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Executive summary

Forest landscape restoration (FLR) requires a long-term commitment from a range of stakeholders to plan the restoration initiative collaboratively and see it through successfully. This is only possible when the people involved – whether they are landholders, indigenous groups, government entities, non-governmental organizations or other crucial actors – come together to define common goals and monitor progress toward those goals. Collaborative monitoring can play a crucial role in these processes by providing a structured way to include diverse stakeholders in FLR, generate local buy-in and catalyze social learning. However, collaborative monitoring is new to many FLR planners and, while they may be interested in implementing collaborative monitoring, they may not know where to start. This diagnostic provides a systematic way for FLR planners to assess their FLR initiatives against a checklist of success factors. The diagnostic helps practitioners to: (1) determine whether they are ready for collaborative monitoring; (2) identify what elements need to be strengthened; and (3) assess whether existing monitoring systems are on the right track. The diagnostic can be applied on at least two scales: it includes factors to be used at a specific FLR site and it outlines the factors that are intrinsic to a multilevel collaborative monitoring system. It consists of a core matrix of 42 success factors, plus suggestions for performing the assessment.

1 Introduction

As global commitments to forest landscape restoration (FLR) have gained momentum, as well as political and institutional support, FLR decision-makers at the global and local levels are increasingly recognizing the central role of collaborative monitoring (also called participatory monitoring[1]) in ensuring restoration success (Edwards et al. 2017; Mansourian et al. 2017; USDA Forest Service 2017). Collaborative monitoring refers to a continuum of engagement between professional researchers and local people in the collection and use of information for decision-making at multiple levels (Cash et al. 2006; Danielsen et al. 2009; Newig et al. 2010). Collaborative monitoring plays a crucial role in providing accountability, generating local buy-in and catalyzing learning in monitoring systems. Furthermore, local people can collect accurate data on forest change, drivers of change, threats to reforestation, and biophysical and socioeconomic impacts that remote sensing often cannot, and they can do this at one-third the cost of professionals with sufficient training and follow-through. Collaborative monitoring is not a panacea, however: it requires investment and staff to build capacity and information infrastructure and to provide follow-through training and support to ensure that the monitoring is correctly carried out and then shared frequently at multiple levels to generate social learning and collaborative decision-making.

1.1 Forest landscape restoration (FLR)

FLR is a planned "process that aims to regain ecological integrity and enhance human wellbeing in deforested or degraded landscapes" (Mansourian et al. 2005), recognizing that there will be trade-offs in a landscape in order to meet a diverse set of goals. FLR does not seek to reforest the landscape entirely, nor to solely implement mono-productive approaches. Rather, FLR integrates a variety of interventions (agroforests, riparian forests, and production and protection forests, including forest protected areas) into the broader landscape. The implementation of FLR actions is guided by a set of six principles (Box 1).

1.2 Why this diagnostic?

FLR planners and implementers who are looking to adopt collaborative monitoring, either in a single site or across multiple sites, need to know what elements or conditions should be in place to support collaborative monitoring. Likewise, if crucial ingredients are not present, they need to understand what work needs to be done to prepare. This diagnostic was developed to assist them in that process by systematically identifying factors that are (1) in place, and/or (2) need to be strengthened in order to implement collaborative monitoring for FLR. The point is not to try to get a 'passing grade', but rather to use the diagnostic as a mechanism for improvement. The diagnostic can also be used as a monitoring tool to score progress in achieving crucial objectives at the various stages of collaborative monitoring. In other words, it can serve to help 'monitor the monitoring' to ensure that collaborative monitoring is being appropriately implemented. The intended user is a professional or interdisciplinary team with experience in participatory methods, forest restoration and monitoring natural resource management.

The diagnostic can be applied in at least two scales: it includes factors to be used at a specific FLR site *and* it outlines the factors that are intrinsic to a multilevel collaborative monitoring system. Which factors are selected for assessment will depend on the goals of the user.

1 In a shift from the prior publications, this document uses the term 'collaborative' in place of 'participatory'. See "Concepts and definitions" for an explanation for this shift.

Box 1. The six principles of FLR (from Besseau et al. 2018).

1. Focus on landscapes	FLR takes place within and across entire landscapes, not individual sites, representing mosaics of interacting land uses and management practices under various tenure and governance systems. It is at this scale that ecological, social and economic priorities can be balanced.
2. Engage stakeholders and support participatory governance	FLR actively engages stakeholders at different scales, including vulnerable groups, in planning and decision-making regarding land use, restoration goals and strategies, implementation methods, benefit sharing, monitoring and review processes.
3. Restore multiple functions for multiple benefits	FLR interventions aim to restore multiple ecological, social and economic functions across a landscape and generate a range of ecosystem goods and services that benefit multiple stakeholder groups.
4. Maintain and enhance natural ecosystems within landscapes	FLR does not lead to the conversion or destruction of natural forests or other ecosystems. It enhances the conservation, recovery and sustainable management of forests and other ecosystems.
5. Tailor to the local context using a variety of approaches	FLR uses a variety of approaches that are adapted to the local social, cultural, economic and ecological values, needs and landscape history. It draws on latest science and best practice, and traditional and indigenous knowledge, and applies that information in the context of local capacities and existing or new governance structures.
6. Manage adaptively for long-term resilience	FLR seeks to enhance the resilience of the landscape and its stakeholders over the medium and long term. Restoration approaches should enhance species and genetic diversity and be adjusted over time to reflect changes in climate and other environmental conditions, knowledge, capacities, stakeholder needs and societal values. As restoration progresses, information from monitoring activities, research and stakeholder guidance should be integrated into management plans.

2 The diagnostic

The success factors were derived from over 80 published resources on participatory and collaborative monitoring (see Appendix 1 for details). Those results were aggregated and synthesized into a series of statements that could be evaluated through inquiries, interviews or workshops. The success factors were then independently evaluated by a group of 20 global experts and ranked regarding their usefulness, relevance and importance. Then, the success factors were synthesized into a matrix, organized by temporal and governance scales (see Figure 1 for a roadmap of the matrix). Table 1 presents the 42 highest rated success factors, which are considered to be essential. The complete, initial list is found in Appendix 3.

The matrix organizes the success factors into a list format for practical purposes. However, it is also important to be aware that there are crucial linkages and interactions among them, as well as priorities, dependencies and bottlenecks. For example, whether or not local people are motivated to participate might be dependent on various issues regarding access to resources, tenure, local staff attitudes, training, governance or other issues not included in the matrix. Users should be aware that these complex realities sometimes underlie a success factor and, where possible, identifying and noting these complexities could help an FLR site make improvements or address those issues.

Identifying the scale at which the success factors operate is crucial to establish when and where they are relevant and how to assess them. The following two sections discuss these concepts in more detail.

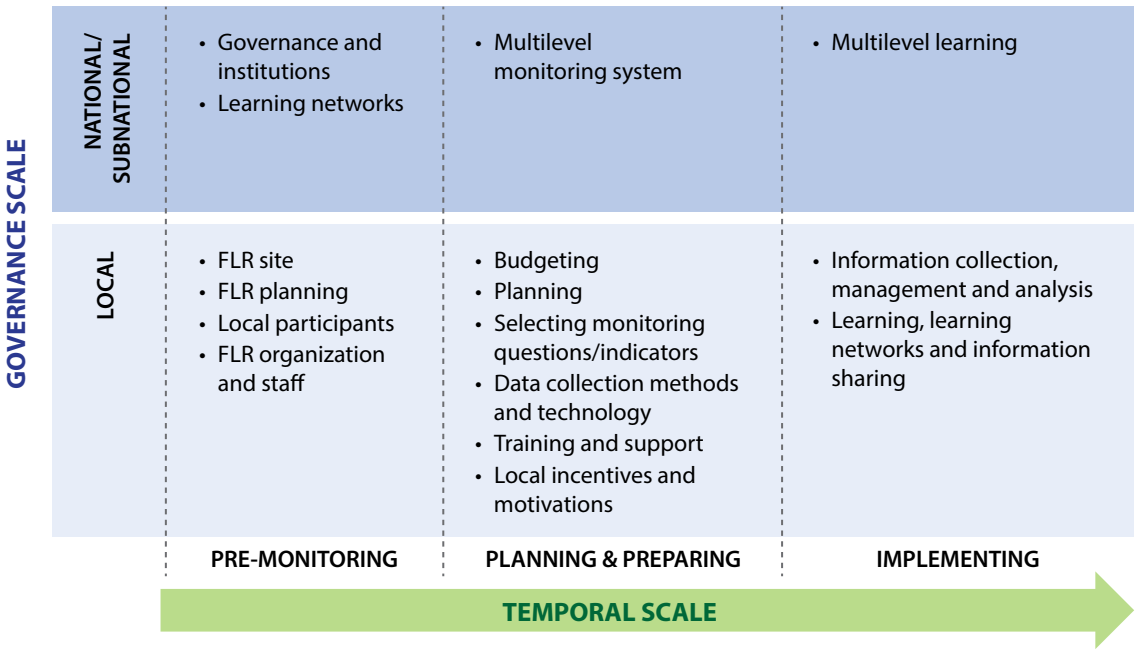

Figure 1. Roadmap to success factors for collaborative monitoring in FLR. Success factors in the matrix (see Table 1) are organized under the bulleted items.

