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RESEARCH REVIEW

Integrated landscape approaches to managing social and environmental issues in the tropics: learning from the past to guide the future

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Abstract

Poverty, food insecurity, climate change and biodiversity loss continue to persist as the primary environmental and social challenges faced by the global community. As such, there is a growing acknowledgement that conventional sectorial approaches to addressing often inter-connected social, environmental, economic and political challenges are proving insufficient. An alternative is to focus on integrated solutions at landscape scales or 'landscape approaches'. The appeal of landscape approaches has resulted in the production of a significant body of literature in recent decades, yet confusion over terminology, application and utility persists. Focusing on the tropics, we systematically reviewed the literature to: (i) disentangle the historical development and theory behind the framework of the landscape approach and how it has progressed into its current iteration, (ii) establish lessons learned from previous land management strategies, (iii) determine the barriers that currently restrict implementation of the landscape approach and (iv) provide recommendations for how the landscape approach can contribute towards the fulfilment of the goals of international policy processes. This review suggests that, despite some barriers to implementation, a landscape approach has considerable potential to meet social and environmental objectives at local scales while aiding national commitments to addressing ongoing global challenges.

Keywords: biodiversity conservation, conservation and development trade-offs, food security, integrated management, landscape approach, Sustainable Development Goals

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Introduction

Poverty, food insecurity, climate change and biodiversity loss continue to persist as the primary social and environmental challenges faced by the global community (Godfray *et al.*, 2010; Laurance *et al.*, 2014; West *et al.*, 2014). There have been some successes in addressing these diverse set of challenges: from 1990 to 2015, the number of undernourished people globally has almost halved (FAO, IFAD & WFP, 2015), more than one billion people have been lifted out of extreme poverty (UN, 2015), and a global network of protected areas has been developed covering over 15% of the terrestrial surface (UNEP/IUCN). Yet despite these advances, many challenges remain approximately 795 million people remain undernourished globally, with 780 million of these from developing countries (FAO, IFAD & WFP, 2015); greenhouse gas emission rates continue to rise (IPCC, 2014); and global poverty remains both high, with almost 900 million people surviving on less than $1.90 per day, and highly concentrated, with 42.6% and 18.8% of the global total occurring in sub-Saharan Africa and South Asia, respectively (World Bank & IMF, 2016). Furthermore, habitat loss due to agricultural expansion (Hansen *et al.*, 2010; Foley *et al.*, 2011; Galluzzi *et al.*, 2011) is widely accepted as a primary contributing factor towards what has already been termed the sixth mass extinction event (Ceballos *et al.*, 2015) or the anthropocene (Lewis & Maslin, 2015).

There is a growing acknowledgement that conventional sectorial approaches to addressing these often inter-connected challenges are proving insufficient (Godfray *et al.*, 2010; Foley *et al.*, 2011; Tscharntke *et al.*, 2012). While the primary social and environmental challenges – poverty alleviation, food security, biodiversity loss and climate change – are undoubtedly

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distinct, the solutions may be more readily devised through an integrated approach. This is primarily because stakeholder groups are likely to diverge in their perceptions on the relative importance of social or environmental challenges (Kutter & Westby, 2014). Additionally, solely focussing efforts on a single challenge may result in concurrent negative social or environmental outcomes. For example, increased agricultural production could lead to increased biodiversity loss or the creation of a protected area to conserve biodiversity may inhibit the socio-economic development of those communities excluded from access to wild resources.

One approach to addressing inter-connected social, environmental, economic and political challenges involves focussing on integrated solutions at landscape scales. Yet, while international policy dialogues increasingly highlight the potential of integrated landscape approaches, it is also recognized that landscapes evolve in a 'more or less chaotic way' (Antrop, 2006; Sayer *et al*., 2008) and the inherent complexity and problems within them are 'in contrast to the disciplinary organization of science' (Tress *et al*., 2001). Therefore, our understanding and subsequent ability to overcome the 'wicked' problems (Balint *et al*., 2011; Freeman *et al*., 2015) apparent within complex systems is dependent on our willingness to work across social, political and scientific disciplinary boundaries (Meinzen-Dick *et al*., 2002; German *et al*., 2007; Barlow *et al*., 2011).

The appeal of integrating systems at the landscape scale has resulted in the production of a significant body of literature in recent decades (See: Scherr & McNeely, 2008; Sunderland *et al*., 2008; Sayer *et al*., 2013; Minang *et al*., 2015; Milder *et al*., 2014). However, a single normative concept of a landscape approach remains elusive. In addition, confusion over terminology, application and utility persists (Redford *et al*., 2003; Pfund, 2010; Sayer *et al*., 2013; Scherr *et al*., 2013). While it is accepted that a universally agreed definition has been – and is likely to remain – elusive (Hobbs, 1997; Tress *et al*., 2001; Musacchio, 2009; Sayer *et al*., 2013), here we argue for broader consensus on the conceptualization of the landscape approach.

Many of these interlinked global challenges intersect in the tropics, where action is urgently needed to avert further biodiversity loss and contribute to sustainable rural livelihoods (Laurance, 1999; Gardner *et al*., 2009). By focusing on the tropics, this study aims to: (i) disentangle the historical development and theory behind the framework of the landscape approach and how it has progressed into its current iteration, (ii) establish lessons learned from previous land management strategies, (iii) determine the barriers that currently restrict implementation of the landscape approach and (iv) document how the landscape approach can help meet the goals of international policy processes.

Methods

This overview of the landscape approach is based upon a robust and thorough review of both the peer-reviewed and grey literature. This involved analysing more than 13 000 peer-reviewed articles, over 500 grey literature documents and screening the websites of over 30 key research organizations (see: Reed *et al*., 2015 for a detailed methodology).

