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Structuring the complexity of integrated landscape approaches into selectable, scalable, and measurable attributes

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ABSTRACT

Integrated landscape approaches (ILA) aim to reconcile multiple, often competing, interests across agriculture, nature conservation, and other land uses. Recognized ILA design principles provide guidance for implementation, yet application remains challenging, and a strong performance evidence-base is yet to be formed. Through a critical literature review and focus group discussions with practitioners, we identified considerable diversity of ILA in actors, temporal, and spatial scales, inter alia. This diversity hampers learning from and steering ILA because of the intractable nature of the concept. Therefore, we developed a tool—an 'ILA mixing board'—to structure the complexity of ILA into selectable and scalable attributes in a replicable way to allow planning, diagnosing, and comparing ILA. The ILA mixing board tool presents seven qualifiers, each representing a key attribute of ILA design and performance (for example, project flexibility, inclusiveness of the dialogue, and the centrality of the power distribution). Each qualifier has five (non-normative) outcome indicators that can be registered as present or absent. This process in turn guides planners, evaluators and other participating stakeholders involved in landscape management to diagnose the ILA type, or its performance. We apply the ILA mixing board to three ILA cases in Nicaragua, Madagascar, and the Congo Basin to show some of the many possible configurations of qualifiers on the mixing board. Further application of the tool would allow comparative analysis of the complexity of ILA in a structured and manageable way thereby enhancing the understanding of ILA performance and informing the development of evidence-based land use policy.

1. The challenges of implementing integrated landscape approaches

Humanity is facing combined and unprecedented challenges related to climate change, environmental degradation, and biodiversity loss, while food insecurity and poverty continue to be the daily reality of millions of people (Díaz et al., 2019; Hoegh-Guldberg et al., 2019). These global challenges fuel intensifying conflicts over land use creating trade-offs on ecological, economic, and social outcomes across scales, and across different groups of people (Löfqvist et al., 2023; Meyfroidt et al., 2022). The resulting governance challenges, often referred to as 'wicked problems', are highly complex, often interconnected and further compounded by the diversity of temporal and spatial scales of processes, feedback loops, and stakeholders they involve (Balint et al., 2011; DeFries and Nagendra, 2017; Rittel and Webber, 1973).

At the landscape level, integrated landscape approaches (ILA) seek to

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address such wicked problems (Reed et al., 2014; Scherr and McNeely, 2008). ILA go beyond sectoral approaches by engaging multiple stakeholders typically in multi-stakeholder negotiation platforms that integrate policy with practice in attempts to address social, environmental, economic, and political drivers (Foli et al., 2018). While there is no single definition of ILA, interpretations generally revolve around the concept of landscape multifunctionality, aim to tackle numerous challenges by balancing multiple (and sometimes contradictory) interests, ideally build on synergies, identify and consider trade-offs (Chia and Sufo, 2016; McShane et al., 2011; Milder et al., 2014; Pfund, 2010; Ros-Tonen et al., 2014). In this article we use the term ILA for activities that fall under this set of concepts and area management goals. Through a multi-sectoral, multi-actor approach ILA are considered a holistic approach, equipped to identify, inform and enact better solutions (Erbaugh and Agrawal, 2017; Reed et al., 2016; Scherr et al., 2013). Our paper intends to accommodate the diversity of ILA. Nevertheless, we belief that minimal criteria need to be fulfilled to call an approach an ILA: 1) a clear reference to an area of land, 2) it considers interactions between biophysical and social processes, and 3) it intends to address management challenges. From this follows that actors may apply approaches which can be considered ILA but using different concepts and terms, such as Integrated Resource Management or Living Labs. It is beyond the scope of this paper to define and distinguish often overlapping social-ecological concepts.

Stakeholder engagement is a critical component of ILA (Ros-Tonen et al., 2018). ILAs acknowledge the dynamic nature of landscapes and emphasize stakeholder negotiation, trade-off analysis, and adaptive management as mechanisms to increase benefits and decrease costs across all stakeholders (Sayer et al., 2013). Facilitated platforms play a crucial role in the identification of potential synergies and trade-offs among stakeholders. By building a participatory theory of change, these platforms help in the development of a shared vision for landscape management, as highlighted in studies by Ros-Tonen et al. (2018) and Reed et al. (2022). Adaptive management processes are then implemented through regular and ongoing negotiation, which allows for continuous reflection and enhancement of synergies while seeking alternative implementation strategies to alleviate trade-offs (Sayer et al., 2015).

In recent decades, ILA have been increasingly invested in across the international environmental and development realms (DeFries and Rosenzweig, 2010; Kremen and Merenlender, 2018; Reed et al., 2020b). To further facilitate their implementation, recent research has developed guiding principles (Arts et al., 2017; Bürgi et al., 2017; Djenontin et al., 2018; Ros-Tonen et al., 2018; Sayer et al., 2013), typologies (Carmenta et al., 2020), governance evaluation mechanisms (Kusters et al., 2018) and decision-support frameworks (McGonigle et al., 2020). Together these contributions emphasize the importance of adaptive management, stakeholder involvement, and the challenge and imperative of reconciling multiple objectives. Yet there remain considerable challenges due to the complexity of ILA, suggesting the need for a tool that facilitates a quick yet informative self-reflection and performance assessments by landscape leaders, implementers, and partners.

