INTEGRATED RESOURCE MANAGEMENT AND PLANNING

Matthew Carlson and Brad Stelfox
ALCES Landscape Ecology Group, Canada

Keywords: Land use, tradeoff analysis, indicator, stakeholder collaboration, adaptive management, monitoring, threshold, zoning, integration.

Contents

Summary

Land use conflicts are increasing in intensity and frequency as a result of expanding development, a finite land base, and a growing environmental ethic. Reactionary strategies, fragmented bureaucracies, and the legacy of utilitarian management approaches have created disjointed environmental management that is poorly suited to resolve land use conflicts. Integrated approaches to resource and environmental management have emerged as an alternative.

Integrate resource management (IRM) applies a number of concepts to balance development and conservation objectives.

1. Stakeholder collaboration: IRM engages a diverse set of stakeholders that represent the full range of existing opinions and knowledge to achieve informed, balanced, and broadly supported resource management strategies.
2. Explicit goals and indicators: IRM is guided by explicit goals with measurable indicators and targets that are an expression of the collective ecological and human values of stakeholders.
3. Tradeoff analysis: an integrated assessment of the tradeoffs between economic and environmental indicators informs the selection of resource management strategies that are consistent with IRM goals.

4. Adaptive management: management experiments reduce uncertainty to improve capacity to select resource management strategies that are consistent with IRM goals.
5. Monitoring: ecological monitoring provides an information feedback loop to assess the impact of management on IRM indicators, thereby guiding when and how land use needs to be adjusted.
6. Development thresholds: IRM strives to establish development thresholds that restrict anthropogenic disturbance to within ecological limits.
7. Zoning: Because all goals can not be achieved through uniform application of land use, varying levels of land use intensity are applied to distinct portions of the landscape, including protected areas where development is prohibited.

1. Introduction

Over the past century evidence of the degradation of ecosystems has become increasingly apparent. Humanity's unprecedented consumption of resources has caused species extinctions at a rate that exceeds natural levels by as much as 1,000 times, and has damaged numerous ecosystem services essential to all life such as climate regulation and the supply and purification of water. Unlike previous eras of colonization, opportunities are few to expand the land base to meet growing demand for resources. At the same time, the environmental movement has grown in prominence and demands to preserve wilderness and biodiversity have increased. The combination of expanding development, a finite land base, and a growing environmental ethic inevitably has caused the frequency and severity of land use conflicts to increase.

Utilitarian resource management approaches with narrow objectives and an assumed capacity to control nature have faltered and a steady stream of environmental crises has ensued. Responses to the crises have typically been reactionary, with new laws and regulations focused on specific issues. As a result, action and tools to mitigate environmental degradation is ad hoc and aimed at treating symptoms rather than systemic effects. Further fragmenting society's response to environmental issues has been the growing compartmentalization of bureaucracies. Most countries have separate laws, institutions and policy objectives to govern sectors such as agriculture, transportation, health, energy, water, and wildlife. The compartmentalization frequently means that decisions to govern a sector are made without sufficient regard for issues outside the sector's narrow mandate, and conflict between agencies and governments can result.

Reactionary strategies, fragmented bureaucracies, and the legacy of utilitarian management approaches have created disjointed environmental management that is inflexible and narrow in scope and spatial and temporal scale. In contrast, environmental problems are typically complex, interconnected, associated with uncertainty, multidisciplinary, and broad in spatial and temporal scale. The severity and complexity of these problems has motivated the creation of integrated approaches to resource management worldwide. In North America, for example, environmental controversies such as the spotted owl and degradation of the Great Lakes have been catalysts for integrated approaches whereas in Australia the impacts of unsustainable agriculture such as salinization and eutrophication have been motivational.