2.1 The temporal scale

The temporal scale is intended to capture the relevant success factors for collaborative monitoring throughout the life cycle of an FLR initiative, starting with a 'pre-monitoring' phase, followed by 'planning' and then 'implementation'. These later phases include success factors of a collaborative monitoring system already in place, not just the existing pre-conditions. This is not to say that at the outset of a collaborative monitoring initiative that these success factors will already be in place; often they will not be. For instance, one of the crucial enabling conditions is appropriate and sufficient training in monitoring for local people. While an FLR site may not already have robust collaborative monitoring training, it is possible to assess the potential at the site to implement the appropriate levels of training. Furthermore, by outlining the success factors in all phases, the matrix may serve as a planning tool for supporting organizations when formulating their monitoring strategies, either for a specific site, or for a multilevel monitoring effort. By knowing what should be achieved in later phases, FLR sites and multilevel monitoring systems can both pre-consider necessary success factors and pre-empt potential constraints.

2.2 The governance scale

The 'governance scale' is often conceptualized as a linear model of actors organized into nested geographical jurisdictions, i.e. top (national/global) to bottom (local community or restoration site). Albeit a simplification, the success factors have been roughly organized in this type of national/subnational/local spectrum for the purposes of practicality and clarity. In reality, the governance scale might more closely resemble a network of actors that influence each other and share information (Pahl-Wostl 2009; Jedd and Bixler 2015), where some actors occupy multiple levels, and relationships and actors shift over time and according to particular issues (McDermott et al. 2010). Therefore, some success factors might be relevant at several levels at the same time and, as such, it is important to consider whether to assess a success factor at levels other than those proposed here. For instance, women in leadership positions at the community level inspire engagement of women in monitoring (Turreira-García et al. 2018) and is also a success factor that could be assessed at the subregional and national levels.

As mentioned above, this matrix could be used as a diagnostic for a specific FLR site or for a multilevel monitoring system that involves multiple FLR sites. In the case of the former, those success factors in the 'local' category will obviously be more relevant and, in the case of the latter, all governance levels may be applicable.

2.3 Motivating local participation

Multiple authors have identified 'local incentives and motivations' as one of the most important issues to address in collaborative monitoring for FLR (Saipothong et al. 2006; Fernandez-Gimenez et al. 2008; Le Tellier et al. 2009; Laake et al. 2013; Boissière et al. 2014; Danielsen et al. 2014; Bellfield et al. 2015; Villaseñor et al. 2016; Brites and Morsello 2017; Turreira-García et al. 2018). Thus, in this document the success factors related to this theme are grouped under their own heading. Special attention should be paid to those success factors.

2.4 Scoring

The success factor matrix serves as the 'scorecard' for the assessment activities, which could involve a combination of interviews, surveys and/or workshops to score the status of the success factors. There are several possible approaches to the scoring. For instance, the 'stoplight' approach (Stanturf et al. 2015, 53) is a simple technique that provides a visual representation of the status of a success factor using one of three values (e.g. red = not in place, no capacity; yellow = in progress or some capacity; green = in place, full capacity). Alternatively, it may be useful to assign Likert scale values (1 to 7) to represent more variation and provide a basis for basic calculations of the values. There are various other methods for graphically illustrating information to communicate it to stakeholders (see e.g. Evans and Guariguata 2016). It may also be desirable to accompany the results with a more nuanced and contextualized explanation in a report format. Next to the 'Score' column in the matrix is a column called 'Intervention'. Users can use this column to note any opportunities or concrete steps for improving the success factors. The matrix was not conceived to provide a static pass/fail grade on a restoration site, but rather as a tool for recognizing strengths and shortcomings; if a reasonable intervention is feasible to improve the status of a success factor, then it can be noted.

The nature of the success factors will dictate the methods used to collect the information. Several methods guides are listed in Appendix 2. These guides present step-by-step instructions on techniques such as stakeholder analysis, participatory mapping and values scoring. Some of the success factors may require relatively simple inquiries or interviews; others may require a more thorough process of engagement to fully understand the scope of the conditions and context. For instance, understanding the nature of governance institutions and relationships among stakeholders may require application of techniques borrowed from social network analysis (Newig et al. 2010; Devisscher et al. 2016; Fischer and Jasny 2017). Each success factor will require some consideration to determine the most appropriate – and feasible – method for assessing it. Time and cost are always central concerns for an assessment activity, and these will vary significantly depending on how many restoration sites are being assessed and their geographic and management characteristics. These considerations should be weighed when the user makes the final determination as to how to assess a success factor.

3 Matrix of core success factors

Listed in Table 1 below are the most crucial success factors, considered core to any FLR collaborative monitoring initiative. All of these factors should be assessed; however, some adaptation may be necessary, depending on the context. For instance, the relevant stakeholders in an FLR site that is primarily private land will vary considerably from the stakeholders in an FLR project in community-owned lands.

Appendix 3 presents an expanded list of additional success factors that might be relevant for a given FLR site. This expanded list can be used to complement the core success factors below. While it is acceptable to make a customized 'shopping list', care should be taken not to pick those factors that are the easiest to assess, or those that are most likely to get higher scores; this type of confirmation bias[2] will undermine the utility of the tool. Approaches such as involving a diverse set of people in the selection and analysis of the success factors can help avoid confirmation bias.

2 Confirmation bias occurs when only those success factors that are likely to score higher are selected in order to confirm a pre-existing belief.

Table 1. Matrix of core success factors

	A. PRE-MONITORING Success factors at the initial phases of the FLR planning, prior to collaborative monitoring	Assessment Score	 Intervention
LOCAL	**FLR site**		
	1. The entire geographical area expected to be impacted by FLR is defined.[a]		
	FLR planning		
	2. Local stakeholders are involved in deciding what constitutes FLR, what restoration success is, and what the restoration goals are.		
	3. The restoration goals are simple, and stakeholders generally agree on them.		
	4. Restoration goals are transformed into feasible objectives and measurable targets.[b]		
	5. Monitoring is considered as essential to restoration success.		
	6. The goals and priorities of all relevant stakeholders are included in the restoration planning, with specific strategies[c] to involve women and marginalized groups in all phases.		
	Local participants		
	7. Local people have access rights[d] to the land and natural resources, and there are relatively few conflicts about access rights.		
	8. The restoration effort is a broad-based coalition[e] of all relevant landscape users who are involved in meaningful ways, whether they are marginalized groups/ castes, women, young people, local leaders, local smallholders, large landholders, non-governmental organizations (NGOs), companies or governments.		
	9. There are strong local intrinsic motivations to participate in the restoration, and local stakeholders perceive that there is a benefit to their participation.		
	10. Participants are involved in elements of benefit sharing or activities related to the restoration (e.g. tourism, reforestation, etc.).		
	Local implementing organization and staff		
	11. Restoration staff are skilled, motivated and appropriately compensated to support collaborative monitoring.		
	12. Restoration staff recognize that time, negotiation and training are necessary parts of the monitoring process and embrace an ethos of learning, experimentation and participation.		
	13. Restoration staff have a diverse toolbox of relevant monitoring techniques that are locally appropriate.		
	14. Restoration staff are motivated and knowledgeable about facilitating participatory approaches to data collection, data analysis, information sharing and learning.		
	15. Collaborative monitoring is written into the workplans of restoration staff so that, if there is a staffing change, monitoring continues.		
NATIONAL/SUBNATIONAL	**Governance and institutions**		
	16. There is a concerted, long-term commitment by stakeholders at the national and sub-national level to establish the collaborative monitoring system and see it through.		
	17. There are strong formal institutions and cooperation among informal institutions, transparent decision-making, equitable distribution of power and low levels of corruption.		
	Learning networks		
	18. The 'community of practice' is identified – the group of people or organizations concerned about the restoration – and they create opportunities for exchanging information and ideas regularly through organizations, websites, meetings, workshops and conferences.		

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Table 1. Continued

B. PLANNING AND PREPARING Success factors during the design and planning of the monitoring activities, including budgeting, training for local people and restoration staff and building systems for information sharing		Assessment	
		Score	Intervention
LOCAL	19. Investments in training, building capacity and follow-up are included in the costs of collaborative monitoring.		
	20. Resources are dedicated to data analysis and social learning activities (meetings, workshops, training sessions, field trips) that support decision-making and adaptive management cycles.		
	21. Costs related to quality control, data management and data storage are included in the budget.		
	22. A specific portion of the restoration budget is dedicated to monitoring for the length of the restoration period, e.g. 10% of total restoration budget.		
	Planning		
	23. Monitoring plans are made early in restoration planning stages, and are closely matched to restoration goals and involve a range of stakeholders.		
	24. Monitoring indicators are closely aligned with management objectives in the short, medium and long term.		
	Selecting monitoring questions and indicators		
	25. The process of defining monitoring questions/indicators, including natural resource use, well-being and others, is collaborative and emphasizes mutual learning.		
	26. Indicators are correlated with restoration goals.		
	27. The indicators are not too technical and do not involve a lot of mathematical knowledge.		
	28. The indicators are not too time-consuming or too expensive to monitor, they are not too numerous, and they are easy to interpret.		
	Data collection methods and technology		
	29. Data collection forms and protocols are designed together with local monitors, researchers and government staff; they are not developed in isolation.		
	30. The data collection tools and methods are geared toward quick and local processing and analysis without complicated calculations, and facilitate sharing with stakeholders at multiple levels and are applied in future restoration efforts.		
	Training and support		
	31. Substantial regular training is provided to local people in the use of tools, forms and technology to collect data, and in interpreting the data to build understanding and answer questions.		
	32. Training is simple and adapted to the technical capacity of the participants.[f]		
	Local incentives and motivations		
	33. Participants feel that their needs are considered in the monitoring system, and activities focus on attributes that are relevant to them rather than fulfilling scientifically complete criteria.		
	34. Data needs and goals of local stakeholders are considered early on and matched with scientists and natural resource managers.		
	35. Monitoring results – both from the local project and of the bigger picture – are regularly shared to motivate participation.		