Integrated landscape management theory: a brief history

An integrated approach to managing landscapes is not a new concept, but rather one refined through multiple iterations during attempts to integrate social and economic development with biodiversity conservation and climate change mitigation. It is widely acknowledged that traditional communities have managed natural resources in a holistic manner for centuries to meet social needs (Feeny *et al*., 1990; Ostrom, 1990; Lansing, 2006; Sayer *et al*., 2013; Cairns, 2015). Moreover, some of the key principles of the most recent landscape approach iteration (Sayer *et al*., 2013), such as adaptive management, while widely recognized as being developed in the 1970s (Holling, 1978; Walters, 1986; Light, 2001), has been broadly discussed for almost a century (Leopold, 1933). Furthermore, the emphasis on integrating environment and development agendas has been consistently promoted for over 40 years, both within the literature and at international conferences (UNCHE, 1972; Barrett, 1992; UNCED, 1992; O'Riordan, 1998; Sayer & Campbell, 2001; Merrey *et al*., 2005; Frost *et al*., 2006; Scherr & McNeely, 2008; Sayer *et al*., 2013).

In the mid-1980s, there was something of a paradigm shift with the promotion of more holistic approaches originating from within the conservation community and the emergence of the scientific discipline of landscape ecology (see: Reed *et al*., 2015). Initiatives such as the WWF 'Wildlands and Human Needs programme' and policy dialogues such as the Brundtland report, the 1992 Earth Summit and Agenda 21, resulted in a transitioning away from the traditional 'fortress conservation' model that imposed 'fences and fines' in an attempt to restrict human interference. There was an increased focus on models that sought to account for the needs of rural communities within conservation projects through the recognition and utilization of multi-functional landscapes (Bellamy & Johnson, 2000; Saxena *et al*., 2001; Tress *et al*., 2001; Fischer *et al*., 2008; O'Farrell & Anderson, 2010; Barlow *et al*., 2011; Scherr *et al*., 2012; Harvey *et al*., 2014). Concurrently, the development discourse began shifting towards the

value of safeguarding natural resources to enhance rural development (Ruttan, 1984; Salafsky & Wollenberg, 2000; WRI, 2000; Murphree, 2002; Shackleton & Shackleton, 2004; Belcher *et al*., 2005; Sunderlin *et al*., 2005; Sunderland *et al*., 2008).

As integrated thinking evolved, a plethora of approaches were conceived. These were largely designed to reconcile social and environmental agendas with the much-heralded objective of delivering 'win-win' outcomes that both conserve biodiversity and enhance socio-economic development. However, while such win-win objectives remain desirable, it has been argued that the true value of such approaches lies in their marketability as opposed to their utility in practice (McShane *et al*., 2011). This marketability has resulted in a strong show of support from donors and policymakers that, as a consequence, has seen a reluctance from the research community to acknowledge the trade-offs that can, and will, occur in targeting joint conservation and development objectives (Faith & Walker, 2002; Wells & McShane, 2004; Sunderland *et al*., 2008; McShane *et al*., 2011; Salafsky, 2011).

This win-win rhetoric has formed the basis of a suite of recent conservation and/or development approaches as many global non-governmental organizations (NGO's) that previously had an explicit objective of conserving nature – such as Conservation International (CI), International Union for Conservation of Nature (IUCN), World Wildlife Fund (WWF), among others – developed projects to recognize the needs of people within the landscape. This review identified a number of prominent approaches that either emerged, or were re-visited, following the Rio Earth summit (e.g. these include Integrated Water Resource Management (IWRM) or Integrated Watershed Management (IWM); Ecosystem Approach (EA); Integrated Rural Development (IRD); Integrated Natural Resource Management (INRM); Integrated Conservation and Development Projects (ICDP's); and Forest Landscape Restoration (FLR)).

Although these approaches are commonly referred-to within the literature, it should be noted that they merely act as umbrella terms for a very wide variety of similar, or even identical initiatives, albeit under different guises (Table 1). While the one dominant commonality of these initiatives was the aim to optimize conservation and development outcomes by managing more holistically, the much sought win-win outcomes often remained elusive. Despite documented cases that show that win-win or even triple win outcomes are achievable (Barrett & Arcese, 1995; Agrawal *et al*., 1997; Wells *et al*., 1999; Ferraro, 2001; Saxena *et al*., 2001; Cao *et al*., 2009; Miller *et al*., 2011), experience suggests these few examples are the exceptions and are not achieved at larger scales. Instead, most management or policy interventions result in winners and losers (Wunder, 2001; Brown, 2002; Berkes, 2007; Laumonier *et al*., 2008; Sunderland *et al*., 2008; Pfund *et al*., 2011; Castella *et al*., 2014).

The acknowledged failings of integrated management approaches have resulted in a number of critiques (Agrawal & Gibson, 1999; Murombedzi, 1999; Adams *et al*., 2004; Chapin, 2004; Robinson & Redford, 2004; Sayer & Wells, 2004; Wells & McShane, 2004; Jeffrey & Gearey, 2006; McShane *et al*., 2011; Redford *et al*., 2013). These suggest that there are three key reasons why it has been difficult to achieve optimal, and multiple, outcomes.