An influential contribution concerning principles of best practice in ILA (Sayer et al., 2013) defines ten principles that should enable a landscape approach to reconcile agriculture, nature conservation, and other competing land uses. The principles cover diverse elements such as embedding learning and adaptive management, soliciting and addressing common concerns, recognizing the relevance of multiple scales among others. Despite this widely recognized framework of principles, persistent implementation, evaluation, and adaptive management challenges remain (Pedroza-Arceo et al., 2022; Vermunt et al., 2020). Common causes of the 'ILA complexity gap', inter alia, include existing sectoral divides (Reed et al., 2020a), insufficient monitoring and impact assessments (Sayer et al., 2017), underrepresentation of certain impact domains (Carmenta et al., 2020), inadequate engagement of diverse stakeholder groups (Reed et al., 2019), and dealing with the long-time planning horizon (Estrada-Carmona et al., 2014; Zanzanaini et al., 2017). Because of these challenges, many landscape initiatives struggle to transition from theory to practice and lack generalizable learning after implementation (Reed et al., 2017; Sayer et al., 2017). This challenge between concept, implementation and knowledge is particularly visible when there is lack of consensus, for instance on the appropriate spatial scale, configuration of actors or what constitutes equitable distribution of resources (Reed et al., 2020a; Ros-Tonen et al., 2021; Ros-Tonen and Willemen, 2021).

This paper introduces the ILA Mixing Board Tool, a scalable and transferable approach designed to help stakeholders evaluate landscape approaches in a structured manner. The tool aims to facilitate planning, decision-making, and assessment of ILA goals by categorizing complexity and providing a structured evaluation framework. The paper is divided into three main sections. Section 2 describes the tool's development including seven key planning dimensions, the development of qualifiers for each dimension and the link with the ten ILA principles (Sayer et al., 2013). Section 3 applies the tool to three case studies, demonstrating its practical application and potential for ILA project planning, which is then discussed more generally in Section 4. The ILA Mixing Board Tool provides a valuable resource for project managers and stakeholders to understand the complexities of a specific ILA and make informed decisions towards achieving ILA objectives. Likewise, the ILA Mixing Board Tool will facilitate cross-learning across landscapes and contexts by enabling the implementation of a scalable and transferable method. Future steps include quantifying ILA assessments and evaluations, currently limited to qualitative measures.

2. Developing a scalable and transferable tool for planning and evaluating ILAs

The design of the ILA Mixing Board Tool followed a comprehensive and robust scoping process that synthetized information from focus group discussions with practitioners and researchers, literature reviews and expert assessment and included five sequential steps (Table 1).

2.1. Scoping

The first three steps were part of a scoping process to 1) identify the most salient gaps that inhibit progress towards ILA implementation; 2) identify key dimensions (such as learning, scope, accountability) from management and planning realms to 3) develop guiding questions which are relevant for dialogues between stakeholders within and about landscapes. These questions were then linked with the ten principles (Sayer et al., 2013) through scalable, actionable, and measurable gradients. For the first three steps, foundational focus group discussions (FGD) were held in June 2021 and a parallel literature review was performed June – August 2021. These FGD included ten experts from CGIAR and partners, doing research and practice on ILA, who participated in two 4-hour online workshops. Part of the FGD was to evaluate scientific literature on best practices in the context of on-the-ground experiences. The collective expertise covered A) tropical geographies (Latin America, sub-Saharan Africa, Southeast Asia), B) over 100 years of cumulative project management experience, and C) inter- and transdisciplinarity (with topical focus on landscape management, agriculture, human geography, ecology, agronomy, economics, social anthropology, social and political sciences). During the FGD, the experts proposed and discussed relevant literature. The literature review was therefore not systematic but based on the collective experience of the participants. In addition to the proposed literature, the authors searched for additional sources based on forward and backward citations. The literature review was used to identify key dimensions in natural resource management—including planning and decision-making—which were then discussed again in a second FGD with the experts. In this way the final qualifiers were agreed on.

In Step 3, as an outcome of the earlier discussions, we developed

Table 1
Five sequential methodological steps for designing and developing the ILA mixing board. The ILA mixing board is a tool that facilitates planning or assessment and evaluation of integrated landscape approaches (ILA).

Step	1 - Gaps	2 - Planning	3 - Principles	4 – Tool assemblage	5 Tool application
Objective	Identify gaps in ILA implementation	Define relevant planning dimensions	Link principles (Sayer et al., 2013) with planning dimensions through key questions	Define ranges and switches to turn dimensions into qualifiers that constitute the mixing board	Apply mixing board to case studies
Method	Focus group discussions, ILA literature review	Focus group discussions; Review of key management and planning literature	Focus group discussions	Focus group discussions; Review of literature on ILA and landscape management	Expert-based assessment
Key terms		*Dimensions* = Key Management Concepts	*Principles*= Ten principles for a landscape approach (Sayer, 2013)	*Qualifier*= Row of the mixing board tool corresponding to one dimension, consisting of five switches. *Range*= range of values that a qualifier can take. *Switches*= basic unit of the mixing board that can be switched on an off.	*Mixing board tool*= consists of seven qualifiers each with five switches and one gauge (which will change position based on the configuration of activated switches)

seven main qualifiers relevant for landscape approaches (Fig. 1), each rooted in a concept from the natural resource management and planning realm. The connection between Sayer et al.'s (2013) 10 ILA principles and the qualifiers was based on common themes and underlying guiding questions. The seven qualifiers of the mixing board are: *Learning* as part of systems thinking from operational research (Checkland, 1985); *motivations* for environmentally relevant actions as part of behavioral economics (Brekke et al., 2003; Carlsson and Johansson-Stenman, 2012); *scope* as part of multi-objective landscape management (Estrada-Carmona et al., 2014), which includes scales (e.g., temporal, spatial) (Berkes, 2000), stakeholders directly and indirectly shaping the landscape (Freeman, 1984) and functions (e.g., ecological processes) (Naveh, 2001); *power distribution* as part of participatory processes (Arnstein, 1969; Ratner et al., 2022), *inclusiveness* related to collective action (Fraser, 2009; Ostrom, 2000), *accountability* as the institutional part of decision-making processes (Willemen et al., 2018), and *risk management* as part of forward-looking landscape planning approaches (White et al., 1997).

