Managing Forested Landscapes for Socio-Ecological Resilience

Convening lead authors: Brenda J. McAfee and Ronnie de Camino
Lead authors: Philip J. Burton, Brian Eddy, Lutz Fähser, Christian Messier, Maureen G. Reed, Tom Spies and Roberto Vides
Contributing authors: Carolina Baker, Milka Barriga, José Campos, Olga Corrales, Leonardo Espinoza, Sachi Gibson, Jonas Glatthorn, Catherine Martineau-Delisle, Cornelius Prins and Nancy-Anne Rose

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Evolution of the concept of sustainability

- First in 16\textsuperscript{th} century Saxon forest regulation
  - economic development and conservation of the environment was lifted to international agenda
- The Word Commission on Environment and Development (Bruntland 1987)
  - sustainable development: the needs of the present should not compromise the ability of future generations to meet their needs
  - the tree pillars of sustainability: economic, social and environmental
Evolution of the concept of sustainable forest management (SFM)

  - by 2003 nine criteria and indicator processes established
  - criteria and indicator processes have supported the development of market based mechanisms, certification

- Convention on Biological Diversity (CBD)
  - the Ecosystem Approach for integrated management of land, water and living resources
  - Malawi Principles of the Ecosystem approach to implement CBD

→ Acknowledgement that forests are socio-ecological systems
Integrating economic, social and environmental outcomes for sustainable development

- Millennium Development Goals set by UN General Assembly:
  - 1. End poverty and hunger
  - 2. Universal education
  - 3. Gender equality
  - 4. Child health
  - 5. Maternal health
  - 6. Combat HIV/AIDS
  - 7. Environmental sustainability
  - 8. Global partnership

- Millennium Ecosystem Assessment by science experts worldwide: scientific appraisal of the condition and trends in the world’s ecosystems
  - need for new approaches, with the maintenance of ecosystem services as a primary goal

→ Many forests are still not managed according to the Forest Principles
Increasing expectations on forests as multi-functional landscapes

• An array of concepts based on holism, sustainability and adaptive management:
  – e.g. ecosystem approach, ecosystem management, adaptive management, integrated landscape/land/systems management
  – landscape approach: forests are managed for the maintenance of ecological integrity and multiple benefits by controlling spatial landscape structure and its dynamics

• Managing for sustainability implies planning for the future

• The systems-concept:
  – includes the interactions, connectedness and feedback loops also between humans and ecological systems
  – socio-economic and ecological systems are complex and continually adapting through cycles of change
Holling’s systems dynamics (Panarchy) model

The nested hierarchies of natural and human systems are linked in continuing cycles of growth (exploitation), accumulation (conservation), restructuring (release) and renewal (reorganisation)
Resilience of socio-ecological systems

- Resilience is the built-in capacity of a system to buffer disturbances and maintain the capacity to provide ecosystem functions (Holling 1973)
- Resilience is measured by the amount of change a system can undergo and still remain within the same state, the degree to which the system is capable of self-organisation, or to which it can build the capacity to learn and adapt
- Resilience management is guided by renewal (Phases 3 and 4 of the model); the focus turned from stability to management of the capacity of ecological and social systems to cope, adapt to, and shape change
Biodiversity balances ecosystem processes

- Facilitation of gradual changes rather than trying to affect resilience by controlling disturbance and changing conditions
  - to avoid the critical rate of change, a tipping point beyond which ecosystems will not be resilient
  - functionally diverse communities are more likely to adapt to variability and change
Resilience management

• Adaptive management a key in managing for resilience
  – flexibility, learning, innovation as a trigger for change and renewal

• Tools:
  – respecting natural disturbance regimes
  – setting aside areas as nature reserves
  – conservation efforts in both disturbed and undisturbed areas
  – actions at the genetic level: isolated tree species at the margins, selection of trees for harvesting
Examples of management planning to integrate ecological, economic and social values (1/2)

- **Triad approach in public forests in Canada** (tested on 0.86 million ha)
  - Forest divided into three complementary zones:
    - conservation (counterbalancing intensive silvicultural zone)
    - natural disturbance-based ecosystem management (NDB; to preserve resilience while accommodating human use)
    - intensive silviculture (for timber production)

- **Nature-oriented forestry – the Lübeck concept** (applied originally on 5000 ha)
  - managing guided by natural processes with minor interference
  - the output should not exceed the potential productivity of natural ecosystem and achieving economic benefits is based on minimising the input rather than maximising the output
Examples of management planning to integrate ecological, economic, and social values (2/2)