First, these prior approaches have often failed to acknowledge the inevitable trade-offs within the landscape, electing instead to maintain appeal with policymakers and landscape practitioners by promoting unrealistic dual or triple win deliverables (Pfund, 2010). It will often be the case that optimal solutions for one person, will be sub-optimal for another and as such, accounting for these trade-offs is fundamental to addressing linked social and environmental challenges. Secondly, despite emphasizing the importance of integration as an objective, researchers, policymakers, and conservation and development practitioners have struggled to overcome disciplinary boundaries. Stucki & Smith (2011) observe that despite the widespread promotion of integration, aside from the rhetoric, researchers remain embedded within their disciplinary silos: 'water resource managers talk about Integrated Water Resource Management (IWRM), ecologists about the Ecosystem Approach (EA), marine professionals about Integrated Coastal Zone Management (ICZM), agricultural scientists about Integrated Natural Resource Management (INRM) and foresters about Forest Landscape Restoration (FLR)'. Finally, the research community may be guilty of 'muddying the waters' when offering solutions to pressing scientific questions. As such, an ever-growing lexicon of terminology has evolved in relation to landscape approaches to environmental and developmental challenges (Ewers & Rodrigues, 2006; Mastrangelo *et al*., 2014; Waylen *et al*., 2014).

Ironically, this confusion may have been perpetuated through the burgeoning zeal of research organizations aiming to embrace integration, with every new tweaking of a given iteration resulting in a plethora of often florid and confusing terms. Organizations from across the spectrum of sectors are developing their own interpretations of landscape approaches and labelling them differently, either due to unawareness of existing approaches or a desire to develop their 'own' brand. However, this may hinder progress as confusion over

Table 1 Terminology identified throughout this review referring to some form of integrated landscape approach

Lead author	Year	Terminology used
Barrett	1992	Agrolandscape ecology
Barrett	1994	Sustainable landscape approach; Landscape approach; Agrolandscape ecology; Noosystem; Holistic management; Sustainable Agrolandscape Management.
Howarth	1999	Lifescape
Bellamy	2000	Integrated Resource Management
Saxena	2001	Integrated Natural Resource Management
Sayer	2001	Integrated Natural Resource Management
Velazquez	2001	Landscape approach; Participatory research approach; Landscape evaluation system.
Browder	2002	Integrated conservation & development project
Younge	2003	Eco-region Based Conservation
Douthwaite	2004	Integrated Natural Resource Management
Keough	2005	Integrative ecosystem management; Collaborative decision making; Integrative collaborative ecosystem management; Collaborative stewardship; Natural Resource Management.
Lllambi	2005	Participatory Conservation
Merry	2005	Integrated Water Resources Management
Sharma	2005	Community Based Natural Resources Management; Participatory Forest Management; Joint forest management; Community forestry; Leasehold forestry; Integrated landscape approach; Livestock Management; Rangeland ecology; Rangeland co-Management
Frost	2006	Integrated Natural Resource Management
Potschin	2006	Landscape Ecology; Sustainability Science; Landscape Approach
Amede	2007	Sustainable land management; Local Level Participatory Planning Approach
Berkes	2007	Community Based Conservation
German	2007	Participatory Integrated Watershed Management
Muhweezi	2007	Transboundary Ecosystem Management Approach
von Kaufmann	2007	Integrated Agricultural Research for Development
Yin	2007	Integrated Assessment Approach
Hall	2008	Payment for Ecosystem Services
Scherr	2008	Ecoagriculture
Shiferaw	2008	Integrated Watershed Management
Cao	2009	Sustainable Environmental Restoration; Sustainable Development; Payment for Ecosystem Services; Poverty Reduction and Environmental Restoration.
Duff	2009	Adaptive Collaborative Landscape Management (ACLM)
Gardner	2009	Adaptive -landscape planning framework
Musacchio	2009	Landscape Ecology; Sustainability Science; Translational Landscape Research and Practice; Holistic Landscape Ecology; Translational Approach
Sayer	2009	Landscape Approach
Termorshuizen	2009	Landscape Services Framework
Ianni	2010	Forest Landscape Restoration; Ecosystems Approach
Pearson	2010	Landscape Ecology; Landscape Ecological Approach; Trans-disciplinary Approach
Sandker	2010	Landscape Approach
Lewis	2011	Community Markets for Conservation
Sellamuttu	2011	Integrated Conservation and Development Project
Stucki	2011	Integrated Water Resources Management; Ecosystem Approach; Integrated Coastal Zone Management; Integrated Natural Resource Management; Forest Landscape Restoration
Haregeweyn	2012	Integrated Watershed Management
Padoch	2012	Landscape Approach
Palsaniya	2012	Integrated Watershed Management
Qiang	2012	Mosaic Agricultural-Forestry-Fishery-Stock Breeding System
Scherr	2012	Ecoagriculture
Sayer	2013	Landscape Approach
Castella	2014	Participatory land use planning
Indrawan	2014	Satoyama
Kutter	2014	Landscape Approach

terms and their application may be impeding donor commitments, slowing policy traction and stalling practitioner uptake. It has also been suggested that researchers, practitioners and development agencies are repeating past mistakes (Castella *et al.*, 2014) and that there remains a large divide between research and practice (Sunderland *et al.*, 2009) and policy (Shackleton *et al.*, 2009; Shanley & López, 2009). It is therefore important to highlight the mechanisms behind these failings and identify how we can best learn to bridge these gaps.

Existing criticism of prior approaches that have not sufficiently addressed development and conservation objectives have galvanized efforts to provide a refined approach to landscape design and management (McShane *et al.*, 2011; Milder *et al.*, 2012; Sayer *et al.*, 2013). The challenge for sustainability scientists and practitioners is to integrate research efforts from design to practice. By acknowledging conservation and development trade-offs and incorporating them into framework designs, management practices can be developed to best account for such trade-offs. This should ensure the delivery of a coherent approach, with the greater clarity appealing to donors, policymakers and practitioners.