2. Defining Integrated Resource Management

Examples of integrated approaches include integrated resource management, integrated environmental management, integrated catchment management, watershed management, bioregional planning, and integrated landscape management. The approaches are characterized by a proactive, holistic, systems-based, and integrated approach to environmental problems. Here we adopt the term integrated resource management (IRM) to refer to integrated approaches to managing environmental and resource issues. While numerous definitions of IRM exist, we adopt Cairns and Crawford's (1991) definition: "*Coordinated control, direction or influence of all human activities in a defined environmental system to achieve and balance the broadest possible range of short- and long-term objectives*."
Four essential characteristics differentiate IRM from other management approaches:

1. *Inclusive*. IRM considers the broad spectrum of ecological, social, political, and economic factors and large spatial and temporal scales that define environmental issues. In contrast to monodisciplinary management approaches such as sustained yield, IRM demands a multidisciplinary approach that engages diverse perspectives and skill sets. Decision making is a collaborative process involving the public. There exists an explicit recognition that empirical science alone can not lead to a solution, but rather that a society informed by science can better arrive at optimal landuse trajectories.
2. *Interconnective*. IRM evaluates how different components of ecological and human systems interact. This system dynamics approach recognizes that ecosystems are complex systems with emergent properties that can not be ascertained through reductionism and that, as a result, environmental problems can not be solved by compartmentalization.
3. *Goal-oriented*. Unlike the reactionary decisions that define much of environmental policy, IRM is goal-oriented and proactively plans for a desired state. The goals are typically broad and defined through a collaborative process involving diverse stakeholders. The goal-setting process therefore not only fosters a proactive perspective, but also inclusivity and broad ownership in planning outcomes.
4. *Strategic*. Goal-setting also focuses attention on key elements of the system of concern. This focus is needed to strategically address environmental issues amongst the complexity and uncertainty of environmental systems. IRM's strategic approach is adaptive and intentionally seeks to improve knowledge of the ecological and social effects of land use. At the same time, IRM is precautionary to limit the risk of unanticipated and undesirable impacts.

3. Elements of an Integrated Resource Management Approach

To further describe IRM, we now discuss seven fundamental elements of IRM: stakeholder collaboration, explicit goals and indicators, tradeoff analysis, adaptive management, monitoring, thresholds, and zoning.

3.1. Stakeholder Collaboration

To successfully balance the broadest range of goals possible, IRM must engage a diverse set of stakeholders that represent the full range of existing opinions and interests. As such, interaction among stakeholders is likely the most important element of IRM and diverse stakeholder involvement is needed to achieve long-term success. Failure to assemble a broad constituency of stakeholders will ultimately lead to an unacceptably narrow definition of issues and problems, and not contribute meaningfully to corrective policy and management actions. Stakeholders that most often should be engaged include: governments that own resources and/or regulate development; companies that develop resources; aboriginal communities that have unique resource rights and perspectives; local communities that are positively and negatively impacted by resource development; and public interest groups that voice concerns for social and environmental issues.

A collaborative approach seeks to build understanding and consensus despite interests and political affiliations. Strategies to support successful stakeholder committee collaboration include providing resources necessary for coordination, communication, administration, and meetings; ensuring that stakeholder committee membership is unbiased; and consensus-based decision making. While time-consuming, these approaches to achieve effective interaction among a diverse set of stakeholders have significant benefits. They foster the development of goals and strategies that represent the full array of information, knowledge and perspectives. Effective stakeholder interaction also builds the social and political capital necessary to implement management strategies recommended by the IRM planning process.

A major impediment to IRM is intra- and inter-governmental fragmentation. Horizontal integration at a given level of government and vertical integration across levels of government (national to local) are needed to achieve mutuality among regulations and management effort. Integration is a major challenge, however, due to the legacy of fragmented institutional structure and poor associational relationships among sectors such that roles and direction of accountability is often unclear. Policy and legislative reform to formally integrate resource management among government agencies is the ultimate answer to fragmentation. For example, an umbrella IRM ministry to inform and guide secondary ministries would reduce the ideological “siloization” of government employees and foster the appetite for integrated problem definition and solution sets. Such reforms may be difficult to achieve due to the numerous agencies and levels of government involved. While policy and legislative reform is being pursued, inter- and intra-governmental integration can also be supported on a case by case basis through collaborative land use planning. A land use planning process that involves all relevant government agencies, as well as other stakeholders, will foster a consistent resource management vision. To facilitate integrated implementation of the vision, a land use plan can specify the roles and direction of accountability of the government agencies that will be responsible for regulating development.