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Table 1. Continued

B. PLANNING AND PREPARING (continued) Success factors during the design and planning of the monitoring activities, including budgeting, training for local people and restoration staff and building systems for information sharing		**Assessment**	
		Score	**Intervention**
NATIONAL/SUBNATIONAL	**Multilevel monitoring system**		
	36. Infrastructure is in place for data registration, storage and processing to scale up to a national monitoring system.		
	37. There are standard procedures for monitoring processes to be consistent and transparent to scale up to a national monitoring system.		
	38. There is a managing organization that is responsible for organizing and overseeing the monitoring and balancing local needs with national and global needs.		

C. IMPLEMENTING Success factors during the monitoring activities, including data collection, analysis, information sharing and learning		**Assessment**	
		Score	**Intervention**
LOCAL	**Information collection, analysis and learning**		
	39. Data are collected at the beginning and then at regular intervals.		
	40. Information on progress and desired endpoints is represented in a way that is visually understandable to stakeholders and discussed in ways that local people can both interpret and apply.		
	41. Local people feel comfortable about sharing their own impressions and what they learned, despite differences in power with officials, and feel empowered to effect changes.[g]		
NATIONAL/SUBNATIONAL	42. There are repeated learning events, interactions, meetings and field trips to the restoration sites for diverse stakeholders to encourage learning and adaptation, build trust, build respect for diverse opinions and increase transparency.		

a Boundaries may need to be flexible to accommodate changes or unforeseen events.

b Measurable can mean simple assessments, such as 'bad, okay, good'.

c The involvement of women and marginalized groups is crucial and must be addressed in a context-specific way.

d This will depend on the context of land tenure and local customs regarding access.

e The make-up of the coalition depends on patterns of land ownership and use rights. Furthermore, roles and types of involvement will vary across groups.

f Note that some projects implement two kinds of monitoring: simpler monitoring (by local people) and something more complex (by project staff).

g This is a process that evolves over time.

4 Glossary of concepts and definitions

This section presents key concepts and definitions to establish a common foundation for understanding the success factors and using the diagnostic.

Monitoring – Monitoring is the systematic gathering and analysis of information in order to assess whether something is changing. Monitoring is more than a single assessment; monitoring must be performed at regular intervals that are appropriate for the subject matter, cost efficient and not overly burdensome. The information is analyzed and the results are evaluated and used for decision-making (Evans and Guariguata 2008).

Monitoring and FLR – There is broad agreement that monitoring is fundamental to successful ecological restoration efforts (Society for Ecological Restoration International Science & Policy Working Group 2004; Clewell and Aronson 2013; Sayer et al. 2013; Dey and Schweitzer 2014). Without monitoring progress and change, it is impossible to gauge whether restoration efforts are successful, are on the path to success or are shifting away from the restoration goals (Holl and Cairns 2002). Furthermore, monitoring generates the information that provides the basis for social learning and adaptive management, both of which are essential processes for FLR (Le et al. 2012; Reed et al. 2016).

Collaborative monitoring and participatory monitoring – Participatory monitoring refers to a 'continuum of engagement' from local people to professional researchers in the collection and use of information for decision-making, primarily at the local level (Danielsen et al. 2009). Collaborative monitoring includes these types of multiparty monitoring activities, and also embraces cross-scale, multilevel actors and interactions that are networked to share information and influence change (Cash et al. 2006; Newig et al. 2010). This diagnostic intentionally uses the term 'collaborative monitoring' rather than the more widely used 'participatory monitoring' because 'collaborative monitoring' recognizes the diversity of actors and interests – sometimes in disagreement – that share a forest landscape and are linked to restoration efforts, and it refers to the crucial importance of learning among those groups (Demeo et al. 2015; USDA Forest Service 2017).

Success factors and constraints – The elements that help a given intervention to achieve its goals are termed here 'success factors'. This term embraces contextual conditions and structural features as well as actors, attitudes and activities. It does not suggest causation, but instead implies a role in contributing to success (Hanson et al. 2015). Those factors that present a barrier or negative impact are termed 'constraints'. Constraints in this context may include either permanent structural impediments or barriers that can be overcome with intervention (Moser and Ekstrom 2010; Devisscher et al. 2016).

Scale – The idea of scale is itself a tool for understanding issues in new ways, and there can be various applications: temporal, governance, spatial, jurisdictional, knowledge based and management based, among others (Cash et al. 2006). To illustrate, it is increasingly recognized that problem solving in natural resource management is hampered due to mismatches among different levels within a scale (e.g. conflicts in the governance scale between local and national or subnational authorities or norms), or between scales (e.g. funding cycles that define project lifetimes are much shorter than the restoration timeframe of a forest) (Brown 2003; Cash et al. 2006; Gallemore et al. 2014). Scale can sometimes be hard to conceptualize and can sound like jargon, so it is important to use it as a tool that makes big ideas easier to understand.

Governance, learning networks and communities of practice – Natural resource governance is increasingly perceived as not being hierarchical categorization of the 'government' and the 'governed', but rather as a network of 'the different

actors and networks that help formulate and implement environmental policy and/or policy instruments' (Pahl-Wostl 2009, 355). Building 'learning networks' and 'communities of practice' that connect these actors so that they can learn together are essential elements of the governance context for collaborative monitoring in FLR (van Oosten et al. 2014). Understanding the local, subnational and national governance contexts is crucial to identifying the capacities and constraints of a multilevel, FLR collaborative monitoring system (Pahl-Wostl 2009). Furthermore, problems related to governance are often the most important stumbling blocks at any FLR site, including the monitoring phase (Mansourian et al. 2017). To this end, developing multilevel monitoring systems that map to the complexity of the governance network is crucial.

References

Bellfield H, Sabogal D, Goodman L and Leggett M. 2015. Case study report: Community-based monitoring systems for REDD+ in Guyana. *Forests* 6:133–56.

Besseau P, Graham S and Christophersen T, eds. 2018. *Restoring Forests and Landscapes: The Key to a Sustainable Future.* Vienna, Austria: Global Partnership on Forest and Landscape Restoration.

Boissière M, Bastide F, Basuki I, Pfund J and Boucard A. 2014. Can we make participatory NTFP monitoring work? Lessons learnt from the development of a multi-stakeholder system in Northern Laos. *Biodiversity & Conservation* 23:149–70.

Borgatti SP. 2002. *NetDraw Software for Network Visualization.* Lexington, KY: Analytic Technologies. https://sites.google.com/site/netdrawsoftware/home

Borgatti SP, Everett M and Freeman LC. 2002. *Ucinet for Windows: Software for social network analysis.* Harvard, MA: Analytic Technologies. https://sites.google.com/site/ucinetsoftware/home

Brites AD and Morsello C. 2017. Beliefs about the potential impacts of exploiting non-timber forest products predict voluntary participation in monitoring. *Environmental Management* 59:898–911.

Brown K. 2003. Integrating conservation and development: A case of institutional misfit. *Frontiers in Ecology and the Environment* 1:479–87.

Buckingham K, Ray S, Arakwiye B, Morales AG, Singh R, Maneerattana O, Wicaksono S, Chrysolite H, Minnick A and Johnston L. 2018. *Mapping Social Landscapes: A Guide to Identifying Networks, Priorities, and Values of Restoration Actors.* Washington DC: World Resources Institute.

Cash DW, Adger WN, Berkes F, Garden P, Lebel L, Olsson P, Pritchard L and Young O. 2006. Scale and cross-scale dynamics: Governance and information in a multilevel world. *Ecology and Society* 11:8. http://www.jstor.org/stable/26265993

Clewell AF and Aronson J. 2013. Ecological references. *In* Clewell AF and Aronson J, eds. *Ecological Restoration: Principles, Values, and Structure of an Emerging Professio*n. Washington DC: Island Press/Center for Resource Economics. 137–53. http://link.springer.com/chapter/10.5822/978-1-59726-323-8_7

Danielsen F, Burgess ND, Balmford A, Donald PF, Funder M, Jones JPG, Alviola P, Balete DS, Blomley T Brashares J, et al. 2009. Local participation in natural resource monitoring: A characterization of approaches. *Conservation Biology* 23:31–42.