The landscape approach

A landscape approach can be defined as a framework to integrate policy and practice for multiple competing land uses through the implementation of adaptive and integrated management systems (Reed *et al.*, 2015). The landscape approach seeks to address global challenges of poverty alleviation, food security, climate change and biodiversity loss. Although it can be viewed as a refinement of prior approaches, it is distinct as it explicitly acknowledges that satisfying all stakeholders will often be unachievable. By bringing together the diverse range of stakeholders operating within the landscape and attempting to understand what each of their requirements and expectations are, trade-offs and synergies can be identified. Management plans should then aim to capitalize on the synergies while the trade-offs will enable planners to identify who is losing out and as such appropriate compensation or alternatives can be sought. Therefore, the landscape approach attempts, through participatory, inclusive negotiation and planning to minimize trade-offs and maximize synergies so that there are fewer losers and more winners (Sayer *et al.*, 2014).

Perhaps the greatest distinction of the landscape approach is that it does not follow the traditional unidirectional project cycle approach. Due to the dynamic nature of living landscapes, it follows that there should be no defined end point to a landscape approach, rather it should be an iterative process of negotiation, trial and adaptation (Sayer *et al.*, 2013, 2014). Adaptive management feedback mechanisms will provide stakeholders the capacity to best account for conservation and development challenges within the landscape (see: Sandker *et al.*, 2010). Below we identify some of the key aspects of a landscape approach (Table 2), for a

Table 2 The key aspects of an effective landscape approach

Five key aspects of an effective landscape approach (the five E's)	Summary
Evaluate progress	Monitoring processes need to balance participatory engagement and scientific rigour
	Metrics must be specific to the landscape context encompassing evaluation of social, environmental, production and governance variables
	Without appropriate metrics, feedback loops fail and adaptive management is unachievable
Establish good governance	Optimal governance structures will vary among landscapes
	Identifying the structure which works best and evaluating these structures over time is key to landscape sustainability
Evolve from panacea solutions	Acknowledge that a landscape approach is not universally applicable
	A landscape approach might not be the most effective strategy all of the time
	Contextualization is fundamental to success
	Every framework must be tailored to the specific landscape configuration and aligned with specific goals
Engage multiple stakeholders	Need for ongoing, inclusive, participatory negotiation processes.
	Enable stakeholders to identify objectives, develop synergies, account for trade-offs
	Align local socio-cultural and global environmental concerns
	Good, and trusted, facilitation is key
Embrace dynamic processes	Individual components of a landscape are not static.
	Frameworks needs to be dynamic
	Frameworks require built in mechanisms to mitigate stochastic and unpredictable changes

more conclusive set of guiding principles, see Sayer *et al.* (2013).

Key aspects of an effective landscape approach

Evaluating progress within a landscape is fundamental to determining where gains or losses are being made. Without – understandable, cost-effective and reliable – tools for measuring landscape outcomes, applying appropriate adaptive management decisions to maximize gains and mitigate losses will become impossible. How such decisions are arrived at will largely depend on the structural arrangements and governance systems in place within and outside the landscape.

Contrary to much of the rhetoric in favour of community-based approaches, experience from the national policies of Brazil and Costa Rica has shown that top-down *governance structures* can be hugely effective in reducing rates of deforestation (Ibrahim *et al.*, 2010; Nepstad *et al.*, 2014). However, such structures have been cited as a major contributor to the lack of success of many integrated conservation and development projects (Browder, 2002; Brown, 2002; Hall, 2008) and go against the basic premise of the landscape approach that calls for multi-scale integration of stakeholders. This does not preclude landscape approaches from utilizing top-down governance, rather there is an increased risk of the implementing partner's objectives being misaligned with the capacities and intentions of practitioners, potentially further marginalizing local stakeholders (Browder, 2002). Again, inclusive study design and ongoing consultation can help to mitigate such undesired eventualities (Scherr *et al.*, 2012).

Similarly, strictly bottom-up governance structures can also face significant challenges. Issues reported in the literature that can impinge the effectiveness of bottom-up or community-based governance systems include lack of social capital or strong leadership (Pretty, 2002, 2003; German *et al.*, 2007), weak institutional support (Princen, 2003), lack of capacity or financial resource (Ewing, 1999; Berkes, 2007), inequitable share of benefits (Ostrom *et al.*, 1999) and inability to prevent 'land grabbing' or elite capture of resources (Dietz *et al.*, 2003). A preferable, and perhaps increasingly common, system of governance for landscapes has a hybrid, multi-level and cross-sectoral structure (Ostrom, 1990; Lemos & Agrawal, 2006; Berkes, 2007; Ostrom *et al.*, 2007; Ros-Tonen *et al.*, 2008; Colfer & Pfund, 2011; Torfing *et al.*, 2012; Kozar *et al.*, 2014) that benefits from the integration of internal traditional knowledge and external institutional and financial support.

Ostrom *et al.* (2007), Sayer *et al.* (2013) and others stress the importance of *not subscribing to panaceas* for resolving complex social–ecological landscape challenges. A landscape approach is not a cure-all remedy and will not be appropriate in all contexts. It is therefore necessary to evaluate the different land-use options across the landscape and provide verifiable data to support management plans for optimal environment and development outcomes. As such, the ten principles of the landscape approach (Sayer *et al.*, 2013) provide a framework from which practitioners can select and then adapt to local conditions. The principles should not be considered a prescriptive approach to spatial planning but rather a 'menu' from which to select appropriately, depending on specific landscape contexts (Tallis *et al.*, 2008a; Sayer *et al.*, 2013; Van Noordwijk *et al.*, 2014).

This need for contextualization extends beyond the evaluation of spatial and biophysical components. A complete landscape assessment should account for the 'sense of place and identity' of landscape inhabitants (Van Noordwijk *et al.*, 2014). Careful consideration must be given to the sociocultural needs and desires of rural communities as 'often land management is not just an economic activity but also a way of life' (Mishra Panda, 1999). This is well illustrated by the tendency of rural communities to align important community rituals and ceremonies with key events in the agricultural calendar (Posey, 1985).