2.2. Tool assemblage

In Step 4 we defined the range of each qualifier based on the potential most contrasting responses to the guiding questions. Five non-normative sub-units (switches) were assigned and labeled for each qualifier, supported by a critical literature review to increase robustness (Zhang et al., 2023). The literature review was performed using Google Scholar and Web of Science, with keywords based on Sayer et al.'s (2013) 10 ILA principles and qualifiers (Supplementary Table S1) proposed during the FGD. To ensure the transferability of the switches to various contexts, we provided general labels that can be applied in different fields such as landscape and land use planning, conservation science, water resources management, and urban planning (Table S1). The switches aim to facilitate a quick yet informative self-reflection and performance assessments by landscape leaders, implementers, partners.

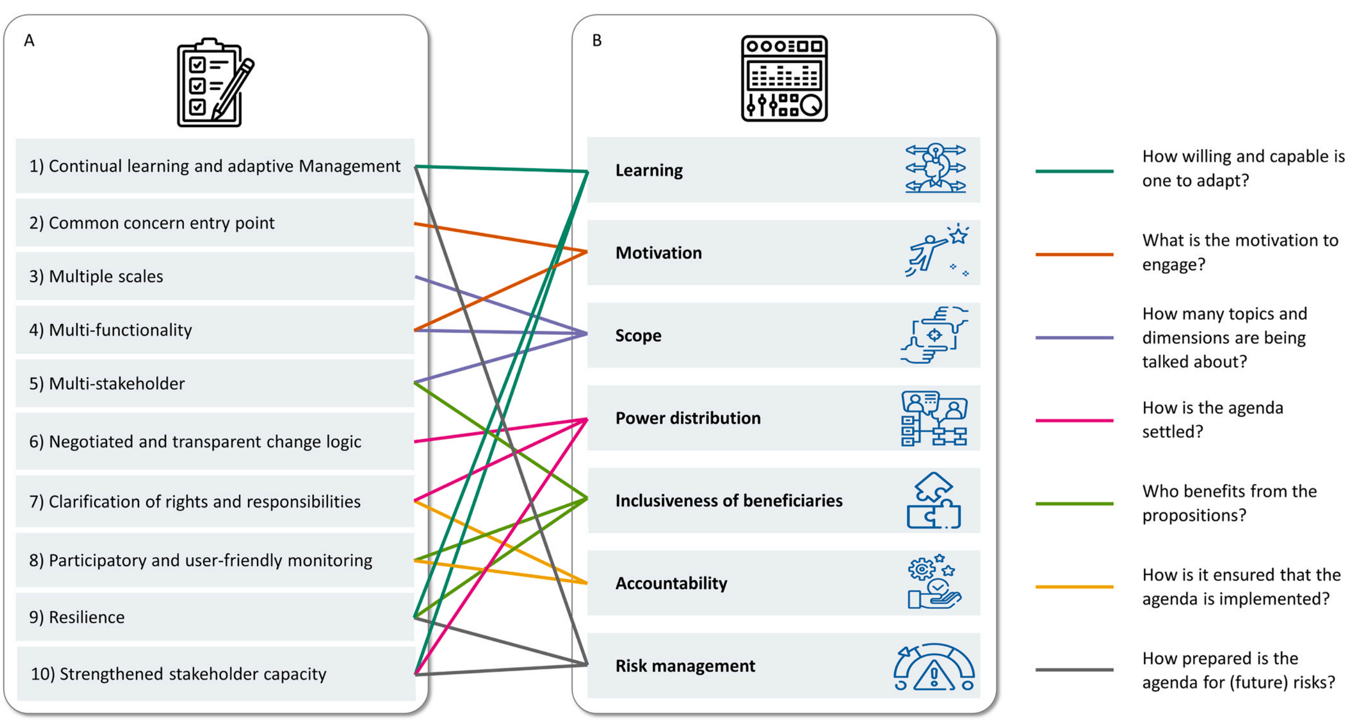

Fig. 1. Developing a mixing board tool for ILA planning or assessment and evaluation. Linking the ten principles (A) of landscape approaches (Sayer et al., 2013) with the seven qualifiers (B) used to develop the ILA mixing board tool. Qualifiers are based on guiding questions derived from the natural resource management and planning literature (color coded). Icons
Source: Flaticon.com.

The draft levels for all dimensions were then again shared with the experts who commented on them and proposed revisions.

2.3. Tool application

Finally, in Step 5, we took the ILA Mixing board tool and tested its applicability to three completed and ongoing projects (Nicaragua, Madagascar, Congo-Basin). The three landscape approaches contrast in scope, geography, spatial and temporal scales, theoretical framework, and methodologies and so demonstrate the wide range of applicability of the seven qualifiers and 35 switches that embody the overall mixing board. We evaluated the case studies based on the literature and our own (authors FK, CG, PW) previous and current involvement in these landscapes. The emerging case descriptions and judgements on the ILA dimensions reflect rather subjective impressions of the case experts based on longstanding transdisciplinary work. Our analysis demonstrates an approach of critical reflection based on situated knowledge and published material. Being transparent about the unavoidable subjective perspective of the cases applications, we contribute to designing more powerful ILA assessment tools through informed arguments (Greenhalgh et al., 2018). This post-hoc evaluation process consisted of turning switches on, while allowing more than one switch per qualifier if needed. The resulting position of the gauge is based on the average location of the switches from left to right. The overall complexity (e.g., orchestrated coordination or monitoring at the landscape level) of the ILA is based on the average position of all seven gauges. The more the gauges are towards the right side of the board, the higher the complexity of the ILA, which comes both with costs and benefits (Anggraeni et al., 2019; Spangenberg et al., 2015) that are not further defined within the scope of this study.