Danielsen F, Jensen PM, Burgess ND, Altamirano R, Alviola PA, Andrianandrasana H, Brashares JS, Burton AC, Coronado I, Corpuz N, et al. 2014. A multicountry assessment of tropical resource monitoring by local communities. *BioScience* 64:236–51.

Demeo T, Markus A, Bormann B and Leingang J. 2015. *Tracking progress: The monitoring process used in collaborative forest landscape restoration projects in the Pacific Northwest Region.* Working Paper Number 54, Ecosystem Workforce Program. Portland, OR: University of Oregon.

Devisscher T, Vignola R, Coll Besa M, Cronenbold R, Pacheco N, Schillinger R, Canedi V, Sandoval C, Gonzalez D and Leclerc G. 2016. Understanding the socio-institutional context to support adaptation for future water security in forest landscapes. *Ecology and Society* 21:48. https://www.ecologyandsociety.org/vol21/iss4/art48/

Dey DC and Schweitzer CJ. 2014. Restoration for the future: Endpoints, targets, and indicators of progress and success. *Journal of Sustainable Forestry* 33:S43–S65.

Edwards PM, Shaloum G and Bedell D. 2017. A unique role for citizen science in ecological

restoration: a case study in streams. *Restoration Ecology* 26:29–35.

Evans K and Guariguata MR. 2008. *Participatory Monitoring in Tropical Forest Management: A Review of Tools, Concepts and Lessons Learned*. Bogor, Indonesia: Center for International Forestry Research (CIFOR). http://www.cifor.org/publications/pdf_files/Books/BGuariguata0801.pdf

Evans K and Guariguata MR. 2016. Success from the ground up: Participatory monitoring and forest restoration. Bogor, Indonesia: Center for International Forestry Research (CIFOR). http://www.cifor.org/library/6284/success-from-the-ground-up-participatory-monitoring-and-forest-restoration/

Evans K, de Jong W, Cronkleton P, Sheil D, Lynam T, Kusumanto Y and Colfer C. 2006. *Guide to Participatory Tools for Forest Communities*. Bogor, Indonesia: Center for International Forestry Research (CIFOR). http://www.cifor.cgiar.org/Publications

Evans K, Guariguata MR and Brancalion PHS. 2018. Participatory monitoring to connect local and global priorities for forest restoration. *Conservation Biology* 32:525–34.

Fernandez-Gimenez ME, Ballard HL and Sturtevant VE. 2008. Adaptive management and social learning in collaborative and community-based monitoring: A study of five community-based forestry organizations in the western USA. *Ecology and Society* 13:4.

Fischer AP and Jasny L. 2017. Capacity to adapt to environmental change: Evidence from a network of organizations concerned with increasing wildfire risk. *Ecology and Society* 22. http://www.jstor.org/stable/26270065

Gallemore C, Rut HP and Moeliono M. 2014. Discursive barriers and cross-scale forest governance in Central Kalimantan, Indonesia. *Ecology and Society* 19. https://www.ecologyandsociety.org/vol19/iss2/art18/

Hanson C, Buckingham K, DeWitt S and Laestadius L. 2015. *The Restoration Diagnostic: A Method for Developing Forest Landscape Restoration Strategies by Rapidly Assessing the Status of Key Success Factors.* Washington DC: World Resources Institute. http://www.wri.org/publication/restoration-diagnostic

Holl KD and Cairns J. 2002. Monitoring and appraisal. *In* Holl KD and Cairns J, eds. *Handbook of Ecological Restoration.* Cambridge, UK: Cambridge University Press. 411–32.

Jedd T and Bixler RP. 2015. Accountability in networked governance: Learning from a case of landscape-scale forest conservation. *Environmental Policy & Governance* 25:172–87.

Le HD, Smith C, Herbohn J and Harrison S. 2012. More than just trees: Assessing reforestation success in tropical developing countries. *Journal of Rural Studies* 28:5–19.

Le Tellier V, Carrasco A and Asquith N. 2009. Attempts to determine the effects of forest cover on stream flow by direct hydrological measurements in Los Negros, Bolivia. *Forest Ecology and Management* 258:1881–8.

Mansourian S, Dudley N and Vallauri D. 2017. Forest landscape restoration: Progress in the last decade and remaining challenges. *Ecological Restoration* 35:281–8.

Mansourian S, Vallauri D and Dudley N. 2005. *Forest Restoration in Landscapes: Beyond Planting Trees.* Berlin: Springer Science & Business Media.

McDermott CL, Humphreys D, Wildburger C, Wood P, Marfo E, Pacheco P and Yasmi Y. 2010. Mapping the core actors and issues defining international forest governance. *IUFRO World Series* 28:19–36.

Moser SC and Ekstrom JA. 2010. A framework to diagnose barriers to climate change adaptation. *Proceedings of the National Academy of Sciences* 107:22026–31.

Newig J, Günther D and Pahl-Wostl C. 2010. Synapses in the Network: Learning in governance networks in the context of environmental management. *Ecology and Society* 15. https://www.ecologyandsociety.org/vol15/iss4/art24/

Pahl-Wostl C. 2009. A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Global Environmental Change* 19:354–65.

Reed J, Van Vianen J, Deakin EL, Barlow J and Sunderland T. 2016. Integrated landscape approaches to managing social and environmental issues in the tropics: Learning from the past to guide the future. *Global Change Biology* 22(7):2540–54.

Saipothong P, Preechapanya P, Promduang T, Kaewpoka N and Thomas DE. 2006. Community-based watershed monitoring and management in Northern Thailand. *Mountain Research and Development* 26:289–91.

Sayer J, Sunderland T, Ghazoul J, Pfund J-L, Sheil D, Meijaard E, Venter M, Boedhihartono AK, Day M, Garcia C, et al. 2013. Ten principles for a landscape approach to reconciling agriculture, conservation, and other competing land uses.

Proceedings of the National Academy of Sciences 110:8349–56.

Schiffer E. 2018, September 24. *Net-Map.* https://netmap.wordpress.com/about/

Schultz CA, Coelho DL and Beam RD. 2014. Design and governance of multiparty monitoring under the USDA Forest Service's Collaborative Forest Landscape Restoration Program. *Journal of Forestry* 112:198–206.

Society for Ecological Restoration International Science & Policy Working Group. 2004. *The SER International Primer on Ecological Restoration*. www.ser.org & Tucson, AZ: Society for Ecological Restoration International. http://www.ser.org/resources/resources-detail-view/ser-international-primer-on-ecological-restoration#8

Stanturf JA, Kant P, Lillesø J-PB, Mansourian S, Kleine M, Graudal L and Madsen P. 2015. *Forest Landscape Restoration as a Key Component of Climate Change Mitigation and Adaptation*. Volume 34, IUFRO World Series. Vienna, Austria: IUFRO. http://www.iufro.org/publications/series/world-series/article/2015/12/01/world-series-vol-34-forest-landscape-restoration-as-a-key-component-of-climate-change-mitigation/

Turreira-García N, Meilby H, Brofeldt S, Argyriou D and Theilade I. 2018. Who wants to save the forest? Characterizing community-led monitoring in Prey Lang, Cambodia. *Environmental Management* 61:1019–30.

USDA Forest Service. 2017. *Expert Consultation on Monitoring Forest Landscape Restoration Workshop Report.* Washington DC: United States Forest Service Office of International Programs.

van Laake P, Skutsch M and McCall MK. 2013. Community forest monitoring. *In* Achard F, ed. *Reducing Greenhouse Gas Emissions from Deforestation and Degradation in Developing Countries: A Sourcebook of Methods and Procedures for Monitoring Measuring and Reporting.* Wageningen, The Netherlands: Global Observation of Forest Cover and Land Dynamics GOFC-Gold. 187–202. http://www.gofcgold.wur.nl/redd/index.php

van Oosten C, Gunarso P, Koesoetjahjo I and Wiersum F. 2014. Governing forest landscape restoration: Cases from Indonesia. *Forests* 5:114362.

Villaseñor E, Porter-Bolland L, Escobar F, Guariguata MR and Moreno-Casasola P. 2016. Characteristics of participatory monitoring projects and their relationship to decision-making in biological resource management: A review. *Biodiversity and Conservation* 25:2001–19.

Appendix 1. Methods

This section describes the process of developing the diagnostic, specifically to identify the success factors. In 2016 and again in 2018, CIFOR surveyed existing knowledge and lessons learned to broaden and deepen understanding of the potentials of collaborative monitoring, producing several publications (e.g. Evans and Guariguata 2016; Evans et al. 2018). Approaching monitoring as a top-down process is unlikely to generate the information, adaptive decision-making and local buy-in that are crucial to achieving the multiple biophysical and socio-economic goals of an FLR intervention (Fernandez-Gimenez et al. 2008; Schultz et al. 2014; Demeo et al. 2015). A search of peer-reviewed literature was performed to identify cases of collaborative monitoring in FLR specifically and in natural resource management generally. Databases searched included Science Citation Index Expanded, Social Sciences Citation Index, Environment Complete, AGRIS, GreenFILE, ScienceDirect, OAIster, MEDLINE, Networked Digital Library of Theses and Dissertations, JSTOR Journals, GEORef, BioOne and SciTech. Relevant keyword combinations included forest landscape restoration, forest restoration, reforestation, rehabilitation, ecosystem restoration, collaborative monitoring, participatory monitoring, community-based monitoring, local monitoring, community monitoring, farmer-managed natural regeneration, agroforestry, forest, landscape, watershed, soil erosion, ecosystem services, governance, networked governance, governance networks, scale, social network analysis, socio-ecological systems.