Inclusive, participatory stakeholder negotiation can help align local socio-cultural and global environmental concerns (Altieri & Masera, 1993; Dewalt, 1994; Saxena *et al.*, 2001; Frost *et al.*, 2006). Without commitment from rural communities, landscape approaches are unlikely to succeed, potentially resulting in community members returning to previous destructive practices (Cao *et al.*, 2009) or circumventing restrictions in favour of high-return, high environmental cost land-use practices (Sen *et al.*, 1997; Nautiyal *et al.*, 1998). However, evidence has emerged that communities are willing to trade environmentally costly land-use practices that deliver short-term economic gains for those that deliver long-term social and environmental gains, providing they are adequately informed and convinced of the benefits (Keough & Blahna, 2006; Cao *et al.*, 2009). Finally, the practitioners of the landscape approach must be cognizant of the cross-cutting challenges of gender inequity, food and nutritional security, and climate change that are often manifest in rural landscapes.

Recognizing dynamic processes

Landscapes are inherently dynamic. The individual components that comprise a landscape, be they biophysical, social or political, never remain static and

stochastic changes can, and will, inevitably occur. To be effective, a landscape approach framework therefore needs to be flexible enough to adapt to such changes. Given that the landscape approach encourages inclusivity of multiple stakeholders, governed at multiple scales through the application of adaptive management to outcomes without specific objectives, it would be remiss of the approach – and it's practitioners – not to be as dynamic as the landscape in which they are working. The landscape approach framework, when applied to its full potential, should be resilient and resistant to stochastic, counter-intuitive or unpredictable changes through well-designed and evaluated systems. Such systems have the potential to identify and avoid perverse outcomes (Kinzig, 2001).

Barriers to implementation of the landscape approach

This literature review provided evidence that there is both a need and demand for the widespread adoption of integrated landscape approaches, with 37% of the final suite of studies explicitly stating the need for the approach in one form or another. However, within the peer-reviewed literature very few documented examples of an integrated landscape approach in practice – as we define it – were found. Furthermore, the examples that were retrieved (from both the peer-reviewed and grey literature) often failed to provide the necessary detail for how the approach had been applied, how progress had been measured and evidence of empirical data to support the outcomes (J. Reed, J. van Vianen, J. Barlow, T. Sunderland, in preparation). This raises questions as to why there is a large gap between knowledge and implementation, why landscape approaches have been implemented but not reported in the scientific literature, what barriers to implementation currently exist, and to what extent these barriers can be overcome? Somewhat ironically, there are processes that are required to effectively implement a landscape approach that also contribute to the current barriers to implementation. As such, there is some overlap between the preceding section – key aspects of a landscape approach – and the subsequent section where we describe some of the key challenges – as identified from the literature – to implementing a landscape approach (Table 3).

Time lags

The lack of documented landscape approaches may be due to the ongoing theory development process, resulting in a time lag whereby implementing partners are reluctant to commit to initiatives until the theory and conceptualization is fully established. However, application of the landscape approach is necessary to advance progress towards environmental and developmental sustainability. Without application, the landscape approach is vulnerable to the same fate of many other integrated approaches (such as the ecosystem approach and integrated conservation and development projects (ICDP's) into which considerable thought, resources and debate, were invested in the design and planning without them ever being fully tested in practice (Wu & Hobbs, 2007; Sunderland *et al*., 2013; Castella *et al*., 2014; Waylen *et al*., 2014). Castella *et al.* (2014) go as far as recommending fewer resources be invested in planning and more in implementation, as many projects fail to make it past the design stage and as such the precise baseline data collected is never utilized. However, this is contrary to the recommendations of others, who consider efficient design to be inte-

Table 3 Current barriers to implementation of a landscape approach

Barriers to effective landscape approach implementation	Recommended solutions (in brief)
Time lags	Landscape approach theory is still evolving Theory needs to be further refined Commitments to implementation efforts are necessary to support our understanding
Terminology confusion	Look beyond current labels in use Accept there are many potential entry points to a landscape approach
Operating silos	All actors (researchers, policymakers, practitioners, donors etc.) engaged in landscape approaches should be encouraged to integrate efforts in order to overcome traditional operating barriers
Internal/external engagement	Implementers should engage stakeholders in full, open and inclusive negation processes Local stakeholders are empowered by identifying their needs rather than what they are prepared to accept
Monitoring	Researchers must continue to develop and refine appropriate and cost-effective metrics Implementers are encouraged to refer to the growing body of literature on landscape metrics

gral to closing the knowledge–implementation gap (Nassauer & Opdam, 2008; Wu, 2008; Pearson & Gorman, 2010). Furthermore, there are numerous examples of ICDP's being implemented but sufficient baseline data for monitoring rarely being collected (Sunderland *et al*., 2013). As with many components of a landscape approach, finding an optimal balance that is context specific will be necessary. With considerate design, application and monitoring, there is considerable potential to generate feedback mechanisms to develop future guidelines for good practice.

The premise of a holistic approach is the capacity to study the whole system even when not fully cognizant of the precise functioning of the component parts (Naveh, 2001). Furthermore, adaptive management promotes a trial-by-error approach that necessitates learning from prior experience to formulate better established management plans through iterative processes (Holling, 1978). While efforts must be made to strengthen the theory and conceptualization of landscape approaches, there is sufficient knowledge already available to apply it in practice. The real value of this knowledge will only be realized through integrated commitments to implement and evaluate the approach over larger spatial and temporal scales.