2.4. The ILA mixing board tool

The ILA tool with its qualifiers, switches, and gauges (i.e., ILA characteristics, Fig. 2, see Supplementary Material for details) relate to the project landscape under scrutiny. The qualifiers of learning, motivation and scope are classic planning dimensions (Fig. 3)—how to approach the landscape in this context? The **learning** qualifier relates to questions around flexibility and certainty/uncertainty of the beliefs held by those leading, i.e., planning and managing, the ILA: Are the working hypotheses defined and predetermined based on other experiences and landscapes, or is the project entering the unforeseeable system with the epistemology of grounded theory to discover an emerging theory (Levers, 2013)? For example, the extreme case of a “white canvas” refers to a stage of open exploration and creativity in the planning process where there is a blank slate to work with, and no predetermined or existing frameworks or structures to follow. The **motivation** qualifier implies motivations and interests (Edmunds and Wollenberg, 2001; Lang et al., 2012; Schmidt et al., 2020): Why engaging in the landscape and what motivation brings together different stakeholders? Does the project address specific threats (e.g., flood risk), or needs (e.g., more agricultural output); or does it follow explicit targets (e.g., community based management areas), is the project based on principles (e.g., the polluter pays principle), or does it follow a broad mission (“Forests for all forever”, an example by FSC, 2017)? The **scope** explores the breadth and depth of the ILA project (Cumming et al., 2015; García-Martín et al., 2016; Hurlbert and Gupta, 2015): How and who defines the challenges or problems, or how broad is the discussion? How many topics, spatial scales, ecological functions, or different stakeholder groups are being included and targeted in the planned ILA? The range goes from one or very small, to few, main, many, and ends with all and everything.

The qualifiers of power and inclusion (Fig. 3) deal with the project relations—who are the people to consider and what are their interactions with the project? **Power** is defined here as the potential to influence the process (Arnstein, 1969; Barletti et al., 2021; Hadorn et al., 2006). The names of the switches are to be understood as technical terms, as modus operandi where the level of participation describes the stakeholders’ contribution to and interaction with the project and ultimately reflects their decision-making power. The qualifier of **inclusiveness** refers to the perspectives, foci or knowledge systems considered by the project (Löfqvist et al., 2023; Riggs et al., 2018). The range spans between the me and the us, and moves along the ladder from individual, tribe, the others, to everyone (e.g., the wider social system), and everything (e.g., people and the environment). At the minimum end, an ILA can focus on “my own company, my own plantation”; on the opposite end, an ILA considers the interests of all living beings and things.

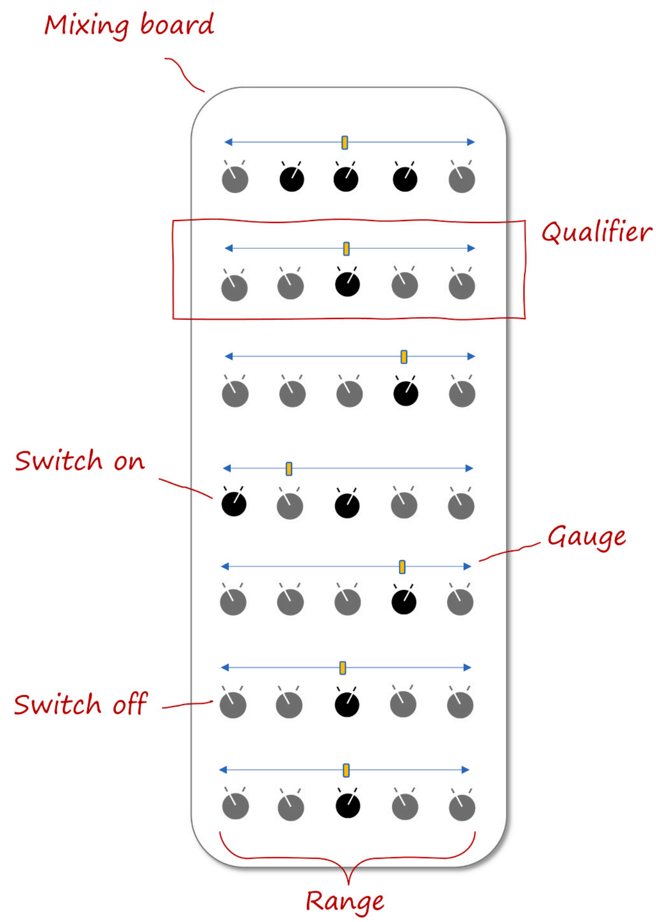

Fig. 2. Annotated scheme of the mixing board. The 5-point scale of switches is not meant to represent the psychometric responses of a Likert scale (viz., highly disagree, disagree, neutral, agree, highly agree); it is also not to be mistaken with commonly used normative star-rating systems such as for hotels, but simply follows this established number of levels.

