

# A Resilience Thinking Perspective on the Ecosystem Approach

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The 12 principles of the ecosystems approach are complementary and interlinked <http://www.cbd.int/ecosystem/principles.shtml>, providing a framework for holistic and inclusive ecosystem management. These principles can be related to application of resilience thinking to ecosystem management. Resilience thinking considers those properties of human and natural systems (“complex adaptive social-ecological systems”) that enhance their resilience: that is, their ability to recover from disturbance or to evolve in response to environmental change.

<b>Ecosystem Approach Principles</b>	<b>Resilience Thinking Perspective</b>
<p><b>Principle 1: The objectives of management of land, water and living resources are a matter of societal choices.</b></p> <p>Different sectors of society view ecosystems in terms of their own economic, cultural and society needs. Indigenous peoples and other local communities living on the land are important stakeholders and their rights and interests should be recognized. Both cultural and biological diversity are central components of the ecosystem approach, and management should take this into account. Societal choices should be expressed as clearly as possible. Ecosystems should be managed for their intrinsic values and for the tangible or intangible benefits for humans, in a fair and equitable way.</p>	<p>Land and seascapes are the co-evolved product of the interaction between humans and nature. The question of enhancing resilience for whom and resilience of what to what kinds of disturbance, are determined by societal choice. The potential trade-offs in resilience for whom and resilience of what are made as explicit as available knowledge allows. A resilience assessment undertaken to develop a vision and strategic goals for ecosystem management would be in accordance with principle 1.</p>

<p><b>Principle 2: Management should be decentralized to the lowest appropriate level.</b></p> <p>Decentralized systems may lead to greater efficiency, effectiveness and equity. Management should involve all stakeholders and balance local interests with the wider public interest. The closer management is to the ecosystem, the greater the responsibility, ownership, accountability, participation, and use of local knowledge.</p>	<p>Decentralized management creates a diversity of smaller scale units that can be managed to suit local social and ecological contexts as well as create redundancy where a number of similar management units are doing more or less the same thing. Decentralization also enables a more rapid response by managers to changing conditions than can be achieved when decision-making is centralized. These advantages increase the capacity of a social-ecological system to recover from disturbance and to evolve over time as the larger environment changes. Decentralized management also provides the basis for creating new organizations and institutions that may be necessary to match the scale of decision making with ecological scale as required by EA principles 3 and 7.</p>
<p><b>Principle 3: Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.</b></p> <p>Management interventions in ecosystems often have unknown or unpredictable effects on other ecosystems; therefore, possible impacts need careful consideration and analysis. This may require new arrangements or ways of organization for institutions involved in decision-making to make, if necessary, appropriate compromises.</p>	<p>Resilience thinking considers the interactions between system components that operate at the scale of management focus (e.g., a protected area); the scale below (e.g., the subsystems that exist within a protected area) and the scale above (e.g., the larger landscape within which the protected area is located). An inability to understand “cross-scale interactions” is a frequent cause of management failure.</p>

<p><b>Principle 4: Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should:</b></p> <ul style="list-style-type: none"> <li>• Reduce those market distortions that adversely affect biological diversity;</li> <li>• Align incentives to promote biodiversity conservation and sustainable use;</li> <li>• Internalize costs and benefits in the given ecosystem to the extent feasible.</li> </ul> <p>The greatest threat to biological diversity lies in its replacement by alternative systems of land use. This often arises through market distortions, which undervalue natural systems and populations and provide perverse incentives and subsidies to favor the conversion of land to less diverse systems.</p> <p>Often those who benefit from conservation do not pay the costs associated with conservation and, similarly, those who generate environmental costs (e.g. pollution) escape responsibility. Alignment of incentives allows those who control the resource to benefit and ensures that those who generate environmental costs will pay.</p>	<p>Resilience thinking considers the financial and intrinsic value of ecosystem services, or nature's contributions to people; and (particularly) among indigenous people, encourages a perspective that considers the reciprocal nature of interactions between humans and nature. Recognizing the trade-offs between the production of different natural contributions; and the need to maintain a balance between regulating and provisioning services in a changing environment will enhance the resilience of an ecosystem. Extractive use of ecosystems that focus on the financially optimized production of a few goods reduces their resilience. Alignment of costs and responsibility through localization of markets improves the feedback between human use and the ecological response of ecosystems, increasing the resilience of the system. Extraction of goods for distant or global commodity markets may disconnect ecosystem users from the effects of their use and ultimately lead to systemic degradation from which it may be difficult, or impossible to recover.</p>
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<p><b>Principle 5: Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.</b></p> <p>Ecosystem functioning and resilience depends on a dynamic relationship within species, among species and between species and their abiotic environment, as well as the physical and chemical interactions within the environment. The conservation and, where appropriate, restoration of these interactions and processes is of greater significance for the long-term maintenance of biological diversity than simply protection of species.</p>	<p>Managing ecosystems for economic purposes alone reduces their resilience and can lead to systemic collapse, hence the need to balance regulating services with provisioning services (EA principle 4) Once collapsed, restoration may be required to return them to a condition where they can support human livelihood. Restoration may be a costly, long term process that at best creates a system that approximately replicates the system that was lost.</p>
<p><b>Principle 6: Ecosystem must be managed within the limits of their functioning.</b></p> <p>In considering the likelihood or ease of attaining the management objectives, attention should be given to the environmental conditions that limit natural productivity, ecosystem structure, functioning and diversity. The limits to ecosystem functioning may be affected to different degrees by temporary, unpredictable or artificially maintained conditions and, accordingly, management should be appropriately cautious.</p>	<p>Being able to detect functional limits and avoid exceeding them is the essence of resilience-based stewardship. This is particularly true of the large scale, slow changing elements of ecosystems such as forests, wetlands, soils, savannas and grasslands, because these provide the long term stability that species, communities and people depend on. Management that drives major system elements across the boundaries of their functional limits will precipitate a cascade of change that affects all the species and communities that occur within that system. Climate change is in the process changing all the world's ecosystems.</p>