Terminology

As previously alluded to, a further barrier to implementation could be the proliferation of terms associated with landscape approaches (see Table 1). Consistent with the findings of this review, a recent study by Ecoagriculture Partners identified over 80 terms all alluding broadly to the same concept of integrated approaches to land management (Scherr *et al*., 2013). It is important that the research community is able to provide a more cohesive argument to better engage with stakeholders and decision-makers. A logical first step could be to look beyond the current labels in use by the various sectors operating within a landscape and instead accept that all are entry points towards a landscape approach (Minang *et al*., 2015). In this sense, a landscape approach becomes less about a destination, or endpoint, and more about the journey, reiterating the need to have regular, inclusive and facilitated negotiation between stakeholders that generate feedback mechanisms for adaptive management.

Operating silos

Implementation may also be being impeded because of a reluctance among individuals and institutions to operate outside of their regular realms of operation and expertise, more critically it is only through strategic partnerships that such integration can be effective. Researchers have long promoted the need for integration (Barrett, 1992; O'Riordan, 1998; Sayer & Campbell, 2001; Merrey *et al*., 2005; Frost *et al*., 2006; Scherr & McNeely, 2008; Sunderland *et al*., 2008; Sayer *et al*., 2013) and yet remain entrenched within their own disciplinary silos (Kinzig, 2001; Barlow *et al*., 2011; Stucki & Smith, 2011). Likewise, multiple sectors represented within the landscape have traditionally maintained sectoral objectives, whether that is be to satisfy agricultural, forestry, tourism, energy, resource extraction or sociocultural demands. At the national level, ministerial silos also exist with a typical administrative structure containing separate ministries for forests, agriculture and energy, for example. To bridge the knowledge–implementation gap, a greater willingness to work across disciplinary, sectoral and political silos must be displayed. There is, however, considerable cause for optimism in this regard, with the continued support for interdisciplinary research, and the emergent field of sustainability science (Kates *et al*., 2000; Clark, 2007).

Finally, donors and project sponsors are also reluctant to break from traditional norms with a tendency to support projects at small spatial and temporal scales. Clearly, to fulfil the objectives of an integrated landscape approach, either longer term commitments from donors must be sought or alternative mechanisms for financing sustainable landscapes be put in place. Established funding donor cycles are inherently maladapted to fully support a truly integrative landscape approach, and a paradigm shift is required to alter how donors see and rate outcomes of implementations. This emphasizes the need for some simple and understandable landscape metrics that will enable stakeholders to evaluate progress and make informed decisions for future management (see below).

Internal/external engagement

The landscape approach encourages full participatory engagement from the outset (Frost *et al*., 2006; Harvey *et al*., 2008; Sayer *et al*., 2013); by bringing stakeholders together and understanding what their specific expectations of the landscape are, which ecosystem goods and services it provides and how optimal land-use strategies can be formulated. Such participatory engagement – underpinned by facilitation, negotiation and compromise – is a key tenet of the approach, and therefore, it is vital that this process is performed with due consideration. All too often, attempts at engaging local stakeholders have merely served as a box-ticking exercise to satisfy the requirements of the project. A German Technical Cooperation Agency (GTZ) study noted that insufficient allocation of resources into project design

led to hasty implementation, resulting in local stakeholders lacking the capacity to understand or implement the concepts (Soulivanh *et al*., 2004). German *et al.* (2007) describe how community meetings were organized with the intention of engaging stakeholders. However, community members were ill-prepared to attend due to lack of time (insufficient notice) or resources (meetings held in inaccessible locations). Furthermore, those that were able to attend did so only to find the meetings conducted in a language they were unable to understand or that pre-existing demographic or social hierarchies prevented adequate engagement. The authors go on to stress that the conducting of, and attendance at, community fora must not be recognized as an adequate 'proxy for true participation'.

A landscape approach must attempt to not only understand the basic needs of local stakeholders but to foster empowerment of community members. By providing local stakeholders an active voice in the design and management of the landscape, it can be determined what people want and expect, rather than what they are prepared to accept (Costanza, 2003). However, caution must be applied as the literature is replete with examples of poorly contextualized interventions with good intentions resulting in outcomes far removed from the objectives. For example, Cao *et al.* (2009) describe how reformation of property rights returned 90% of forests to individual farmers with the intention of alleviating forest degradation, only for farmers to exponentially increase transformation of their newly acquired forests; Carpentier *et al.* (1999) outline how tripling the market value of Brazil nuts (a pro-conservation extraction product) did not lead to – the anticipated – reduction in forest loss, as households invested their additional income in cattle ranching leading to increases in deforestation; finally, the classic acceleration example shows forest dependent communities investing in chainsaws with predictable outcomes (Wunder, 2001).

Inclusive consultation will also assist in aligning the often multi-scale objectives of internal and external land users. External stakeholders often encompass corporate entities whose role in the landscape is one of economic bottom lines that often run counter to rural development and environmental objectives. Commonly, these can include ecotourism, mineral extraction, agri-business, logging or industry. Equally, an external stakeholder may be promoting pro-environmental interventions, which may or may not be appealing to rural communities, such as large-scale reforestation programmes; UN REDD+ pilot projects; agroforestry initiatives; climate-smart, organic or sustainably intensive agriculture projects. For external stakeholder driven land-use projects to be achievable and sustainable, a degree of consensus among landscape inhabitants is necessary. Communities will need to be engaged and this will ordinarily take the form of co-operation, co-investment or compensation. A landscape approach can be applied to address specific landscape challenges, both existing and novel. By selecting appropriate landscape principles, positive synergies can be identified and inevitable trade-offs better accounted for, enabling the identification of the optimal form of engagement for community members.