The qualifiers of accountability and risks refer to the governance of a project. The **accountability** qualifier deals with the proximate levels of project implementation. The qualifier range that we are referring to spans from horizontal accountability, which pertains to agreements between relatively equal stakeholders or institutions (cf. O’Donnell, 1998), to vertical accountability, which pertains to relationships between parties with uneven power dynamics. Its switches contain types of accountabilities that are commonly referred to (Lindberg, 2013; Willemen et al., 2018). The **risk management** qualifier refers to the management of a key component of intractable problems. How does a project account for inherent future risks? The qualifier ranges from inert (reductionism with identified cause-effect relationships and predictable sub-systems) to agile (a system consisting of high numbers of interconnected and interacting components with unpredictable emerging characteristics, Chester et al., 2021). The switches span from rigid

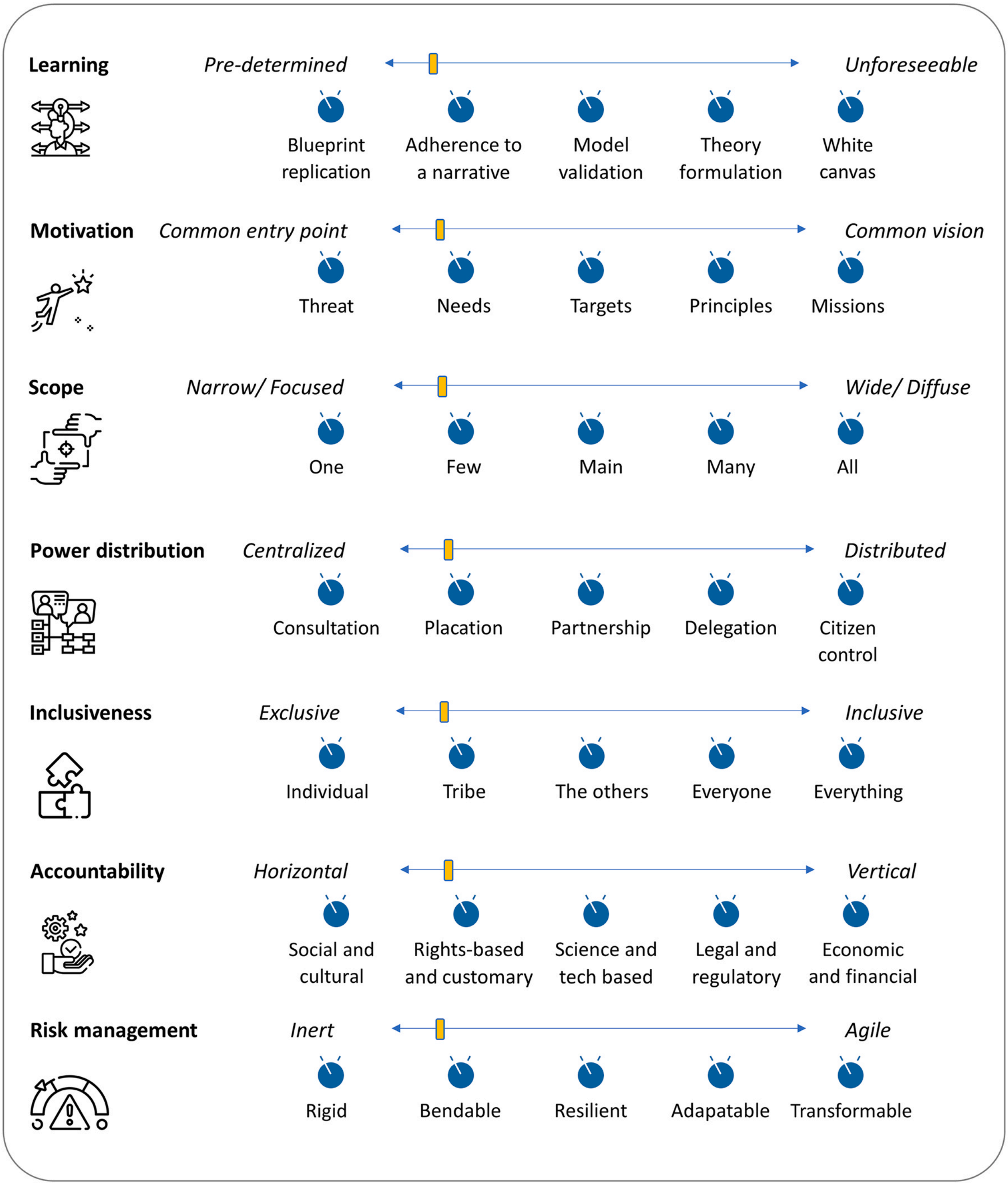

Fig. 3. ILA mixing board tool. Each of the seven planning or assessment qualifiers are in turn linked to five switches to be activated in response to the ILA characteristics. Depending on the number and configuration of activated switches, the gauge (yellow shape on the blue line) will move between two extremes of the qualifier range. All the elements listed here are to be understood as descriptive in nature and not as normative goals. The ranges do not represent from worst to best or vice versa; they are non-judgmental and value neutral. See Supplementary Material for additional explanation of terms and foundation in the literature. Icons Source: Flaticon.com.

(increased vulnerability to risks and change, Gunderson and Holling, 2002) to bendable (an attribute that is less vulnerable to risks than the previous one but which is not as ready to absorb shocks as its switch to the right), resilient (the capacity to absorb shocks while retaining functionality, Walker et al., 2004), adaptable (the capacity to influence resilience, Folke et al., 2004), and transformable (the capacity to embody risks and fundamentally change the system, Folke et al., 2010).

3. Application of the mixing board to ILA cases

In this section, we apply the mixing board tool to three case studies in tropical landscapes in a post-hoc way to illustrate its utility for ILA assessment and reflection (Fig. 4). This qualitative assessment provides a means of comparing different ILAs despite their diversity. After presenting the case studies, we evaluate the tool as a comparative approach and a boundary object, highlighting its potential strengths and limitations.

