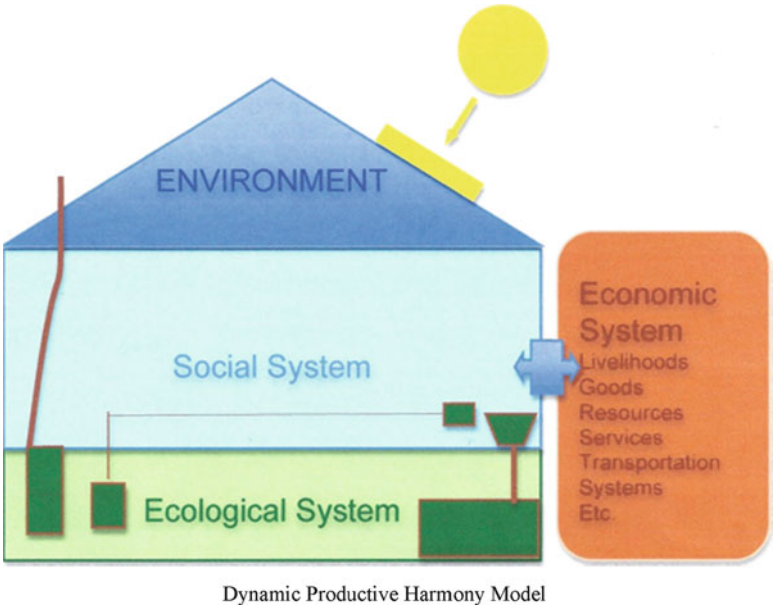

Fig. 1.2 In this conceptual model the ecological system is the foundation and infrastructure for robust social systems and strong economic systems. Sustainability is not possible without a healthy ecosystem. This is a dynamic model reflecting the complex and complicated dynamics of coupled natural and human systems. The "*house*" needs constant upkeep and if the needs of the family (society) change it can be expanded and remodeled. It is a dynamic, process-oriented model. Sustainability is attainable as an outcome of continual decision-making processes

false sense of security. The house must be constantly maintained (a continuing process) to stay in good repair. Given a strong foundation, the house can be remodeled and enlarged—breaking out of the original "box." The architect (scientist/engineer), general contractor (policy maker/economic actors), subcontractors (natural resource managers/land use planners), and owner (citizen/community) together can create something new to fit the growing needs of the family (society/nation).[7]

The distinction between these conceptual models is critical as they represent two fundamentally different approaches to restoring and sustaining lands and setting environmental policy. Following the first conceptual model, policy tends to move toward compromise among the three systems by seeking the center of the triangle, equating harmony as balance, but generally requiring tradeoffs among systems. Trade-offs are presumed at the expense of one system over another. In the second, policy focuses on sound construction and preservation of the foundation and the overall decision framework to sustain and preserve the superstructure, infrastructure, and resource flows. Trade-offs may still be necessary in this model. However, value can be added by "remodeling" mitigating trade-offs. Others have described this

[7] Anyone who has built a house knows that there is constant negotiation and tension among the architect, contractor, subcontractors, and owner. When tension is managed well, a superior house is built.

intersection of environmental, economic, and social values as achieving "triple bottom line" or win-win-win outcomes.

The recognition that natural resources—the environment—must be conserved for the wellbeing of future generations emerged at the turn of the nineteenth century. President Theodore Roosevelt designated thousands of acres as national parks and national forests. The Progressive Movement reflected in these designations was, in part, a reaction to what was perceived as an over-exploitation of natural resources during the middle of the nineteenth century. He and America's first professional forester, Gifford Pinchot, introduced the concept of scientific management into the federal agencies and policy apparatus. The objective nature of science was thought to counter subjective and partisan politics as factors in making decisions about the management of natural resources. Yet this perspective has at least two limitations. First, the conduct of science itself is situated within value frameworks that shape (and may limit) the questions addressed through scientific inquiry. Second, resource management decisions involve matters linked to personal and social values, preferences, and priorities—such issues are not purely technical. To overlook these constraints can result in unintended consequences.[8] "Just because an idea is true doesn't mean it can be proved. And just because an idea can be proved doesn't mean it is true. When the experiments are done, we still have to choose what to believe" (Lehrer 2010, 57).[9]