Aligning external and internal objectives and capacities is a significant challenge for effective implementation of a landscape approach (Chia & Sufo, 2015). However, 'identifying and managing, rather than avoiding social conflict' can assist in achieving mutually beneficial outcomes (Keough & Blahna, 2006). Recommendations to improve equitable input towards landscape design and sustainable, long-term engagement include: participatory land-use planning (PLUP) (Pfund *et al*., 2011; Castella *et al*., 2014), participatory mapping (Chambers, 1994; Boedhihartono & Sayer, 2012), forum groups (Colfer & Pfund, 2011) and semi-structured interviews (Watts & Colfer, 2011) to name a few already well-established examples. Furthermore, the literature suggests that developing a mechanism to facilitate negotiation between stakeholders' aids progress, with numerous examples where committees comprising both internal and external stakeholders have been instrumental in contributing to successful participatory involvement (Curtis & Lockwood, 2000; Lebel & Daniel, 2009; Scherr *et al*., 2012). In these cases, the committee tends not to have any formal authority, rather they advise on basic planning, conflict resolution and budget or decision-making processes (Lebel & Daniel, 2009).

It is now well recognized that landscapes may provide the workable space for addressing inter-connected global challenges (Wu, 2013; Bustamante *et al*., 2014; Estrada-Carmona *et al*., 2014; Milder *et al*., 2014; Mbow *et al*., 2015). However, without sufficient political and private sector support, landscape approaches may not be fully realized. Should this be the case, the landscape approach may fall into the traps of preceding approaches and fall out of favour before meeting – what the authors here see as – the high potential for tackling global challenges (see: Redford *et al*., 2013). A 2012 Global Canopy Programme (GCP) report found that from an annual budget of $52 billion committed to conservation efforts, only $10 billion came from the private sector – with over $6.5 billion of this accounted for by 'green commodities', natural products carrying sustainable or fairly traded certification for example (Parker *et al*., 2010). Clearly, there is considerable scope to close the gap between private and

public sector investments in landscape initiatives. To this end, the research community must persevere with efforts to provide convincing evidence-based research that illustrates the potential for investment in sustainable landscapes.

Monitoring

Monitoring is the least developed area of landscape approach application (Lebel & Daniel, 2009; Sunderland *et al*., 2013), and the recognized need to establish more effective systems of monitoring is consistent throughout the literature. A number of articles refer to either the lack of efficient monitoring systems (Gruber, 2010) or state the requirement for their development in order for landscape approach interventions to succeed (Tallis *et al*., 2008b; Scherr *et al*., 2012). Adaptive management is a key tenet of a landscape approach (Sayer *et al*., 2013). Fundamental to successful adaptive management is the production of metrics that contribute to feedback mechanisms that inform stakeholders and guide decision-making processes (Holling, 1978; Noss, 1990). Put simply, without quantifiable and measurable data, evaluation of progress within the landscape would be indeterminable, feedback loops would fail, adaptive management would be unachievable, and landscape approaches would thus be ineffective.

Landscape monitoring is an inherently challenging task. The size and complexity demand significant intellectual willingness, and financial, institutional and human resource commitments (Singh *et al*., 2014). Despite the general lack of frameworks for data collection and landscape evaluation, a body of theory is beginning to develop. Researchers have developed a number of tools and indices in recent years (Bebbington, 1999; Bond & Mukherjee, 2002; Aldrich & Sayer, 2007; Sayer *et al*., 2007; Belcher *et al*., 2013) and the emergence of participatory approaches to landscape monitoring and evaluation are encouraging – as mentioned in the preceding section. Although participatory approaches may lack some credibility with scientists (Sandker *et al*., 2010) when well applied, they have the capacity to cost-effectively generate the necessary data for project implementers to identify impacts and project beneficiaries to be further empowered through increased engagement. Ideally, landscape approaches should be assessed along a minimum of four dimensions – environmental protection and restoration; sustainable production; livelihoods security; and institutional capacity/governance (J. Sayer, A.K. Boedhihartono, L. Buck, B. Campbell, A. Dale, C. Elliott, P. Gunarso , K. Kusters, M. Lane, P. Minang, A. Purnomo, H. Purnomo, J. Reed, R. Riggs, J. Langston, T. Sunderland, unpublished). Efficient management, negotiation and decision-making can then help to identify the sub-level indicators of these four dimensions that will be most applicable to the given landscape context. Achieving the right balance of broadness and specificity is vital to ensuring both stakeholder capacity and sufficient scientific rigour. Meanwhile, a further challenge lies in how to maintain the motivation of local people towards participatory monitoring processes, especially once project cycles and funding streams conclude.

Linking the landscape approach to global policy dialogues

As a further output of our literature screening we attempted to identify where a landscape approach displayed potential to significantly contribute towards the fulfilment of the goals of existing or forthcoming international policy dialogues. Specifically, we have focused

Table 4 Aichi goals and targets that have been identified as being likely to benefit from utilization of the 10 principles of the landscape approach. For a full list of the specific targets refer to the CBD website (https://www.cbd.int/sp/targets/)

10 Principles of a landscape approach	Aichi strategic goal most likely to benefit	Aichi target(s) most likely to benefit
Adaptive management and learning	E	17, 18, 19
Common concern entry point	E	4, 17, 18
Multiple scales	A	2, 4, 11
Multi-functionality	D	4, 14, 15, 16, 19
Multiple stakeholders	E	4, 14, 17, 18
Negotiated, transparent change logic	A	1, 4
Clear rights and responsibilities	D	4, 14, 16, 18
Participatory user-friendly monitoring	A, B, D	1, 2, 4, 17, 18
Resilience	C	9, 12, 13, 14, 15
Capacity building	E	1, 17, 19, 20

Strategic Goal A: Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society.
Strategic Goal B: Reduce the direct pressures on biodiversity and promote sustainable use.
Strategic Goal C: To improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity.
Strategic Goal D: Enhance the benefits to all from biodiversity and ecosystem services.
Strategic Goal E: Enhance implementation through participatory planning, knowledge management and capacity building.

on two international commitments: 1. The Aichi targets and 2. The Sustainable Development Goals (SDGs), and mapped where the ten principles of the landscape approach (Sayer *et al.*, 2013) display overlap with the objectives of these commitments.