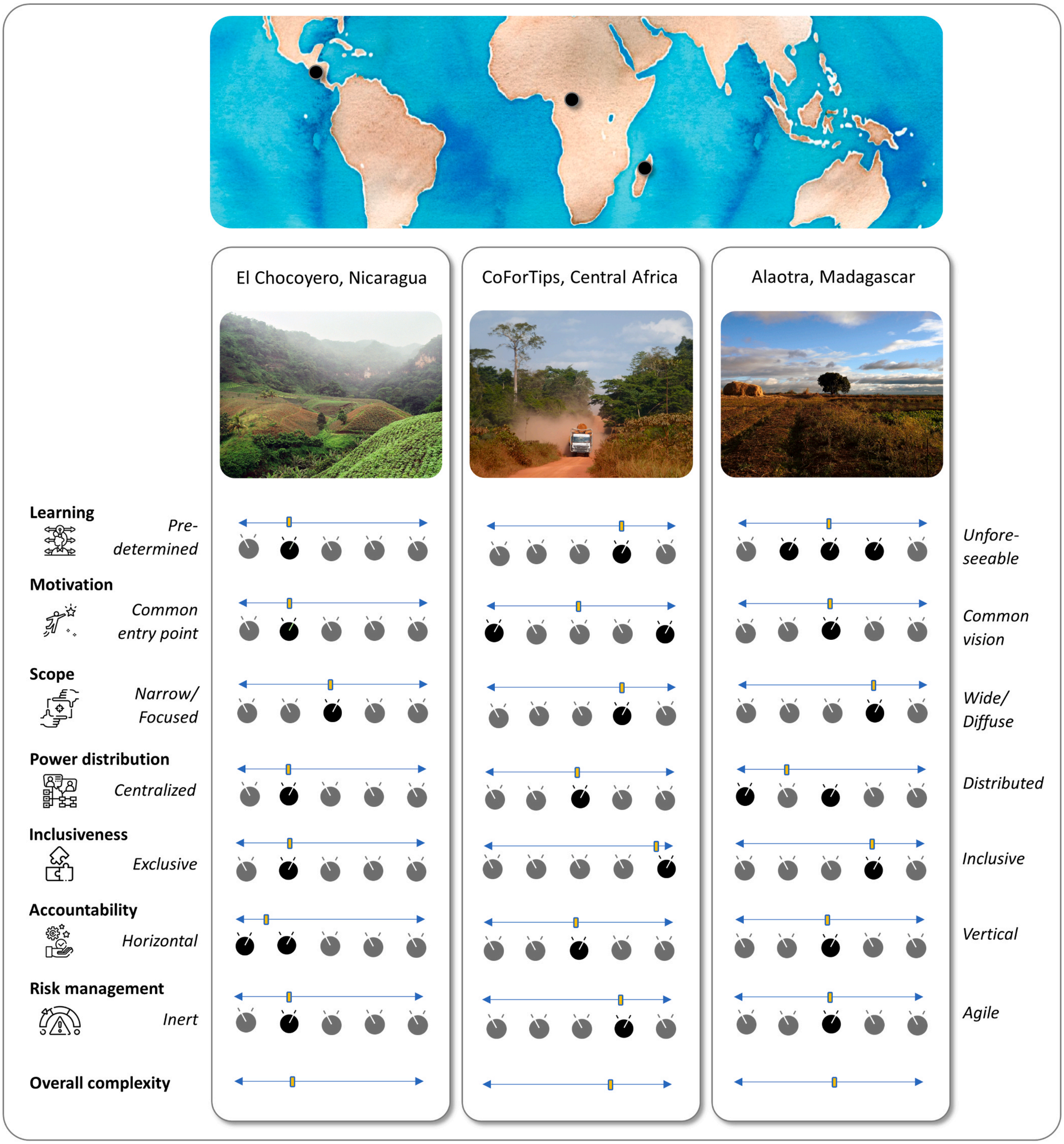

Fig. 4. Application of the ILA mixing board tool for post assessment. The cases represent different spatial and temporal scales and differ in their socio-economic characteristics. The switches are turned on (dark) or off (gray) according to case assessment. The gauge position depends on the active switches. To handle the ILA mixing board tool familiarity and expertise with respective projects are required. Pictures Nicaragua and Central Africa: FK, picture Madagascar: Arnaud De Grave, EcoPalimpseto(Photo)Graphies // Le Pictorium agency. Icons: Flaticon.com. Map tiles by Stamen Design based on OpenStreetMap.

3.1. The Nicaragua case

The Chocoyero-el-Brujo nature reserve in the municipality of Ticuantepe in Nicaragua is administered by the local agricultural cooperative Juan Ramón Rodríguez, consisting of 36 pineapple and coffee farmers with their fields in the surroundings of the reserve (Kreimann, 2017). The reserve contains water sources that are used by two community-based initiatives that access, distribute and maintain local water resources (CAPS, Comité de Agua Potable y Saneamiento, Romano, 2017) to bring water to the communities of El Eden and Los Rios, benefitting a population of around 5000 people (Kreimann Zambrana and Acevedo Jirón, 2006). Ecologically, the nature reserve is known for a large population of endemic pacific parrots (*Aratinga strenua*), nesting in a cliff inside the forest (Castañeda Mendoza et al., 2004). It was a conscious decision of both the cooperative and the CAPS to actively protect the forest from agricultural conversion and encroachment to conserve and manage the water resources together and at the same time generate incomes from ecotourism, mostly from domestic visitors from the nearby capital Managua (pers. obs.). Here, the ILA consists of the coordination between conservation, land use and water management within the communities and their self-administered decision-making bodies in an equitable manner. The common necessity to distribute and conserve available water is what originally motivated and continues to sustain the ILA. Accordingly, the learning dimension is *adherence to a narrative* and the motivation is based on *needs*. The scope of the approach includes the *main* actors and elements of this social ecological system (Kreimann, 2014). The overall power distribution is at the *placation* level, as most people in the community benefit from the landscape as water users. Yet not all members have an equal say in the negotiations, and marginalized groups and women are underrepresented in the process (Kreimann Zambrana and Acevedo Jirón, 2006). The inclusiveness is therefore at the *tribe* level. Accountability is mostly ensured through *social and cultural, rights-based and customary* approaches. Overall, the initiative cannot be considered fully resilient, due to the way conflicts are handled when resource availability becomes more severe (Kreimann, 2017). The risk management strategy is at the *bendable* level.