Choosing what to believe is a function of values, worldviews, and cultural norms; people with different worldviews may hold the same values, but they may weigh each value differently. One's choices can change as one's life experiences accumulate and thinking evolves. The career of Aldo Leopold is exemplar in this regard (Meine 1988). Leopold was trained at the Yale School of Forestry in the scientific method of land management. Early in his career, he practiced the utilitarian principles of multiple uses of forests; forests were surveyed and trees counted to assess

[8]Karl was an instructor in the Bureau of Land Management Community-based Ecosystem Stewardship course; he taught the role of science in collaborative processes. These courses were taught at sites of some of the most contentious environmental issues in the country. He would start by asking the participants what they thought of and what their experience had been with science and scientists. A few people would say: "Smart people." "People in white lab coats." Many, though would say: "Lying SOBs." "You can't trust them as far as you can throw them." "You can pay any one of them to say anything you want." Clearly, their experiences with scientists and the information they produce were not that of objectivity. This experience was an epiphany for Karl. Every scientist that he has related the story too, has expressed shock. Too many scientists stay in their offices, laboratories, and discount local knowledge when in the field. More scientists should work with people to experience problems from their perspectives. Scientists might then take a more humble attitude toward their science and knowledge (see for example, Andrews 2002).

[9]The issue is not whether to "believe" experimental results per se. Indeed, science is all about a method of replication to try to validate results, rendering them (potentially) more robust. Rather, the issue goes back to the matter of different cognitive and decision purposes. Science is about asking, "how does the world work." But social and political choices are about "what values do we hold, what priorities do we hold, what are our individual preferences." Science cannot answer these questions. For example, scientists can examine what happens if some contaminant enters the soil. They can't answer the question: how clean is clean enough, which is a values question.

number of board feet that could be harvested in a sustainable way. Game (wildlife was a term not then used) management consisted of protecting prey species and killing predators. The field of ecology was not yet invented. Gradually and progressively Leopold began to understand that species were not isolated but connected as part of a complex biotic system and that it is the system (the environment) that must be preserved; disturbing any one part causes unbalance and dysfunction throughout the ecological system. But he understood more—he understood that science was not enough. In *Thinking Like A Mountain*, he describes the killing of a pack of wolves (Leopold 1949, 130). "We reached the old wolf in time to watch a fierce green fire dying in her eyes. I realized then, and have known ever since, that there was something new to me in those eyes—something known only to her and to the mountain." His personal evolution was cut short by an untimely death fighting a fire in 1948. His prescient work culminated in the *Land Ethic* (Leopold 1949). With regard to restoring and preserving lands, "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise (224–225)." Notably Leopold states, "I have purposefully presented the land ethic as a product of social evolution, because nothing so important as an ethic is ever 'written'. … I think it is a truism that as the ethical frontier advances from the individual to the community, its intellectual content increases" (225).

With this simple yet profound statement, Leopold had captured the essence of advances in social-ecological system thinking to the present day. Today we talk in terms of resilience, emergent properties, and dynamics of coupled natural and human systems (Gunderson et al. 1995; Folke et al. 1998; Gunderson and Holling 2002; Gunderson and Pritchard 2002; Berkes et al. 2003; Liu et al. 2007). The enhanced scientific and conceptual understandings of social-ecological systems are effectively refinements of Leopold's land ethic; and even with all the scientific advances, application of these concepts to environmental policy remains elusive. We need to make routine the processes that have been developed that teach us how to learn (double-loop learning; Argyris and Schon 1978), to learn from doing, and to make mid-course adjustments in our decisions based on what we learn. Research and analysis remains important so that we continue better to understand complex, dynamic ecosystems. Above all, however, we need better ways to strengthen linkages of science with experiential knowledge and to enhance processes and institutions that facilitate dynamic decision-making. We need to nurture the *political and social will to undertake the hard work of collaboration, and, particularly, to shape the institutions, policy tools, and science support that sustain collaborative action over time.*

We hope to advance the social evolution of the land ethic by inspiring our readers to reflect upon their relationship with the environment and to *take action to reflect that land ethic in decision making processes and resource management choices*.[10]

[10]Climate change has accelerated the need for society to evolve socially and to continue to develop a land ethic that instead of economics is the basis for political and social action. We must find ways to adapt to changing climate. We must evolve a new mindset that jumps beyond the bounds of the current environmental movements, which seem to have ground to a halt only staying the line and not moving further toward the goal.