From these searches, and from the bibliographies of articles found in the searches, approximately 80 relevant articles were identified and reviewed. Success factors and constraints that contribute to effective collaborative monitoring were identified using these guiding questions:

- What were the biophysical, social and institutional conditions of the site or cases described that contributed to (or constrained) successful collaborative monitoring?
- Who was involved (local people, subnational, national, global actors, institutions, charismatic leaders, champions), what were their roles and what were the characteristics of their successful (or unsuccessful) participation?
- What were the other factors that contributed to (or constrained) success, including, but not limited to, governance structures, organizations, networks, resources, technology, events, funding, information flows and scale dynamics?

Those results were aggregated and synthesized into a series of statements that could be evaluated through inquiries, interviews or workshops. The success factors were then independently evaluated by a group of 20 global experts and ranked regarding their usefulness, relevance and importance. Then, the success factors were synthesized into a matrix, organized by temporal and governance scales (see Figure 1 for a roadmap of the matrix). Table 1 presents the 42 highest rated success factors, which are considered to be essential. The complete, initial list is found in Appendix 3.

As mentioned above, there are, so far, no scalable multi-site collaborative monitoring networks that provide the type of multilevel information exchange and learning that we consider to be necessary for the success of the national and international FLR agenda. Therefore, the present document does not claim to be a quantitative analysis of published cases – the available sample is neither large enough nor sufficiently consistently described to make reliable comparisons. There are, nonetheless, multiple examples ($n \approx 80$) from collaborative monitoring, forest restoration, polycentric governance, learning networks and other related topics that collectively contribute to identifying the necessary success factors and constraints that enabled the production of this diagnostic for collaborative monitoring.

Appendix 2. Scoring approaches and assessment resources

Many of the success factors can be assessed using common information-eliciting activities such as interviews, focus groups or surveys. There are also tools and assessment resources that are geared to gathering information in a group setting, which can often lead to a richer understanding of the complexities of the success factors. Several of these are noted below. Care should be taken to obtain prior, informed consent from all participants.

Guide to Participatory Tools for Forest Communities (Evans et al. 2006) – This guidebook describes various tools that can be used to elicit information for the assessment. Tools for evaluating stakeholder relationships include the Who Counts matrix, Venn diagrams, pebble scoring and the Four Rs. Other tools, such as participatory mapping, can elicit perceptions about landscapes, and others elicit perspectives about an issue, such as discourse-based valuation, pebble scoring and spidergrams. http://www.cifor.org/publications/pdf_files/Books/BKristen0601.pdf

Social network analysis (SNA) – SNA has been used in various contexts to identify key actors related to a specific issue, determine their spatial scale of influence, and quantify their relationships and influence on each other as well as barriers to success. The article "**Understanding the socio-institutional context to support adaptation for future water security in forest landscapes**" (Devisscher et al. 2016) describes the application of SNA to forest communities and the methods used, including participatory social mapping, semi-structured interviews and validation workshops. The process is time intensive, but could be modified. It identifies crucial barriers and bottlenecks (lack of knowledge, lack of trust, lack of institutional support) related to the issue of water.

Another relevant example of SNA can be found in "**Capacity to adapt to environmental change: evidence from a network of organizations concerned with increasing wildfire risk**" (Fischer and Jasny 2017). The methods are simpler, utilizing interviews (some in person, some via email) using a snowball approach. Both examples used Netdraw (Borgatti 2002) and UCInet software (Borgatti et al. 2002) to visualize the networks and analyze network metrics.

Schiffer (2018) has developed a simplified, interactive non-computer-based SNA method that can be used with stakeholders of all education backgrounds called Net-Map. The Net-Map method is also employed by the World Resources Institute in ***Mapping Social Landscapes*** (Buckingham et al. 2018) (see below).

Mapping Social Landscapes: A Guide to Identifying Networks, Priorities, and Values of Restoration Actors (Buckingham et al. 2018) adapts several analytic approaches to understand how people organize themselves on the land. It uses two approaches, SNA and priorities and values questionnaires, to understand the relationships, roles and influence of actors in the landscape.

The Restoration Diagnostic: A Method for Developing Forest Landscape Restoration Strategies by Rapidly Assessing the Status of Key Success Factors (Hanson et al. 2015) – The authors created criteria for successful FLR by looking at historical cases. They developed a diagnostic tool that was used in workshops and in interviews with key informants and then field-tested it.

Appendix 3. Expanded list of success factors

Below is the complete list of success factors that were identified. This expanded list includes the essential 'core' success factors from the main text, plus additional optional success factors. As noted in the main text, while it is acceptable to make a customized 'shopping list', care should be taken not to simply pick those factors that are the easiest to assess, or those that are most likely to get higher scores; this type of confirmation bias will undermine the utility of the tool. Approaches such as involving a diverse set of people in the selection and analysis of the success factors can help avoid confirmation bias.

	A. PRE-MONITORING Success factors at the initial phases of the FLR planning, prior to collaborative monitoring	Assessment		Reference
		Score	Intervention	
LOCAL	**FLR site**			
	1. The entire geographical area expected to be impacted by FLR is defined.			1,2
	2. There is reliable physical access to and within the restoration sites at the times needed for restoration work.			3,4
	3. Basic thematic/physical maps are available.			4
	FLR planning			
	4. There is understanding of the impacts of forest loss, and the drivers of deforestation have been defined.			3–5
	5. Local stakeholders are involved in deciding what constitutes FLR, what restoration success is, and what the restoration goals are.			5–10
	6. The restoration goals are simple, and stakeholders generally agree on them.			5–10
	7. Restoration goals are transformed into feasible objectives and measurable targets.			6,10,11
	8. The restoration site staff have adopted adaptive approaches, such as adapting objectives and targets over time, to adjust to unforeseen events.			7,12
	9. Monitoring is considered as essential to restoration success.			13
	10. The goals and priorities of all relevant stakeholders are included in the restoration planning, with specific strategies to involve women and marginalized groups in all phases.			9,14,15
	11. Collaborative monitoring is not seen primarily as a way to save money by shifting the cost of monitoring to local people.			16,17
	Local participants			
	12. Local people know their forest intimately.			18
	13. Local people have access rights to the land and natural resources.			9

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A. PRE-MONITORING (continued) Success factors at the initial phases of the FLR planning, prior to collaborative monitoring		Assessment		Reference
		Score	Intervention	
LOCAL	Local participants (continued)			
	14. The restoration effort is a broad-based coalition of all relevant landscape users who are involved in meaningful ways, whether they are marginalized groups/castes, women, young people, local leaders, local smallholders, large landholders, NGOs, companies or governments.			19–21
	15. There are strong local intrinsic motivations to participate in the restoration, and local stakeholders perceive that there is a benefit to their participation.			22,23
	16. Participants are involved in elements of benefit sharing or activities related to the restoration (e.g. tourism, reforestation, etc.).			4,9
	17. Stakeholders are not fatigued from multiple development interventions.			22
	FLR implementing, organization and staff characteristics			
	18. Restoration staff are skilled, motivated and appropriately compensated to support collaborative monitoring.			13,24,25
	19. There is a multidisciplinary team and they collaborate together effectively: e.g. ecologists, agronomists, social scientists and local people with experience in planting, cultivation and soils at that location, facilitation, social analysis, conflict resolution.			5,26
	20. There is capacity to support extensive participant training in data collection, tool use, data analysis, data interpretation and use for information exchange.			4,15,27–30
	21. Restoration staff recognize that time, negotiation and training are necessary parts of the monitoring process and embrace an ethos of learning, experimentation and participation.			8,26,27,31
	22. Power and knowledge differences between the staff and local people are recognized and addressed, and staff adopt attitudes of respect, flexibility and humility.			32,33
	23. Restoration staff have a broad repertoire of potentially relevant monitoring techniques that are locally appropriate.			34
	24. Restoration staff are motivated and knowledgeable about facilitating participatory approaches to data collection, data analysis, information sharing and learning.			5,8,25
	25. Collaborative monitoring is written into the workplans of restoration staff so that, if there is a staffing change, monitoring continues.			13,28
	26. There is reliable, convenient access to appropriate technical resources such as digital devices, computers, software, satellite imagery and an internet connection.			35
NATIONAL/SUBNATIONAL	**Governance and institutions**			
	27. National policy makers are involved and are willing to help support, network and replicate successful efforts.			5,19,36
	28. There is a concerted, long-term commitment by stakeholders at the national and subnational levels to establish the collaborative monitoring system and see it through.			28,37
	29. There is a commitment by regional and national stakeholders to maintain local and regional training capacity for staff and local participants.			24