The Aichi targets are a set of 20 targets, established by the UN Convention on Biological Diversity (CBD), that are central to global efforts to preserve biodiversity with commitments from 193 countries until the year 2020. A key objective of the landscape approach is to ensure landscape resilience (Sayer *et al.*, 2013). Therefore, a landscape approach to biodiversity conservation, applied appropriately and contextually, has the capacity to contribute to all of the 20 Aichi targets (Blackie & Sunderland, 2015). Key to the success of a landscape approach for the Aichi targets would be to align the most suitable landscape principles to each specific target. Table 4 illustrates how many of the Aichi goals and targets would benefit from the ten landscape principles.

A key outcome from the Rio+20 conference was a commitment from the member states to produce a set of global goals that – using Agenda 21 and the Johannesburg Plan of Implementation as a framework – will supersede the Millennium Development Goals. The recently adopted Sustainable Development Goals will guide the post-2015 development agenda. After many months of speculation and canvassing from various sectors for inclusion of their recommendations within the goals, a set of 17 goals encompassing 169 related targets were unanimously ratified in September 2015 by 193 UN member states (see: www.sustainabledevelopment.un.org). It is made explicit in the document that 'holistic and integrated approaches to sustainable development' are required; however, many of the goals retain a sectorial focus. Forests and biodi-

Table 5 Specific Sustainable Development Goals where the landscape approach can be applied to various degrees. Levels of applicability were determined by examining all the drafted sub-goals (169 targets) and applying the same classification. The applicability scores presented here are an average take from the larger list of sub-goals. The full matrix that assesses the applicability of the landscape approach to each of the 169 targets is included in the supplementary material

Goal number	Sustainable development goal description	Landscape approach applicability
1	End poverty in all its forms everywhere	Important
2	End hunger, achieve food security and improved nutrition and promote sustainable agriculture	Important
3	Ensure healthy lives and promote well-being for all at all ages	Relevant
4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	Relevant
5	Achieve gender equality and empower all women and girls	Relevant/Not applicable
6	Ensure availability and sustainable management of water and sanitation for all	Vital
7	Ensure access to affordable, reliable, sustainable and modern energy for all	Relevant
8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	Relevant
9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	Relevant
10	Reduce inequality within and among countries	Relevant
11	Make cities and human settlements inclusive, safe, resilient and sustainable	Relevant
12	Ensure sustainable consumption and production patterns	Relevant
13	Take urgent action to combat climate change and its impacts	Important
14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development	Important
15	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	Vital
16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	Not applicable
17	Strengthen the means of implementation and revitalize the global partnership for sustainable development	Relevant

Vital = Goal unlikely to be achieved without a landscape approach.
Important = Landscape approach would be a suitable framework for achieving these goals.
Relevant = Goals could benefit from adopting the philosophies of the landscape approach.
Not applicable = Landscape approach unlikely to be applicable.

versity are covered in the 'environment' goal (number 15), while hunger and health are covered in goals 2 and 3, respectively. Despite this, there is very clear overlap between the goals identified and the objectives of a landscape approach (Table 5). It is implicit that the majority of the goals are inter-connected and the landscape approach would likely be the most suitable framework for achieving many of the stated goals or at least the targets would benefit by being addressed through a landscape lens.

Conclusion and recommendations

A landscape approach is a multi-faceted integrated strategy that aims to bring together multiple stakeholders from multiple sectors to provide solutions at multiple scales. It can be broadly defined as a framework to address the increasingly widespread and complex environmental, economic, social and political challenges that typically transcend traditional management boundaries (Reed *et al*., 2015). By ensuring the equitable and sustainable use of land, a landscape approach is a potential mechanism to alleviate poverty in an equitable manner, conserve biodiversity, safeguard forests, sustainably manage natural resources, while maintaining food production and mitigating climate change.

By synthesizing the fragmented evidence base on landscape approach theory and conceptualization, we reveal that despite significant progress the landscape approach theory remains incomplete and barriers to implementation persist. By learning from past experiences and highlighting the areas that require attention, we hope to provide the basis for the development of an improved landscape management framework. Theoretically, a landscape approach framework that incorporates lessons learnt should be the primary overarching tool, fundamental to achieving global environment and development objectives and overcoming the inherent challenges therein. Implemented to their full potential, landscape approaches should encourage coordinated commitment to a given landscape and bridge disciplinary and sectoral divides. We have shown that the literature is replete with calls for more integrated approaches. Overlaps between landscape approach philosophies, the Aichi targets and the SDGs should in theory provide a convincing case for donors, policymakers and researchers to commit to well-funded and well-designed long-term, large-scale implementation of landscape-scale initiatives.

Further research into the design and application of landscape approaches is still required, with a particular focus in the areas of monitoring and evaluation. Moreover, a greater degree of integration between disciplines and stakeholders operating within landscapes is needed to further the progress made in truly synthesizing the socio-economic and environmental challenges within these complex systems. As such, this study is both an attempt to clarify the current position of integrated landscape research and an invitation for future collaboration to better align current thinking with future policy and local realities on the ground.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Table S1. The breakdown of the sub goal scoring for Table 5.