To do this, we need to nurture a *new ethos* with respect to people's relationships to nature and the governance and management of natural resources and ecosystems; Nurturing the sort of land ethic Leopold and others have described will take generations of institutional evolution and experience.[11]

Beyond the challenges of reorienting how we think about the interrelationship of social, economic and environmental systems, land and resource managers face another conceptual challenge. Restoring and sustaining lands are wicked problems (Rittel and Webber 1973; Miller 1999; Ison and Collins 2008; Brown et al. 2010) because they require decisions at the interface of science, engineering and technology, governance and policy, ecology, culture, values, and livelihoods. We have described the possibilities of blending environmental, economic, and social values in land and resource management decisions. However, even where this blending may be possible, many land and resource management issues are "wicked problems" that have no solution only better or worse outcomes. In part, they are wicked problems because these problems unfold within highly dynamic physical, social, and political contexts. Change is often nonlinear and, hence, not readily predicted. Moreover, many of these problems involve multiple physical variables and many potentially desirable outcomes all of which cannot be jointly achieved in a context of scarce human, financial, and other resources. These problems require a continual process to address them, just as our dynamic productive harmony model requires an ongoing process of decisions regarding routine "maintenance" and adaptation to surprises (a tree falling on the roof) for sustainability. In recognition of these properties and to simplify discussion, we grouped chapters into three sections:

- Science, Technology, and Engineering (Tools and Methods)[12]
- Politics and Policy (Governance and Frameworks)
- People and Action (Stewardship, Community, and Implementation)

The order of these sections mirrors in a way the chronology of approaches to land restoration.

Scientific management was introduced at the turn of the nineteenth to twentieth century and "decisions based on sound science" has been the mantra for natural resource management agencies ever since (McKinney and Harmon 2004; Karl et al. 2007). Engineering solutions started modestly with control of flooding, for example, by constructing dams and levees and draining wetlands and marshlands to turn them into "productive" lands. As technology advanced, engineering solutions became more ambitious; the construction of the enormous dams in the western

[11] Although it appears late in this book, Chap. 20, *The Tomales Bay Watershed Council: A Model for Collective Action*, is especially important as an exemplar of this new ethos in action.

[12] "Our job is to harmonize the increasing kit of scientific tools and the increasing recklessness in using them with the shrinking biotas to which they are applied. In the nature of things we are mediators and moderators, and unless we can help rewrite the objectives of science we are predestined to failure."— Aldo Leopold (1949)

Sections III and IV address our role as mediators and moderators and stewards of the land.

states and the attempt to manage water in the Greater Everglades Ecosystem for agricultural purposes are examples. Whereas some of these projects have provided great benefits, they have also often transformed ecosystems in ways that have resulted in unintended negative outcomes. The devastation of New Orleans by Hurricane Katrina is one example, which many attribute to man and not nature (Groat 2005; Thornburgh 2005). Nature repeatedly has taught us many lessons, but we do not learn those lessons well. Without doubt, science, engineering, and technology have produced innumerable benefits to humankind. However, with respect to engineering large ecological systems we have come up short. Leopold (Meine 1988, 383) hit the nail on the head:

> 'What I decry is not so much the prevalence of public error in the use of engineering tools as the scarcity of engineering criticism of such misuse.' The engineer respects mechanical wisdom, … because he creates it; *he lacks respect for ecological wisdom not because he is contemptuous of it, but because he is unaware of it* [emphasis added]. 'We end,' Leopold concluded, 'at what might be called the paradox of the twentieth century: our tools are better than we are, and grow better and faster than we do. They suffice to crack the atom, to command the tides. But they do not suffice for the oldest task in human history: to live on a piece of land without spoiling it.'

Our use of the word science includes the social and political sciences as well as the natural and physical sciences. The dynamics and complexity of coupled natural and human systems require an *integrated,* interdisciplinary approach. And local, experiential, and indigenous knowledge need to be part of the equation for describing and understanding these systems. Scientists often dismiss this form of knowledge. But as Thoreau states in *Walden* (Sayre 1985, 490):

> Fisherman, hunters, woodchoppers, and others, spending their lives in the fields and woods, in a peculiar sense a part of Nature themselves, are often a more favorable mood for observing her, in the intervals of their pursuits than philosophers or poets even, who approach her with expectation. She is not afraid to exhibit herself to them. … We are most interested when science reports what those men already know practically or instinctively, for that alone is a true *humanity* [emphasis original], or account of human experience.