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A. PRE-MONITORING (continued) Success factors at the initial phases of the FLR planning, prior to collaborative monitoring		Assessment		Reference
		Score	Intervention	
NATIONAL/SUBNATIONAL	Governance and institutions (continued)			
	30. There are legal instruments to regulate and promote FLR.			38
	31. There is a legal mandate to collaborate with local stakeholders and involve them in monitoring.			39
	32. There are mechanisms to formalize the collaborative relationships between the restoration effort and local stakeholders, such as Memoranda of Understanding, collaborative committees or new collaborative organizations.			39
	33. There are women leaders in the governance network who incentivize better participation by women.			23
	34. Technical and traditional ways of discussing restoration have been bridged, eliminating barriers to participation and collaboration.			32,33
	35. There are strong formal institutions and cooperation among informal institutions, with low levels of corruption, transparent decision-making, and equitable distribution of power.			5,12
	Learning networks			
	36. The 'community of practice' is identified – the group of people or organizations concerned about the restoration – and they create opportunities for exchanging information and ideas regularly through organizations, websites, meetings, workshops and conferences.			12,40,41
	37. There are 'boundary' or 'bridging' organizations to connect different networks and communities of practice and facilitate the co-production of knowledge.			12,41,42
	38. There are multilevel learning networks to connect people, restoration activities and landscapes, through events, workshops and the internet, including a website and an organization to run it.			19,21,36, 41,43
	39. There are diverse perspectives in the community of practice that are taken into account when developing learning networks.			44,45

B. PLANNING AND PREPARING Success factors during the design and planning of the monitoring activities, including budgeting, training for local people and restoration staff and building systems for information sharing		Assessment		Reference
		Score	Intervention	
LOCAL	**Budgeting**			
	40. Investments in training, building capacity and follow-up are included in the costs of collaborative monitoring.			16
	41. Resources are dedicated to data analysis and social learning activities (meetings, workshops, training sessions, field trips) that support decision-making and adaptive management cycles.			46
	42. Costs related to quality control, data management and data storage are included in the budget.			46
	43. A specific portion of the restoration budget is dedicated to monitoring for the length of the restoration period, e.g. 10% of total restoration budget.			5,6,8,10,13, 13,25,47
	44. The budget for restoration includes resources for knowledge sharing to guide effective action and adaptive management.			48

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B. PLANNING AND PREPARING (continued) Success factors during the design and planning of the monitoring activities, including budgeting, training for local people and restoration staff and building systems for information sharing		Assessment		Reference
		Score	Intervention	
LOCAL	**Planning**			
	45. Monitoring plans are made early in restoration planning stages, are closely matched to restoration goals and involve a range of stakeholders.			6,10,28,49
	46. There are action thresholds – early warning systems – in case things are not working, and there are milestones or trigger points to judge progress.			6,10
	47. There is an ethos of experimentation, focusing on small experiments that can be changed based on learning.			26
	48. Monitoring indicators are closely aligned with management objectives in the short, medium and long term.			6,10,50
	Selecting monitoring questions and indicators			
	49. The process of defining monitoring questions/indicators, including natural resource use, well-being and others, is collaborative and emphasizes mutual learning.			25,51
	50. The monitoring framework includes both indicators of success and drivers of success.			3
	51. Outside facilitation for developing the indicators is available.			31
	52. Multiple meetings or workshops are planned for defining indicators, with a process for systematically refining and paring down the number of indicators based on criteria.			25
	53. Indicators are correlated with restoration goals.			38,52
	54. There is a process for identifying milestones and trigger points after the indicators.			6,50
	55. There are special strategies to involve women and marginalized people, including organizing mixed/separate groups, special outreach efforts to make sure that training and technical resources reach those groups and prioritized participation in some monitoring protocols.			14,15,53
	56. The indicators are not too technical and do not involve a lot of mathematical knowledge.			27
	57. The indicators are not too time-consuming or too expensive to monitor, they are not too numerous, and they are easy to interpret.			25,27–29, 54
	58. Indicators are decided locally.			27
	Data collection methods and technology			
	59. Data collection forms and protocols are designed together with local monitors, researchers and government staff; they are not developed in isolation.			25,28,51
	60. The appropriate level of accuracy – not necessarily the most scientifically rigorous – is used for determining the data collection methods.			1,6,10,13, 17,34,55
	61. The data collection tools and methods are geared toward quick and local processing and analysis without complicated calculations and facilitate sharing with stakeholders at multiple levels and are applied in future restoration efforts.			5,27,29,34, 56–61
	62. Mobile devices with paper backups are available for monitoring.			4

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	B. PLANNING AND PREPARING (continued) Success factors during the design and planning of the monitoring activities, including budgeting, training for local people and restoration staff and building systems for information sharing	**Assessment**		**Reference**
		Score	**Intervention**	
LOCAL	Data collection methods and technology (continued)			
	63. There is a system of cross-checking involving triangulation with experts, random spot checks or statistical analysis to identify anomalies and to ensure reliability, accuracy and data integrity and to avoid data fabrication.			18,34,55, 59,62
	64. There are basic criteria for evaluating the completeness and consistency of records.			29
	65. Existing data (such as social data already collected by the government) have been identified so that they can be used.			13
	66. If used, digital data entry applications are geared toward those with limited literacy and there is a commitment to provide continual outside expertise and support.			63,64
	67. Digital devices are not seen as a panacea and are only used if there is strong foundation in place of collaboratively defined questions, objectives and approaches.			64
	Training and support			
	68. Substantial regular training is provided to local people in the use of tools, forms and technology to collect data, and in interpreting the data to build understanding and answer questions.			4,9,15,16, 27–30
	69. Training is simple and avoids complex aspects and terminologies.			30
	70. Technical assistance and capacity are sufficient to assure the scientific validity and credibility of the monitoring.			28
	71. Appropriate technical resources, such as computers, software, satellite imagery and an internet connection, are available to communicate results to stakeholders.			35
	72. Skilled and well-compensated regional staff are available to support training and capacity building.			24
	Local incentives and motivations			
	73. Benefits or financial incentives are available for local participants, they are competitive with other livelihoods, and they are provided at least annually (not at the end of a multi-year phase).			7,17,29,34
	74. Multiple strategies to promote participation are pursued, providing incentives and removing barriers to participation.			23,37,65
	75. Participants feel that their needs are considered in the monitoring system, and activities focus on attributes that are relevant to them rather than fulfilling scientifically complete criteria.			18,27,51,59
	76. Data needs and goals of local stakeholders are considered early on and matched with scientists and natural resource managers.			29
	77. Local participants collect data or are involved in related activities regularly to maintain interest.			34
	78. Monitoring generates information that local people can use in their own productive activities, such as agriculture and hunting.			66
	79. Monitoring results – both from the local project and of the bigger picture – are regularly shared to motivate participation.			28,67
	80. Monetary benefits are not tied to monitoring results, to avoid incentivizing falsification, manipulation or fabrication of data.			18,62
	81. Authorities are trusted, and people are not wary of providing information.			23

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B. PLANNING AND PREPARING (continued) Success factors during the design and planning of the monitoring activities, including budgeting, training for local people and restoration staff and building systems for information sharing		Assessment		Reference
		Score	Intervention	
NATIONAL/SUBNATIONAL	**Multi-level monitoring system**			
	82. Infrastructure is in place for data registration, storage and processing to scale up to a national monitoring system.			35
	83. There are standard procedures for monitoring processes to be consistent and transparent, to scale up to a national monitoring system.			35
	84. There is a managing organization that is responsible for organizing and overseeing the monitoring and balancing local needs with national and global needs.			47,68
	85. There is a national monitoring framework to integrate local needs and global demands.			20,35,69
	86. There is a national monitoring framework that provides a small set of common national indicators, and then a bank of indicators that local sites can select from.			2,25
	87. There is more than just a monitoring protocol; there is a monitoring system that can be realistically implemented and supports data collection, aggregation, analysis, adaptation and learning.			5,46
	88. The monitoring system has a built-in capacity to learn and adapt.			46
	89. Local monitoring systems are recognized by policy/decision-makers and built upon when possible.			23,33

C. IMPLEMENTING Success factors during the monitoring activities, including data collection, analysis, information sharing and learning		Assessment		Reference
		Score	Intervention	
LOCAL	**Information collection, management and analysis**			
	90. Data are collected at the beginning and then at regular intervals.			6,10
	91. Data are collected about the monitoring process itself: work sessions, treatments and costs.			6,10
	92. Monitoring information is regularly uploaded to a traditional knowledge database and a GIS database.			70
	93. There is a data-sharing and ownership protocol that defines who owns the data and how it is shared, and there is professional support for data management, storing and analysis.			51
	94. Professionals and community members jointly participate in data analysis and information exchange, which they use for decision-making and to identify inconsistencies.			15,33,34
	95. Monitoring data are analyzed frequently, after small amounts of data are collected, instead of at the end of the restoration activities.			26
	96. Local people have a clear understanding of how to interpret and use data from science-based tools.			29
	Learning, learning networks and information sharing			
	97. There are regular meetings among monitors to discuss findings and to exchange information and data.			29,70
	98. Information on progress and desired endpoints is represented in a way that is visually understandable to stakeholders and discussed in ways that local people can both interpret and apply.			6,10,66,67