3.2. Explicit Goals and Indicators

As discussed above, goals in an IRM process should be an expression of the collective values of relevant stakeholders. Two types of values are relevant to IRM: ecological values and human values. Ecological values are those understood as necessary for maintaining healthy ecosystems. These include abiotic resources such as water and soil, biotic resources including the full suite of native species, and formative ecological processes such as disturbance regimes, hydrological processes, and nutrient cycles. Human values are those products and services generated by ecosystems that are beneficial to humans. These include harvested and extracted resources and associated economic benefits; recreational opportunities; ecosystem services such as flood control and climate regulation; and spiritual values.

To guide management, goals must be translated into measurable indicators for which quantitative targets can be set. In addition to being relevant to goals, indicators should be sensitive to ecological variability in order to provide early warning of change; understandable by decision makers and the public; and cost-effective to monitor. Maintaining biodiversity, for example, is a frequently expressed goal in resource management. On its own, however, this goal is uninformative due to the overwhelming complexity of ecosystems. To operationalize the goal of maintaining biodiversity, three types of indicators are often used as biodiversity surrogates: representation, focal species, and ecological processes. Representation seeks to protect examples of all ecological communities in order to promote the maintenance of biodiversity without requiring the impossible task of analyzing the individual requirements of all native species. Patterns of biodiversity are dictated by ecological processes such as natural disturbance and hydrology, and management should strive to maintain processes within their natural range of variation. Representation of ecological communities and maintenance of the natural range of variation of ecological processes are coarse-filter approaches which, while relatively efficient, may not always equate to species persistence. Managing for a set of focal species provides a more thorough check of whether management strategies will support the persistence of sensitive wildlife populations.

-
-
-

Bibliography

Bellamy, J.A., G.T. McDonald, G.J. Syme, and J.E. Butterworth. (1999). Evaluating integrated resource management. *Society and Natural Resources* 12(4): 337-353. [Differentiates between traditional and integrated resource management approaches and presents a conceptual framework for evaluating IRM programs.]

Cairns, J. Jr. and T.V. Crawford. (1991). *Integrated Environmental Management*, 215 pp. Lewis, MI, USA. [A handbook for integrated environmental management.]

Carlson, M. and F. Schmiegelow. (2002). Cost-effective sampling design applied to large-scale monitoring of boreal birds. *Conservation Ecology* 6(2): 11. [online] URL: http://www.consecol.org/vol6/iss2/art11 (accessed December 19, 2007). [An example of power analysis to identify cost-effective sampling designs for monitoring biodiversity.]

Carlson, M., E. Bayne, and B. Stelfox. (2007). *Seeking a Balance: Assessing the Future Impacts of Conservation and Development in the Mackenzie Watershed*. Canadian Boreal Initiative, Ottawa, ON. [An example of a scenario analysis to explore the cumulative effects of land use in the Mackenzie Valley of northwestern Canada.]

Davidson, D.J., and N.A. MacKendrick. (2004). All dressed up with nowhere to go: the discourse of ecological modernization in Alberta, Canada. *Canadian Review of Sociology and Anthropology* 41(1): 47-65. [Discusses how the term integrated resource management can be misapplied to reinforce existing and ineffective management strategies.]

Dehcho Land Use Planning Committee. (2006). *Respect for the Land: The Dehcho Land Use Plan Background Report (Final Draft)*, 346 pp. [online] URL: http://www.dehcholands.org/docs_final_draft_dehcho_land_use_plan_june_02_06.htm (accessed December 19, 2007). [A thorough description of the Dehcho Land Use Plan, an example of integrated resource management.]

Duraiappah, A.K. and S. Naeem. (2005). *Millennium Ecosystem Assessment: Ecosystems and Human Well-being - Biodiversity Synthesis*, 100 pp. World Resources Institute, Washington, DC. [An overview of ecosystem degradation caused by human activities.]