Thoreau, in 1854, appears to have answered the question that E.O. Wilson posed in 1998 (13) and believes every college student should be able to answer: *"What is the relation between science and the humanities, and how is it important for human welfare?"*[13]

We need to heed voices of the past such as Thoreau and Leopold, while continuing to make new discoveries. *Ultimately, however, it is through social and deliberative processes that individuals singly and in communities articulate their values and priorities, identify challenges to fulfilling those values and priorities, and determine*

[13]Theodore Roosevelt also pondered this question. "His subject, 'Biological Analogies in History,' was one that he had pondered since discovering, as a teen ager, that he was equally drawn to science and the humanities. It seemed to him that these disciplines, rigorously separated in the nineteenth century might drawer closer again in the twentieth, as scientists looked for narrative explanations of the mysteries of nature, and scholars became more abstract and empirical in their weighing of evidence (Morris 2010, 74).

how to address those challenges. Scientific and technical tools should be aids to a deliberative process and not an intrinsic end.

Political systems refer to institutions and rules by which communities, regions, and nations conduct their collective decisions and allocate shared resources. Politics arise as participants jockey for voices in shaping these institutions and rules. Because many natural resources are public and land and natural resource decisions—public and private—affect communities, these decisions are buffeted by political jockeying. There is constant conflict between the western and eastern states at the federal level over resource issues. Communities compete for water. Resource users compete over who has access to what resources, when, where, and how. Different federal agencies have mandates to manage the same resources. The Bureau of Reclamation has jurisdiction over many hydropower and irrigation projects; the Army Corps of Engineers constructs and manages navigation and flood control projects. The Bureau of Land Management (Department of the Interior) and U.S. Forest Service (Department of Agriculture) both manage public lands, often with conflicting regulations pertaining to logging, grazing, recreation, and other land uses. There is little coordination among agencies, and often competition for limited financial resources. Here again, Leopold (1949, 213) was prescient: "At what point will governmental conservation, like the mastodon, become handicapped by its own dimensions?" In response to the unimaginable environmental crises of the 1960s—polluted waters, contaminated soils, dirty air—a series of laws were enacted (NEPA, Clean Water Act, and Endangered Species Act are examples). Many of these acts are administered by different agencies with sporadic or no coordination and often rivalry.

Within this medley of agencies, sometimes overlapping laws, competing priorities, and political conflict, environmental and natural resource managers often looked to science, in rhetoric if not always in practice. Again, analogous to the initiation of scientific management to mitigate or obviate partisan politics, outcomes mandated by some of these acts were based on concepts of risk assessment (National Research Council 1996), though regulatory decisions and environmental management practices reflected a continual mix of politics and science.

The concept of adaptive management, first clearly articulated in the early 1970s (e.g. Holling 1973, 1978; Walters 1986), produced insights about resource management in a context of scientific uncertainties and dynamic conditions. Subsequently, recognizing the interconnectedness of many resource management issues, the concept of ecosystem-based management surfaced in attempts to manage natural resources and public lands more holistically. However, in more than three decades of practice only a handful of adaptive management cases worldwide have been successful, and many large-scale efforts at ecosystem-based management have met with significant implementation challenges. The reasons for this vary and involve ecological, political, and social issues. Changes in ecosystems in response to management decisions may take decades to detect; the short-term nature of the political and funding cycles is not compatible with the long-term nature of adaptive and ecosystem-based management. Consequently, funds are not appropriated to monitor and evaluate the effects of management decisions,

which is a basic principle of adaptive management. Sometimes adaptive management plans have been developed without close collaboration of scientists and managers. Perhaps most fundamental is that current governance rules and structures are not well suited to use these management practices that require flexible and cross-agency decision making.

