APPENDIX 1. The definition and key features of FLR.

Definition

The standard definition of FLR used to date describes it as "*a planned process that aims to regain ecological integrity and enhance human well-being in deforested or degraded forest landscapes*" (Maginnis et al. 2007, Mansourian 2005). In this context a landscape is defined as "*a contiguous area, intermediate in size between an 'ecoregion' and a 'site', with a specific set of ecological, cultural and socio-economic characteristics distinct from its neighbours*". A forest landscape is considered to be "*a landscape that is, or once was, dominated by forests and woodlands and which continues to yield forest-related goods and services*" (Maginnis and Jackson 2007).

Here we critically evaluate the definition of FLR. First, we note that one of the features of FLR is its active involvement of stakeholders throughout the planning and implementation process (Maginnis et al. 2007). We suggest that this might usefully be emphasized by referring to FLR as a participatory, rather than as a planned process, in its definition.

Secondly, the term 'ecological integrity' requires clarification. Mansourian (2005) defines 'ecological integrity' as '*maintaining the diversity and quality of ecosystems, and enhancing their capacity to adapt to change and provide for the needs of future generations'*. Lamb and Gilmour (2003) further expand on this definition, suggesting that it includes '*ecological authenticity (eg ecological naturalness, viability, health) as well as the functional effectiveness of the restoration process (eg the extent to which key ecological processes are regained)*'. As pointed out by Newton (2007, 2011), terms such as 'authenticity', 'naturalness' and 'health' are poorly defined and are consequently difficult to measure; the same may therefore be said of 'ecological integrity'. Terms that are difficult to operationalise should be avoided (Peters 1991), and we therefore propose that 'ecological integrity' should not be employed either as part of the definition of FLR or as one of its features. For this reason, we propose that FLR be redefined as "*a participatory process supporting the recovery of degraded forest landscapes, to increase their value for both biodiversity and human livelihoods*".

Key features

Maginnis and Jackson (2007) identify four key features of FLR:

1. FLR is a process, which embodies three key principles: (i) it is participatory, (ii) it is based on adaptive management and is therefore responsive to social, economic and environmental change, and (iii) it requires a clear and consistent evaluation and learning framework.

2. FLR seeks to restore ecological integrity; simply replacing one or two attributes of forest functionality across and entire landscape tends to be inequitable and unsustainable.

3. FLR seeks to enhance human well-being, based on the principle that the joint objectives of enhanced ecological integrity and human well-being cannot be traded off against each other at a landscape scale.

4. FLR implementation is at a landscape scale; in other words, site-level decisions need to be made within a landscape context.

Some of these features require further elaboration. First, the reference to adaptive management implies the systematic analysis of different management actions to achieve a desired outcome. Adaptation also involves changing assumptions and interventions in response to the information obtained as a result of monitoring. A monitoring programme is therefore essential if an adaptive management approach is to be effective, together with an appropriate evaluation and learning framework to ensure that lessons are learned from management experience (Salfasky et al. 2002).

The third feature listed by Maginnis and Jackson (2007) focuses on enhancing human well-being. The linkage between human well-being and the condition of ecosystems is currently a major focus of research, as illustrated by the Millennium Ecosystem Assessment (2005). Central to this research approach is the concept of 'ecosystem services', or the benefits provided by ecosystems to humans. FLR should therefore increase the provision of ecosystem services, by restoring those ecological processes and functions on which this provision depends (Fisher et al. 2008). This should be explicitly recognized in the principles of FLR.

Maginnis and Jackson (2007) also suggest 'that the joint objectives of enhanced ecological integrity and human well-being cannot be traded off against each other at a landscape scale'. This depends on an implicit assumption that human well-being and ecological integrity are coincident within a landscape, an assumption that is largely untested. However, it is not difficult to envisage how conflicts could arise: human well-being is heavily dependent on access to food, which is generally more readily obtained from cropland than from forest. Evidence suggests that 'win-win' solutions between human well-being and ecosystem condition may be difficult to achieve in practice; trade-offs may also need to be made between one ecosystem service and another (Tallis et al. 2008).

Principles of FLR

On the basis of these points, we propose that the following fundamental principles of FLR be defined, by revising the features presented by Maginnis and Jackson (2007) as follows:

1. FLR is a flexible process, which embodies three key features: (i) it is participatory, requiring the engagement of stakeholders to be successful; (ii) it is based on adaptive management and is therefore responsive to social, economic and environmental change; and (iii) it requires both an adequate monitoring program and an appropriate learning process.

2. FLR seeks to restore ecological processes at the landscape scale that will ensure maintenance of biodiversity and ecosystem functions, and confer resilience to environmental change.

3. FLR seeks to enhance human well-being, through restoration of ecosystem services.

4. FLR implementation is at a landscape scale; in other words, site-level decisions need to be made within a landscape context.

LITERATURE CITED

Fisher, B., K.Turner, , M. Zylstra, R. Brouwer, R. de Groot, S. Farber, P. Ferraro, R. Green, D. Hadley, J. Harlow, P. Jefferiss, C. Kirkby, P. Morling, S. Mowatt, R. Naidoo, J. Paavola, B. Strassburg, D. Yu, and A. Balmford. 2008. Ecosystem services and economic theory: Integration for policy-relevant research. *Ecological Applications* 18: 2050-2067.

Lamb, D., and Gilmour, D. 2003. *Rehabilitation and restoration of degraded forests*. IUCN and WWF International, Gland, Switzerland and Cambridge, UK.

Maginnis, S. and Jackson, W. 2007. What is FLR and how does it differ from current approaches? Pages 5-20 *in* J. Rietbergen-McCracken, S. Maginnis, and A. Sarre, editors. *The forest landscape restoration handbook*. Earthscan, London, UK.

Maginnis, S., J. Rietbergen-McCracken, and W. Jackson. 2007. *Introduction*. In: Rietbergen-McCracken, J., Maginnis, S., Sarre, A. (Eds.). Pages 1-4 *in* J. Rietbergen-McCracken, S. Maginnis, and A. Sarre, editors. *The forest landscape restoration handbook*. Earthscan, London, UK.

Mansourian, S. 2005. Overview of forest restoration strategies and terms. Pages 8-16 *in* S. Mansourian, D. Vallauri, and N. Dudley, editors. *Forest restoration in landscapes: beyond planting trees*. Springer, New York, USA.

Millennium Ecosystem Assessment. 2005. *Ecosystems and human well-being: current state and trends. Findings of the Condition and Trends Working Group*. World Resources Institute, Washington, DC.

Newton, A. C. 2007. *Forest ecology and conservation. A handbook of techniques*. Oxford University Press, Oxford.

Newton A. C. 2011. Synthesis: principles and practice of forest landscape restoration. Pages 353-383 in A. C. Newton, A.C. and N. Tejedor, editors. *Principles and practice of forest landscape restoration: case studies from the drylands of Latin America*. IUCN, Gland, Switzerland.

Peters, R. H. 1991. *A critique for ecology*. Cambridge University Press, Cambridge, UK.

Salafsky, N., R. Margoluis, K. Redford, and J. Robinson. 2002. Improving the practice of conservation: a conceptual framework and agenda for conservation science. *Conservation Biology* 16: 1469-1479.

Tallis, H., P. Kareiva, M. Marvier, A. Chang. 2008. An ecosystem services framework to support both practical conservation and economic development. *PNAS* 105: 9457–9464.