<p><b>Principle 7: The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.</b></p> <p>The approach should be bounded by spatial and temporal scales that are appropriate to the objectives. Boundaries for management will be defined operationally by users, managers, scientists and indigenous and local peoples. Connectivity between areas should be promoted where necessary. The ecosystem approach is based upon the hierarchical nature of biological diversity characterized by the interaction and integration of genes, species and ecosystems.</p>	<p>As with EA principle 3, resilience thinking considers at least three levels of scale to understand change processes. For migratory species and rivers, still larger levels of scale may be encompassed by a nested hierarchical governance system that incorporates subsidiarity, redundancy, and ability to manage interactions across scales. Centralized decision-making would be replaced with nodes of decision-making across nested networks where management authority is devolved to the location in the network where feedbacks can be most readily detected and acted on. Creating the new organizations and institutions needed to achieve this will not be easy as it requires a redistribution of power in decision-making.</p>
<p><b>Principle 8: Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term.</b></p> <p>Ecosystem processes are characterized by varying temporal scales and lag-effects. This inherently conflicts with the tendency of humans to favor short-term gains and immediate benefits over future ones.</p>	<p>This principle is consistent with the need to manage ecosystems within the limits of their functioning (EA principle 6), especially with regard to large systems that change slowly over time and provide stability for smaller scale systems. Intensive arable agriculture and industrial ocean fisheries are examples of ecosystem uses focused on short-term gain at the expense of long-term stability and resilience.</p>

<p><b>Principle 9: Management must recognize that change is inevitable.</b> Ecosystems change, including species composition and population abundance. Hence, management should adapt to the changes. Apart from their inherent dynamics of change, ecosystems are beset by a complex of uncertainties and potential "surprises" in the human, biological and environmental realms. Traditional disturbance regimes may be important for ecosystem structure and functioning, and may need to be maintained or restored. The ecosystem approach must utilize adaptive management in order to anticipate and cater for such changes and events and should be cautious in making any decision that may foreclose options, but, at the same time, consider mitigating actions to cope with long-term changes such as climate change.</p>	<p>Resilience based stewardship is based on a model or models of change that recognize the key drivers and balancing feedbacks that operate in a system and estimate how close a system is to its limits. Monitoring and adaptive management are used to determine the outcomes (both intended and unintended) of ecosystem management interventions. Active adaptive management is used to test assumptions in the change model and learn how a system behaves at the edge of its limits, and what kinds of new system might evolve from the old. This provides communities with a method for developing scenarios of the future and choosing between alternative pathways towards sustainable use of biodiversity. The most important part of a resilience approach is the establishment of organizations and institutions for social learning that can conceptualize, anticipate and learn from change over time.</p>
<p><b>Principle 10: The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.</b> Biological diversity is critical both for its intrinsic value and because of the key role it plays in providing the ecosystem and other services upon which we all ultimately depend. There has been a tendency in the past to manage components of biological diversity either as protected or non-protected. There is a need for a shift to more flexible situations, where conservation and use are seen in context and the full range of measures is applied in a continuum from strictly protected to human-made ecosystems</p>	<p>Resilience thinking enables the develop change models and adaptive management techniques that enable ecosystem managers to balance ecosystem use for multiple outcomes in a changing environment. A changing environment implies the need to shift use across land and seascapes when necessary to maintain resilience. Simple dichotomies that emphasize exclusive protection or use, restrict the abilities of nature and humans to respond to change and reduce ecosystem resilience.</p>

<p><b>Principle 11: The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.</b></p> <p>Information from all sources is critical to arriving at effective ecosystem management strategies. A much better knowledge of ecosystem functions and the impact of human use is desirable. All relevant information from any concerned area should be shared with all stakeholders and actors, taking into account, inter alia, any decision to be taken under Article 8(j) of the Convention on Biological Diversity. Assumptions behind proposed management decisions should be made explicit and checked against available knowledge and views of stakeholders.</p>	<p>This transdisciplinary perspective is an integral part of a resilience thinking and essential for developing a good mental model of major change processes at play in an ecosystem. Integrating multiple sources of knowledge (traditional, expert, local, agency and academic) for planning, management and monitoring will create a stronger foundation for ecosystem management than an approach based on a narrow range of perspectives. A resilience based approach would establish experiments to test the more important assumptions incorporated in management decisions through active adaptive management.</p>
<p><b>Principle 12: The ecosystem approach should involve all relevant sectors of society and scientific disciplines.</b></p> <p>Most problems of biological-diversity management are complex, with many interactions, side-effects and implications, and therefore should involve the necessary expertise and stakeholders at the local, national, regional and international level, as appropriate.</p>	<p>As with EA principle 11, this is explicit in a resilience-based approach that considers interactions between humans and nature across multiple scales.</p>