- Landscape-level land use planning with ecosystem approach in Bosque Seco Chiquitano
  - integrated plan for conservation and sustainable development grew into a landscape ecoregional land planning system
  - priorities and actions based on maintaining ecological integrity of the component ecosystems, strengthening local resource management, utilizing territorial land at different scales, identifying economic value for wild plant resources and integrating traditional and scientific knowledge
  - keys to success in integration of multi-sector and participatory public policies
  - yet, focusing primarily on economic objectives can lead to changes in ecological system
• Should include natural, human, social and economic assets and the condition, trends and intensity of use of all ecosystem services
  – natural assets: dynamic ecosystems and environmental features that provide a flow of goods and services; cannot be substituted by other assets
  – human assets: collective attitudes, skills and abilities of people
  – social assets: shared norms or values that facilitate individual or collective action generated by networks of relationships, reciprocity, trust and social norms
  – economic and financial assets: can be directly converted into money
Lessons learnt from monitoring at landscape scale

An example from Northwest Forest Plan, USA:

- Ecological and socio-economic outcomes should be clearly stated to put monitoring results into context
- It may be necessary to monitor both habitat and populations for a few species, because habitat and trends, and drivers of those trends, may differ
- Not practical to survey large numbers of rare species, structure-based approaches may be all that agencies can afford for most species
- Scientists and managers must work together: scientists to develop protocols and analyses and managers to do the monitoring work
Landscape-level modelling for planning and evaluation

- Lessons learned:
  - using scenarios can help to understand the possible consequences and cumulative effects of site- and landscape-level plans and activities
  - most models have to rely on a mix of relationships derived from empirical studies or expert judgment
  - necessary to explain assumptions, limitations and uncertainties
  - developing the geographic information system (GIS) layers and supporting models can take considerable time and effort
  - validation of models is extremely difficult and is often approximated

→ Modelling alone rarely changes policy and management, but it is a critical part of a systems-based landscape management process that includes monitoring, research and stakeholder involvement
Challenges in managing for change: Forest adaptability and resilience

- Accepting heterogeneity and unpredictability implies allowing forest development to follow a variety of possible paths
  - conventional approach has been to control disturbances and to be able to predict forest development
- A systems framework takes into account the lack of certainty and spatial and temporal variation within ecosystems
  - this can guide development of more flexible management practices that allow forests to adapt and be resilient
- Managing for system resilience means recognising that
  - ecosystem dynamics are of non-linear and non-equilibrium nature
  - changes in ecological processes in one level can affect those in other levels
Challenges in managing for change: Risk assessment and risk management

- Forecasting future changes and impacts is challenged by the unpredictability of ecosystems and limited scientific knowledge
- Risk assessment and risk management deal with near- and long-term sustainability planning
- It is equally important to consider what is not known to what is known about a particular ecosystem and to make all uncertainties explicit
- Risk-based approach should
  - be scientifically robust
  - accommodate stakeholder values and perceptions
Challenges in managing for change: climate change

• In general, climate change will through further land use changes also
  – shift community priorities and change local/regional economic activities
  – result in contingent pathways of succession and more alternative stable states through interaction of ecosystems on the landscape
→ calls for more effective, holistic and systems-based management practices and closing the gap between current landscape management practices and emerging scientific perspectives
→ calls for timely information for pro-active actions for “resistance”, “resilience” and “response”
Challenges in managing for change: Empowered participatory governance

- Is a key for land use planning and asset utilisation
- For successful management enabling conditions are needed, as well as
  - practical orientation related to practical problems
  - deliberative generation of acceptable solutions to generate collective action
  - bottom-up participation empowering the community
  - devolution of access to land and other resources
  - decentralisation with clear responsibilities at local level
  - colonisation of the state by the community (transforming the national natural resource agenda into implementation of a local agenda)
Adaptive management to deal with uncertainty

- In adaptive and collaborative management the effects of decisions and practices are continually monitored and utilised, along with research results, to modify activities
- In adaptive management interested parties (persons, communities) agree to collaboratively plan, observe and learn from the implementation
- Conservation and development processes cannot be formulated through central planning agencies
  - rather they need to be cultivated through the development of capacities in communities
Necessary shifts in management approaches:

- From separating people from protected areas to an acceptance that people must remain embedded within landscapes in order to protect biological and cultural diversity.
- From expert based ecosystem management towards participatory approaches that seek ways to include local knowledge, perspectives and interests.
  → This requires strong linkages and partnerships across spatial and temporal scales, trust-building, capacity-building, mutual learning and sufficient time and resources.
  - Examples: Biosphere Reserves and Model Forests.
Emerging new paradigm for resilience management

- A developing consensus: long-term sustainability of forest resources requires a multi-level (spatial and temporal) collaborative approach where forested landscapes are viewed as eco-sociological systems.
- Such a conceptual framework recognises the complexity of forest systems (ecological, economic and social), their hierarchical structures, the interactions and their capacity for self-organisation.
- The key activity is integration.
- Systems thinking and trans-disciplinary approaches can guide in the development of new approaches.