Ford, A. (1999). *Modeling the Environment: An Introduction to System Dynamics Models of Environmental Systems*, 415 pp. Island Press, Washington, D.C. [An introductory text for the application of computer models to the study and management of environmental systems.]

Groffman, P.M., J.S. Baron, T. Blett, A.J. Gold, I. Goodman, L.H. Gunderson, B.M. Levinson, M.A. Palmer, H.W. Paerl, G.D. Peterson, N.L. Poff, D.W. Rejeski, J.F. Reynolds, M.G. Turner, K.C. Weathers, and J. Wiens. (2006). Ecological thresholds: the key to successful environmental management or an important concept with no practical application? *Ecosystems* 9: 1-13. [A discussion of the utility of ecological thresholds in environmental management.]

Hegmann, G., C. Cocklin, R. Creasey, S. Dupuis, A. Kennedy, L. Kingsley, W. Ross, H. Spaling, and D. Stalker. (1999). *Cumulative Effects Assessment Practitioners Guide*, 134 pp. Prepared by AXYS Environmental Consulting Ltd. and the CEA Working Grouop for the Canadian Environmental Assessment Agency, Hull, Quebec. [online] URL: http://www.acee-ceaa.gc.ca/013/0001/0004/Cumulative-Effects_e.pdf (accessed December 19, 2007). [A discussion of cumulative effects assessment from a Canadian perspective.]

Margerum, R.D. (1999). Integrated environmental management: the foundations for successful practice. *Environmental Management* 24(2): 151-166. [Presents a framework for operationalization of IRM.]

Noss, R.F. and A.Y. Cooperrider. (1994). *Saving Nature's Legacy: Protecting and Restoring Biodiversity*, 443 pp. Island Press, Washington, D.C. [A comprehensive guide for the protection of biodiversity.]

Peterson, G.D., G.S. Cumming, and S.R. Carpenter. (2003). Scenario planning: a tool for conservation in an uncertain world. *Conservation Biology* 17(2): 358-366. [A discussion of scenario analysis in environmental management.]

Reagan, D.P. (2006). An ecological basis for integrated environmental management. Human and Ecological Risk Assessment 12: 819-833. [Describes an integrated resource management approach intended to strategically conserve human and ecological values.]

Schmiegelow, F. K. A, S. G. Cumming, S. Harrison, S. Leroux, K. Lisgo, R. Noss and B. Olsen. (2006). *Conservation Beyond Crisis Management: A Conservation-Matrix Model*, 7 pp. BEACONs Discussion Paper, No. 1. [online] URL: http://www.rr.ualberta.ca/research/beacons/resources.htm (accessed December 19, 2007). [Describes an approach to protected areas planning that emphasizes the role of protected areas as ecological benchmarks.]

Walters, C.J. and C.S. Holling. (1990). Large-scale management experiments and learning by doing. *Ecology* 71(6):2060-2068. [A description of adaptive management.]

Biographical Sketches

Matthew Carlson completed a Master of Science in conservation biology at the University of Alberta in 2001 where he investigated cost-effective sampling designs for monitoring biodiversity. He is an Ecologist with the ALCES Landscape Ecology Group and the Canadian Boreal Initiative in Ottawa, Ontario. Integrated resource management projects include scenario analyses to evaluate the sustainability of land use options in a range of landscapes including the Mbaracayu Biosphere Reserve, Paraguay and the Mackenzie Valley, Canada; assessing the state of Canadian national parks; and developing a web-based simulation tool to teach sustainable land use concepts in Alberta, Canada (www.albertatomorrow.ca).

Dr. Brad Stelfox is an adjunct professor at the Department of Biological Sciences, University of Alberta and the Department of Environmental Design, University of Calgary. In 1995, Dr. Stelfox established FOREM Technologies, which focuses on the interface between human landuses and regional landscapes. The major development stream of FOREM has been ALCES© (A Landscape Cumulative Effects Simulator), a program gaining rapid acceptance by the governments, industry, the scientific community, and NGO's to explore issues between landscapes, landuses (agriculture, forestry, oil and gas, mining, human populations, tourism, and transportation sectors), and ecological and economic integrity.