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C. IMPLEMENTING (continued) Success factors during the monitoring activities, including data collection, analysis, information sharing and learning		Assessment		Reference
		Score	Intervention	
LOCAL	Learning, learning networks and information sharing (continued)			
	99. Local people are involved in social learning through opportunities for reflection, public meetings to discuss lessons learned and learning workshops.			28,33
	100. Reports are regularly produced and presented, at least yearly.			15
	101. Results are disseminated regularly through various media (radio, internet, texts) to enhance transparency, highlight monitors' work and improve management.			15,70
	102. There are specific activities to use the information, such as environmental education campaigns and regular reporting back to the communities.			66
	103. Local people feel comfortable about sharing their own impressions and what they learned, despite differences in power with officials, and feel empowered to effect changes.			33
NATIONAL/SUBNATIONAL	**Multilevel learning**			
	104. There are community-to-community exchange visits to facilitate learning, demonstrate new ideas and generate interest in restoration.			9
	105. There are repeated learning events, interactions, meetings and field trips to the restoration sites for diverse stakeholders to encourage learning and adaptation, build trust, build respect for diverse opinions and increase transparency.			25,28,53, 57,71
	106. There are informal moments during non-monitoring activities, such as spending meaningful time in the community, for stakeholders to connect and build trust.			25,31

References

1. Viani RA, Barreto TE, Farah FT, Rodrigues RR and Brancalion PH. 2018. Monitoring young tropical forest restoration sites: How much to measure? *Tropical Conservation Science* 11:1940082918780916.
2. Brancalion PHS and Chazdon RL. 2017. Beyond hectares: Four principles to guide reforestation in the context of tropical forest and landscape restoration. *Restoration Ecology* 25:491–6.
3. Le HD, Smith C, Herbohn J and Harrison S. 2012. More than just trees: Assessing reforestation success in tropical developing countries. *Journal of Rural Studies* 28:5–19.
4. Pratihast AK, DeVries B, Avitabile V, de Bruin S, Kooistra L, Tekle M and Herold M. 2014. Combining satellite data and community-based observations for forest monitoring. *Forests* 5:2464–89.
5. Mansourian S, Dudley N and Vallauri D. 2017. Forest landscape restoration: Progress in the last decade and remaining challenges. *Ecological Restoration* 35:281–88.
6. Holl KD and Cairns J. 2002. Monitoring and appraisal. In Perrow MR, ed. *Handbook of Ecological Restoration.* Cambridge, UK: Cambridge University Press. 411–32.
7. Boissière M, Bastide F, Basuki I, Pfund J and Boucard A. 2014. Can we make participatory NTFP monitoring work? Lessons learnt from the development of a multi-stakeholder system in Northern Laos. *Biodiversity & Conservation* 23:149–70.
8. Schultz CA, Coelho DL and Beam RD. 2014. Design and governance of multiparty monitoring under the USDA Forest Service's Collaborative Forest Landscape Restoration Program. *Journal of Forestry* 112:198–206.
9. Galabuzi C, Eilu G, Mulugo L, Kakudidi E, Tabuti JRS and Sibelet N. 2014. Strategies

for empowering the local people to participate in forest restoration. *Agroforestry Systems* 88:719–34.
10. McDonald T, Jonson J and Dixon KW. 2016. National standards for the practice of ecological restoration in Australia. *Restoration Ecology* 24:S4–S32.
11. Stanturf JA, Palik BJ and Dumroese RK. 2014. Contemporary forest restoration: A review emphasizing function. *Forest Ecology and Management* 331:292–23.
12. Pahl-Wostl C. 2009. A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Global Environmental Change* 19:354–65.
13. Dudley N, Cu N and Manh VT. 2003. *A Monitoring and Evaluation System for Forest Landscape Restoration in the Central Truong Son Landscape, Vietnam*. Hanoi: WWF Indochina Programme and Government of Vietnam.
14. Mwangi E, Meinzen-Dick R and Sun Y. 2011. Gender and sustainable forest management in East Africa and Latin America. *Ecology and Society* 16:17.
15. Constantino P, Carlos HSA, Ramalho EE, Rostant L, Marinelli CE, Teles D, Fonseca S, Batista Fernandes RB and Valsecchi J. 2012. Empowering local people through community-based resource monitoring: A comparison of Brazil and Namibia. *Ecology and Society* 17:22.
16. Holck, MH. 2007. Participatory forest monitoring: an assessment of the accuracy of simple cost-effective methods. *Biodiversity Conservation* 17:2023–36.
17. Danielsen F, Skutsch M, Burgess ND, Jensen PM, Andrianandrasana H, Karky B, Lewis R, Lovett JC, Massao J, Ngaga Y, et al. 2011. At the heart of REDD+: a role for local people in monitoring forests? *Conservation Letters* 4:158–67.
18. Danielsen F, Jensen PM, Burgess ND, Altamirano R, Alviola PA, Andrianandrasana H, Brashares JS, Burton AC, Coronado I, Corpuz N et al. 2014. A multicountry assessment of tropical resource monitoring by local communities. *BioScience* 64:236–251.
19. Tougiani A, Guero C and Rinaudo T. 2009. Community mobilisation for improved livelihoods through tree crop management in Niger. *GeoJournal* 74:377–89.
20. Brancalion PHS, Viani RAG, Calmon M, Carrascosa H and Rodrigues RR. 2013. How to organize a large-scale ecological restoration program? The framework developed by the Atlantic Forest Restoration Pact in Brazil. *Journal of Sustainable Forestry* 32:728–44.
21. Pinto SR, Melo F, Tabarelli M, Padovesi A, Mesquita C, de Mattos Scaramuzza C, Castro P, Carrascosa H, Calmon M, Rodrigues R, et al. 2014. Governing and delivering a biome-wide restoration initiative: The case of Atlantic Forest Restoration Pact in Brazil. *Forests* 5:2212–29.
22. Newton AC, del Castillo RF, Echeverría C, Geneletti D, González-Espinosa M, Malizia LR, Premoli AC, Rey Benayas JM, Smith-Ramírez C and Williams-Linera G. 2012. Forest landscape restoration in the Drylands of Latin America. *Ecology & Society* 17:268–94.
23. Turreira-García N, Meilby H, Brofeldt S, Argyriou D and Theilade I. 2018. Who wants to save the forest? Characterizing community-led monitoring in Prey Lang, Cambodia. *Environmental Management* 61:1019–30.
24. DellaSala D, Martin A, Spivak R, Schulke T, Bird B, Criley M, van Daalen C, Kreilick J, Brown R and Aplet G. 2003. A citizen's call for ecological forest restoration: Forest restoration principles and criteria. *Ecological Restoration* 21:15.
25. Demeo T, Markus A, Bormann B and Leingang J. 2015. *Tracking Progress: The Monitoring Process Used in Collaborative Forest Landscape Restoration Projects in the Pacific Northwest Region*. Portland, OR: University of Oregon.
26. Mills AJ, van der Vyver M, Gordon IJ, Atwardhan A, Marais C, Blignaut J, Sigwela A and Kgope B. 2015. Prescribing innovation within a large-scale restoration programme in degraded subtropical thicket in South Africa. *Forests* 6:4328–48.
27. Sabai D and Sisitka H. 2013. Analysing learning at the interface of scientific and traditional ecological knowledge in a mangrove ecosystem restoration scenario in the eastern coast of Tanzania. *Transylvanian Review of Systematical & Ecological Research* 15:185.
28. Fernandez-Gimenez ME, Ballard HL and Sturtevant VE. 2008. Adaptive management and social learning in collaborative and community-based monitoring: a study of five community-based forestry organizations in the western USA. *Ecology and Society* 13:4.
29. Saipothong P, Preechapanya P, Promduang T, Kaewpoka N and Thomas DE. 2006. Community-based watershed monitoring and management in Northern Thailand. *Mountain Research and Development* 26:289–91.