3.2. The Congo Basin case

CoForTips (Forest of the Congo Basin: Resilience and Tipping Points) worked to foster better management of the forests and landscapes in the Congo Basin. The project was led by a coalition of research institutions and NGOs including WWF Central Africa and IUCN between 2014 and 2018. The learning level chosen by the project at the onset was *theory formulation* and it remained at this position throughout most of the project. The loss of rainforest was an emerging issue in the Congo Basin at the time of drafting the project (Scholes and Biggs, 2010), while the level of threat on biodiversity had been comparatively low compared to other regions in Africa, given low human pressures, low rates of endemism and large species distribution areas (Burgess et al., 2006). The motivation that brought people together was the long-term perspective and the *mission* to ensure better management for the landscapes of the region. Some individual components had necessarily a narrower focus (e.g., alternative livelihood strategies of local Bantu farmers to changes in their landscape). The interdisciplinarity of the project and the set of project partners, however, ensured that the scope of the project consistently kept a *many* if not *all* approach to the landscape dialogues (Garcia et al., 2022). The participatory modeling approach in the project design (Barreteau et al., 2003) empowered stakeholders to define research questions, select study sites and identify target beneficiaries. Yet, the flow of funds to certain partners was restricted by funding agencies' rules. Hence, the appropriate descriptor for the power and control qualifier is *partnership*. The strong emphasis of the project on collectively building scenarios for guiding decision-making positions the accountability descriptor as *science and tech based* contributing also to an *adaptable* strategy for managing risk (Kleinschroth et al., 2019).

3.3. The Madagascar case

AlaReLa (Alaotra Resilience Landscape) was a 'research for development' academic project (2013–2017) which aimed to understand how the landscapes in the Alaotra, the fish and rice production center in NE Madagascar, are shaped. The approach was one of exploration through participatory modeling, where room was given for surprises to emerge and for learning (Reibelt et al., 2019). The learning approach was characterized by both *adherence to a narrative* and *model validation* (Bodonirina et al., 2018; Reibelt et al., 2019). Given the advanced environmental destruction (Lammers et al., 2015), combined with increasing hardship for the average rural resource users to maintain a livelihood (Copsey et al., 2009a,b; Rakotoarisoa et al., 2016; Rakotoarisoa et al., 2015), the project motivation was at the *target* level. The specific aim was to reduce degradation of the Lake Alaotra wetlands, which are crucial for the fish stocks (Pidgeon, 1996), endemic biodiversity (e.g., *Hapalemur alaotrensis*, the sole primate on earth to live permanently in marshes, Waeber et al., 2018a), and for meeting an increasing demand for water for agricultural production (Ferry et al., 2009). The entry level of the project was set at *main* representing a medium range scope. The project ended up with a clear understanding of few specific cases only, such as perception towards conservation (Reibelt et al., 2017; Waeber et al., 2018b), or gained an understanding of the attitude towards forest governance in the Zahamena (IUCN I) protected area (Bodonirina et al., 2018), or the rice value chain, from production to local, regional, and national markets (Ravaka et al., 2019). The project invested twelve months engaging with various groups of stakeholders to learn about the Alaotra landscapes and drawing on different strands of knowledge. In this way, the relevant problems were identified together with different stakeholders, across multiple levels of power. During the project, the researchers collaborated with more than 1000 resource users and 30 decision makers in over 100 workshops and meetings. The stakeholders primarily included fishers and farmers, but also miners, charcoal producers, and market sellers. Though AlaReLa project came much closer to reaching its main goal of understanding the Alaotra SES, it did not encourage any policy changes.

4. Discussion

4.1. Comparative appraisal

The ILA mixing board tool provides an almost universally applicable framework for a large variety of situations without oversimplifying, as illustrated by the three case studies. It is not the purpose of the tool to compare across ILAs, but it does allow the degree of complexity addressed in the design and practice of each ILA to be assessed and could enable cross-learning. Increased complexity comes with higher implementation costs. A bottom-up, long-term community-based initiative, such as the case in Nicaragua, might not be able to afford the costs of embracing full complexity. In contrast, a research-driven project such as the one in the Congo Basin was designed as a short-term approach to embrace a high degree of complexity. The mixing board tool allows the evaluation of such highly contrasting ILAs and provides visual clues that trigger the imagination of people involved about which aspects they want to improve.

To take stock of the many ILA done around the globe, and to avoid common mistakes with future projects, appraisal is a commonly accepted way to identify drivers and barriers to implementation and effectiveness (Antrop, 2000; Carmenta et al., 2020; Vermunt et al., 2020). With the ILA mixing board tool, both comparative appraisal between ILA, as well as inward looking appraisal are made possible. This type of assessment is useful if we are to learn from the numerous ILA operating around the world. In the previous examples, the ILA mixing board tool has been used by experts highly familiar with the projects to zoom into three specific and finished projects, to operate the switches and read the gauges. The tool not only highlighted the diversity of the projects (by setting the switches), but its gauge function allowed to emphasize a key aspect which would elude assessment when focusing on details only: while the Nicaragua project's gauges are mostly to the left of the complexity range, the Central Africa project gauges are mostly on the opposite end of complexity; the Madagascar example is somewhere in between. The tool also evidenced a shared commonality of the projects: All our case studies illustrate larger underlying institutional and governance issues that were left unresolved or were not addressed, which hampered the overall impact of the projects. The use of the ILA mixing board can create awareness of such issues and nudge management towards resolving them.