Increasingly, conventional top down governance models and policy tools for managing lands are not sufficient for dynamic, integrated solutions to our vexing and complex environmental problems (Koontz et al. 2004; Brunner et al. 2005; Ison and Collins 2008). Consequently, new governance models such as adaptive governance and networked governance are emerging. These new models emphasize cross-agency coordination, public-private collaboration, and flexible responses to ever-changing conditions. In part as a consequence of the environmental crises of the 1960s and out of frustration over what was perceived as insufficient action by the federal and state governments, citizens became more active in environmental and natural resource management issues. Many watershed associations sprang up around the country. Now there are hundreds of collaborative groups where citizens participate in managing lands with uneven success.[14]

No process or approach is a panacea. Still, well-designed collaborative processes that involve diverse participants hold great promise (Wondolleck and Yaffee 2000; Bryant 2004; National Research Council 2008). The Department of the Interior, the Nation's largest land management agency, in its fiscal year 2003–2008 strategic plan, set as a goal the creation of a nation of citizen stewards with department personnel gradually working as facilitators with citizens to manage and restore lands. In essence, it is an attempt to develop a community of practice. Once again, we go to Leopold's well (1949, 203, 204). "All ethics so far evolved rest upon a single premise: that the individual is a member of a community of interdependent parts. … The land ethic simply enlarges the boundaries of that community to include soils, waters, plants, and animals, or collectively: the land."

This book mirrors that enlarged community through the mix of chapters that are interdependent. Each section is introduced with a chapter that sets the context and links the section chapters into a coherent whole. The authors are colleagues and friends of the editors. Collectively, they represent scores of years of practice and active research. The narratives, for the most part, are not analyses of the work of others and cases. They manifest "action" research, policy-making, experiences, and practice of

[14] "It is not the critic who counts, not the man who point outs out how the strong man stumbles, or where the doer of deeds could have done them better. The credit belongs to the man who is actually in the arena, whose face is marred by dust and sweat and blood, who strives valiantly, who errs, and comes up short again and again, because there is no effort without error or shortcoming; but who does actually strive to do the deeds; who knows the great enthusiasms; the great devotions; who spends himself in a worthy cause; who at the worst, if he fails, at least fails while daring greatly, so that his place shall never be with those cold and timid souls who know neither victory or defeat." Theodore Roosevelt, Citizenship in a Republic, speech given at the Sorbonne, Paris, France, April 23, 1910.

doers on the ground. Their experiences are not filtered through the lens of analysts and interpreters. There are many academic books and articles that offer analyses of cases and critiques of the methods and processes set forth in this book. Whereas we may not necessarily agree with some of the premises, analyses, and interpretations of these authors, they are valuable as different points of view and should be read and reflected upon by anyone reading this book. Although there is a plethora of second-person interpretations and analyses of collaborative conservation, there is a dearth of first-person accounts. This book provides the unfiltered perspectives and stories of those whose work is often interpreted by others. We conclude the book with a synthesis of the barriers and challenges for restoring lands and sustainability, a road map for overcoming these barriers and a prescription for designing and implementing the new processes and institutions to tackle wicked problems to achieve sustainability, and an outlook for the future.

It may come as a surprise that we have so prominently cited a few voices from the past. However, in these and other classic and timeless works, there are insights that are the keys to living in harmony with nature. In our view, it is those who have lived with nature and whose livelihoods and wellbeing are bound to nature that are best able to discern and unravel how humans can live in harmony with nature. Yet, we do not marginalize the discoveries of science that provide us with information. Neither science nor local, experiential, and indigenous knowledge alone is sufficient for understanding complex and interdependent natural and human systems (Adler and Birkhoff 2002). It is through the social and political processes that these two forms of knowledge are integrated with community values. Through collaborative learning we might attain the wisdom to make better choices.

Before continuing, it is essential to define collaboration—what people acting together means to us—so that you, the reader, and we are talking the same language. There is a continuum of public participatory practices.[15] In this book we focus on the use of consensus-based decision-making processes by local groups comprised of diverse stakeholders, what is usually called multi-party negotiation (Susskind et al. 1999). Chapter 20 describes this in practice. These groups could be pieces of a larger networked collaboration. A consensus-based process sets out not to achieve compromise among the parties, but to *create value for mutual gains* (Susskind and Field 1996). This is an important distinction. There are times it is not possible to add value and the group settles for compromise. Collaborative groups arise for a number of reasons—sometimes because of the threat of litigation and sometimes organically because participants hold shared values or shared concerns. It is the grass roots, organically emergent collaborative efforts that especially interest us here.

Partnerships and coordination among parties are forms of collaboration but they ought not to be confused with a well-designed, consensus-seeking participatory collaborative process, which is guided by specific protocols and best practices. The

[15]To learn more visit the International Association for Public Participation website http://www.iap2.org/