30. Vergara-Asenjo G, Sharma D and Potvin C. 2015. Engaging stakeholders: Assessing accuracy of participatory mapping of land cover in Panama. *Conservation Letters* 8:432–439.
31. Izurieta A, Sithole B, Stacey N, Hunter-Xenie H, Campbell B, Donohoe P, Brown J and Wilson L. 2011. Developing indicators for monitoring and evaluating joint management effectiveness in protected areas in the Northern Territory, Australia. *Ecology and Society* 16.
32. Gallemore C, Rut HP and Moeliono M. 2014. Discursive barriers and cross-scale forest governance in Central Kalimantan, Indonesia. *Ecology and Society* 19.
33. Staddon SC, Nightingale A and Shrestha SK. 2015. Exploring participation in ecological monitoring in Nepal's community forests. *Environmental Conservation* 42:268–77.
34. Laake P, van Skutsch M and McCall MK. 2013. Community forest monitoring. *In* Achard F, ed. *Reducing Greenhouse Gas Emissions from Deforestation and Degradation in Developing Countries: A Sourcebook of Methods and Procedures for Monitoring Measuring and Reporting*. Wageningen, The Netherlands: Global Observation of Forest Cover and Land Dynamics GOFC-Gold. 187–202.
35. Torres AB. 2014. Potential for integrating community-based monitoring into REDD+. *Forests* 5:1815–33.
36. Smale CR and Gray Tappan M. 2009. *Agroenvironmental Transformation in the Sahel: Another Kind of 'Green Revolution'*. Washington, DC: International Food Policy Research Institute.
37. Boissière M, Beaudoin G, Hofstee C and Rafanoharana S. 2014. Participating in REDD+ measurement, reporting, and verification (PMRV): Opportunities for local people? *Forests* 5:1855–78.
38. Chaves RB, Durigan G, Brancalion PHS and Aronson J. 2015. On the need of legal frameworks for assessing restoration projects success: new perspectives from São Paulo state (Brazil). *Restoration Ecology* 23:754–9.
39. Monroe AS and Butler WH. 2016. Responding to a policy mandate to collaborate: Structuring collaboration in the collaborative forest landscape restoration program. *Journal of Environmental Planning and Management* 59:1054–72.
40. van Oosten C. 2013. Restoring landscapes. Governing place: A learning approach to forest landscape restoration. *Journal of Sustainable Forestry* 32:659–76.
41. Fischer AP, Vance-Borland K, Jasny L, Grimm KE and Charnley S. 2016. A network approach to assessing social capacity for landscape planning: The case of fire-prone forests in Oregon, USA. *Landscape and Urban Planning* 147:18–27.
42. Cash DW, Adger WN, Berkes F, Garden P, Lebel L, Olsson P, Pritchard L and Young O. 2006. Scale and cross-scale dynamics: Governance and information in a multilevel world. *Ecology and Society* 11.
43. van Oosten C, Gunarso P, Koesoetjahjo I and Wiersum F. 2014. Governing forest landscape restoration: Cases from Indonesia. *Forests* 5:1143–62.
44. Fischer AP and Jasny L. 2017. Capacity to adapt to environmental change: Evidence from a network of organizations concerned with increasing wildfire risk. *Ecology and Society* 22.
45. Spies T, Scheller R and Bolte J. 2018. Adaptation in fire-prone landscapes: Interactions of policies, management, wildfire, and social networks in Oregon, USA. *Ecology and Society* 23.
46. Evans K and Guariguata MR. 2016. *Success from the ground up: Participatory monitoring and forest restoration*. Bogor, Indonesia: Center for International Forestry Research.
47. Cheng A and Sturtevant V. 2012. A framework for assessing collaborative capacity in community-based public forest management. *Environmental Management* 49:675–89.
48. Chazdon RL, Brancalion PHS, Lamb D, Laestadius L, Calmon M and Kumar C. 2015. A policy-driven knowledge agenda for global forest and landscape restoration. *Conservation Letters* 10:125–132.
49. Scheyvens H, ed. 2014. *Community-Based Forest Biomass Monitoring: Action Research in PNG, Cambodia, Indonesia, Lao PDR and Vietnam.* Hayama, Japan: Institute for Global Environmental Strategies.
50. Dey DC and Schweitzer C J. 2014. Restoration for the future: Endpoints, targets, and indicators of progress and success. *Journal of Sustainable Forestry* 33:S43–S65.
51. Bellfield H, Sabogal D, Goodman L and Leggett M. 2015. Case study report: Community-based monitoring systems for REDD+ in Guyana. *Forests* 6:133–56.
52. Dale VH and Beyeler SC. 2001. Challenges in the development and use of ecological indicators. *Ecological Indicators* 1:3–10.
53. Evans K, Larson AM, Mwangi E, Cronkleton P, Maravanyika T, Hernandez X, Müller P, Pikitle

A, Marchena R, Mukasa C, et al. 2014. *Field Guide to Adaptive Collaborative Management and Improving Women's Participation*. Bogor, Indonesia: Center for International Forestry Research (CIFOR).
54. Viani RAG, Holl K, Padovezi A, Strassburg B, Turini FF, Garcia L, Chaves R, Rodrigues R and Brancalion P. 2017. Protocol for monitoring tropical forest restoration: Perspectives from the Atlantic Forest Restoration Pact in Brazil. *Tropical Conservation Science* 10, 1940082917697265.
55. Skutsch M, McCall M and Larrazabal A. 2014. Balancing views on community monitoring: The case of REDD+. *Biodiversity & Conservation* 23:233–6.
56. Danielsen F, Balete DS, Poulsen MK, Enghoff M, Nozawa CM and Jensen AE. 2000. A simple system for monitoring biodiversity in protected areas of a developing country. *Biodiversity and Conservation* 9:1671–705.
57. Danielsen F, Jensen PM, Burgess ND, Coronado I, Holt S, Poulsen MK, Rueda RM, Skielboe T, Enghoff M, Hemmingsen LH, et al. 2014. Testing focus groups as a tool for connecting indigenous and local knowledge on abundance of natural resources with science-based land management systems. *Conservation Letters* 7:380–89.
58. Schumann M and Waikaniwa C. 2004. *Monitoring a Fuel Reduction Treatment: Analysis of Pre- and Post-Treatment Data. A Participatory Research Project with the Pueblo of Zuni*. Santa Fe, NM: Forest Guild Research Center.
59. Le Tellier V, Carrasco A and Asquith N. 2009. Attempts to determine the effects of forest cover on stream flow by direct hydrological measurements in Los Negros, Bolivia. *Forest Ecology and Management* 258:1881–8.
60. Burton PJ. 2014. Considerations for monitoring and evaluating forest restoration. *Journal of Sustainable Forestry* 33:S149–S160.
61. Zahawi RA, Dandois JP, Holl KD, Nadwodny D, Reid JL and Ellis EC. 2015. Using lightweight unmanned aerial vehicles to monitor tropical forest recovery. *Biological Conservation* 186:287–95.
62. Nielsen M and Lund J. 2012. Seeing white elephants? The production and communication of information in a locally-based monitoring system in Tanzania. *Conservation and Society* 10:1.
63. Peters-Guarin G and McCall MK. 2010. *Community Carbon Forestry (CCF) for REDD: Using CyberTracker for Mapping and Visualising of Community Forest Management in the Context of REDD*. Kyoto: Think Global, Act Local (K: TGAL). http://www.communitycarbonforestry.org
64. Brammer JR, Brunet ND, Burton C, Cuerrier A, Danielsen F, Dewan K, Herrmann T, Jackson MV, Kennett R, Larocque G, et al. 2016. The role of digital data entry in participatory environmental monitoring. *Conservation Biology* 30:1277–87.
65. Brites AD and Morsello C. 2017. Beliefs about the potential impacts of exploiting non-timber forest products predict voluntary participation in monitoring. *Environmental Management* 59:898–911.
66. Villaseñor E, Porter-Bolland L, Escobar F, Guariguata MR and Moreno-Casasola P. 2016. Characteristics of participatory monitoring projects and their relationship to decision-making in biological resource management: A review. *Biodiversity and Conservation* 25:2001–19.
67. Dawson L, Elbakidze M, Angelstam P and Gordon J. 2017. Governance and management dynamics of landscape restoration at multiple scales: Learning from successful environmental managers in Sweden. *Journal of Environmental Management* 197:24–40.
68. Reed J, Van Vianen J, Deakin EL, Barlow J and Sunderland T. 2016. Integrated landscape approaches to managing social and environmental issues in the tropics: Learning from the past to guide the future. *Global Change Biology* 22(7):2540–54.
69. Murcia C, Guariguata MR, Andrade A, Andrade GI, Aronson J, Escobar EM, Etter A, Moreno FH, Ramirez W and Montes E. 2016. Challenges and prospects for scaling-up ecological restoration to meet international commitments: Colombia as a case study. *Conservation Letters* 9:213–20.
70. Stankovich M, Cariño C, Regpala ME, Guillao JA and Balawag G. 2013. *Developing and Implementing Community-Based Monitoring and Information Systems: The Global Workshop and the Philippine Workshop Reports*. Benguet, Philippines: Tebtebba Foundation.
71. USDA Forest Service. 2017. *Expert Consultation on Monitoring Forest Landscape Restoration Workshop Report*. Washington, DC: United States Forest Service Office of International Programs.

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Forest landscape restoration (FLR) requires a long-term commitment from a range of stakeholders to plan the restoration initiative collaboratively and see it through successfully. This is only possible when the people involved – whether they are landholders, indigenous groups, government entities, non-governmental organizations or other crucial actors – come together to define common goals and monitor progress toward those goals. Collaborative monitoring can play a crucial role in these processes by providing a structured way to include diverse stakeholders in FLR, generate local buy-in and catalyze social learning. However, collaborative monitoring is new to many FLR planners and, while they may be interested in implementing collaborative monitoring, they may not know where to start. This diagnostic provides a systematic way for FLR planners to assess their FLR initiatives against a checklist of success factors. The diagnostic helps practitioners to: (1) determine whether they are ready for collaborative monitoring; (2) identify what elements need to be strengthened; and (3) assess whether existing monitoring systems are on the right track. The diagnostic can be applied on at least two scales: it includes factors to be used at a specific FLR site and it outlines the factors that are intrinsic to a multilevel collaborative monitoring system. It consists of a core matrix of 42 success factors, plus suggestions for performing the assessment.

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