While we consider the ILA mixing board to be a boundary object or concept (Westerink et al., 2017) to facilitate consensus on project planning or evaluation and to set project targets, it does not challenge the underlying institutional conditions. With the help of the mixing board tool, we were able to juxtaposition the three cases despite totally different socio-economic, political, environmental, and cultural realities, and different project ambitions, goals, and consortiums. As a tangible and dynamic tool, the mixing board can help clarify common misconceptions about ILA and provide alternative ways of thinking and talking about the integration issues of landscape approaches. ILA are not about physical landscapes so much as they are about what people (e.g., resource users and decision-makers) say about a landscape and how they say it. This is important, because landscapes are not only physical spaces, but they include people's sense of place, based on perceptions and narratives (Kleinschroth et al., 2021; Verbrugge et al., 2019). Landscape boundaries can be both biophysically determined and social constructions that can be developed upon biophysical discontinuities (Pfund, 2010; Rose and Wylie, 2006).

4.2. The Mixing Board Tool as a boundary object

Integrated Landscape Approaches have been supported by many international organizations (Freeman et al., 2015), but challenges remain on how to best address the complexity gap, especially in the absence of universally acceptable definitions of ILA. The proposed mixing board tool for ILA planning, assessment and evaluation helps to characterize and structure inherent complexity. With limited resources but growing pressure to find solutions to wicked problems, evidence is key for increasing future efficiency in the context of landscape approaches (Downey et al., 2021; Pullin and Knight, 2009; Tengö et al., 2014). Efficiency is gained by learning from past mistakes and avoiding them in the future. The mixing board tool systematically describes ILAs to allow for such learning.

The advantage of the ILA mixing board tool are its intuitive switches, making it accessible to all people involved in landscape decision-making. In other words, this mixing board tool can also be used as a boundary object for stakeholder discussions (sensu Star and Griesemer, 1989; Star, 2010). It can increase stakeholder engagement as per Arnstein's participator ladder (Arnstein, 1969), which has the potential to increase a project's legitimacy and thus ownership within affected communities (Mathur et al., 2008). Such meetings can identify potential barriers to ILA implementation and allow for timely mitigation measures (Holcombe and Anderson, 2010; Jemberu et al., 2018). The type of reflection can enable stakeholders to discuss together how they may want to reorientate the ILA and define what progress they would like to see in coming years (Garcia et al., 2022).

4.3. Limitations and future research

Generally speaking, additional deliberate effort is needed to activate more switches on the mixing board, and different configurations of landscape features and associated governance systems call for contextualizing the way the landscape approach is conducted. Further, ILA come with other challenges that remain outside the capacity of our tool: difficulties engaging the private sector (Estrada-Carmona et al., 2014; Reed et al., 2020a), lack of funding and institutional support (García-Martín et al., 2016; Zanzanaini et al., 2017) or overlapping incompatible policies and structures (Forsyth and Springate-Baginski, 2021; Vermunt et al., 2020) to list some aspects of the ILA complexity gap. The most prominent aspects of it, however, can be addressed by the framework presented here. A caveat of the ILA mixing bord as a project assessment and evaluation tool is that the decisions, whether by experts or by stakeholders, on turning a switch on or off are only based on what has happened so far and has changed over time. For example, we do not know how 'bendable' risk management of an ILA project would be in the face of a war, or an immense drought. Further, the tool does not allow to simulate projections into possible or plausible futures (sensu Lindgren et al., 2003).

While it often seems detrimental to have landscape approaches that seem to somehow 'muddle through', some degree of this is inevitable (Lindblom, 1959; Sayer et al., 2008). The best laid management plans cannot account for black swan events, the COVID-19 pandemic or the Ukraine-Russia war being timely cases in point. Bringing the mixing board into practice can help planners and decision-makers to think beyond often misconceived logframes (Sayer and Wells, 2004). For example, the ten principles by Sayer et al. (2013) can be ticked off like in a tick list while it might remain unknown to what extent a principle has been fulfilled or addressed (Sayer et al., 2017); alternatively, project planners may opt for selective "cherry picking" from the principles. To attenuate such risks, the ILA mixing board tool, which covers and embraces all principles, with tangible and scalable attributes, ensures that ILA planners consider every aspect of project management.

The ILA mixing board tool sets the path for additional analysis that could seek to explore how outcomes are related to the position of the mixers, and to the various combinations. What combinations should be a target in a particular landscape? Or in situations of conflict? It is not the focus of this paper, however, to quantify how frequent the different configurations of the switches are, or how they co-vary. These valid questions are left for future research. Applying the mixing board tool to the three case studies—Nicaragua, Central Africa, Madagascar—illustrates the levels of nuance that are needed given existing overlaps and uncertainties in practice and at the same time justifies the chosen degree of generalization.

5. Conclusions

Researchers and practitioners all agree there is no one-size-fits-all approach to landscape approaches (Bennett and Satterfield, 2018; Sayer et al., 2017). The ILA mixing board tool caters for this diversity, by allowing for a high number of configurations. Some problems require more complexity to be embraced, while others require more focus (Boedhihartono et al., 2018; Gardner et al., 2009). In other words, there is not one right way to conduct an ILA. Application of the mixing board tool can raise awareness of the contextual issues faced in the landscape and direct management towards identifying appropriate responses. We see the ILA mixing board tool as a way to systematically describe the large diversity of ILA for enabling cross-learning and better supporting ILA while leading to more informed choices about the allocation of available resources and guidance for context-specific implementation of ILA into practice.

CRediT authorship contribution statement

Conceptualization: PW, FK, CG, AF; Formal analysis: PW, FK; Funding acquisition: FK; Methodology: all; Project administration and supervision: FK; Validation: all; Visualization: FK; Writing – original draft: PW, FK; Writing – review & editing: all.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.envsci.2023.06.003.

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