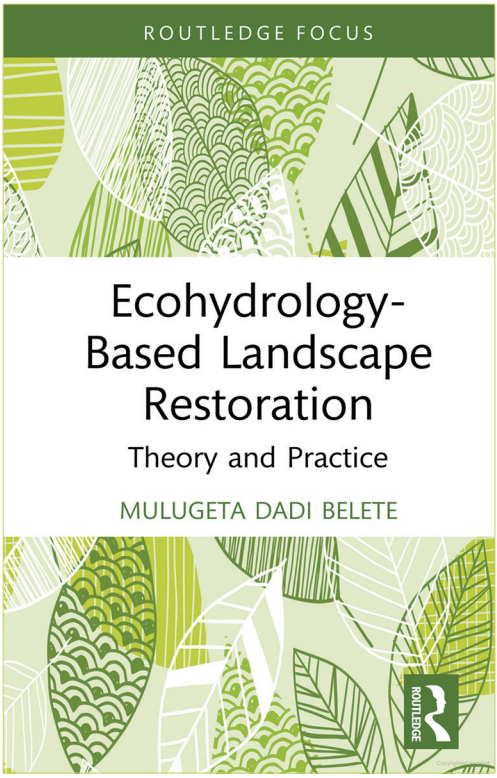
BOOK REVIEW SECTION

Belete, M.D. (ed.): Ecohydrology-Based Landscape Restoration. Theory and Practice. Abingdon–New York, Routledge, 2024. 180 p.

Managing, maintaining and restoring natural landscapes is challenging worldwide, as human activity has significantly altered our environment. Efforts to restore natural conditions and conserve biodiversity and ecosystems are increasing. However, the effectiveness of these activities is always a key question. Efficient solutions require a holistic approach and a comprehensive understanding of how our environment operates. As the environment is a complex system, a systems approach and collaboration between different disciplines can help to find appropriate solutions for its conservation and sustainable use. The growing trend towards applying nature-based solutions is certainly a way forward in this respect.

The present book contributes to this problem by presenting the EcoLAR (Ecohydrology-Based Landscape Restoration) approach, which provides a solution for sustainable natural resource management and landscape rehabilitation. This concept was developed by Ethiopian researchers who recognised that integrating the ecohydrological approach is essential for effective landscape management. They intended to develop a new methodology to address Africa's growing and unsolved problem of landscape degradation. Accordingly, the book focuses on typical African landscapes in water-limited regions and provides practical suggestions for their management.



And why ecohydrology? Ecohydrology combines ecology and hydrology to understand water-biota interactions and to use this knowledge for environmental management. As water and ecosystems are determining part of the landscape their impact on the landscape cannot be neglected. Considering the combined role of ecosystems and water is forward-looking in landscape management and can lead to more efficient solutions.

The reviewed book is edited by Mulugeta Dadi Belete, the sole author of eight chapters of the nine. He is an Ethiopian university professor and a practitioner. His co-authors in Chapter 4 are university researchers from Ethiopia, while the main author of the chapter, Johannes Zerihun Negussie has a government background. Their various backgrounds influence the book's content and structure. The book contains both a theoretical approach and a description of the related practical solutions. The first three chapters present the EcoLAR approach, explain its theoretical background, and provide a possible workflow and a decision tool for different landscape types. The last chapters focus on solutions for different landscape types and case studies from Ethiopia illustrating the methods and demonstrating their applicability. Therefore, the book can be useful for practitioners, especially in African countries, but academics may find it also interesting, as the concept is well applicable to other regions.

The first chapter is about the „philosophical background" of the concept. It starts with a literature review summarising the main challenges in terms of landscape restoration, including the actual management strategies and solutions. According to the description, the concept of landscape restoration is continuously evolving from a mechanistic, engineering approach towards a more ecological concept. However, there are still some limitations to these ap-

proaches, and to fill this gap, the author and his contributors tried to find a complementary method to the existing „mechanical" practices to „ecologically re-engineer" them into a more efficient solution. The main idea involved ecohydrological consideration and the use of water-biota interactions to rehabilitate the landscapes more effectively.

The concept is fundamentally rooted in the ideas of previous researchers (e.g. Zalewski, M. *et al.* 2003) and it is a combination of existing methods and principles. The main theory is based on the following four statements: (1) hydrological and ecological processes follow the Trigger-Transfer-Reverse-Pulse logical framework (Ludwig, J.A. *et al.* 2005), so they influence each other in a circular system, (2) regulation of hydrological systems can control biological processes, (3) ecosystems can impact and regulate water conditions, and (4) at landscape scale the regulating effect of water and biota on one another is an effective tool to establish or maintain good conditions („dual regulation"). These statements are aligned with the principles of ecohydrology. In the EcoLAR concept, the first task is the regulation of the water flow (abiotic component – achieved by hydromechanical solutions), after the water availability facilitates the establishment of the biotic ecosystems (biotic component – achieved by „place-based and used inspired plantation"), which feeds back into the water flow component. Finally, the whole system can maintain itself. The construction of this system follows the green-(semi)grey infrastructure concept, where the grey component is the engineering solution, and the green component is the ecohydrological factor. The practice follows the engineering design principles (Bergen, S.D. *et al.* 2001), complemented by new elements such as minimum earthwork, use of local materials and application of indigenous knowledge. According to the author, this new approach can give answers to the limitations of the existing conventional methods, e.g. over-engineering of the environment, lack of system approach, and lack of consideration of dual regulation of water and ecosystems on the landscape.

Having established the need for the concept, Chapter 2 summarises the main principles of it from planning to realisation. Seven guiding principles were set up, which relate to the planning phase (1), the target-setting (2–3), management (4–6) and implementation (7) of the theory. The first principle states that hydrological and ecological systems need to be considered as basic management units of the concept. The second principle emphasises the need for local stewardship building to involve local people, stakeholders and actors in the activities. The third principle states that the parameters of the WBSRCE (water, biodiversity, ecosystem services, resilience, culture and education) system need to improve simultaneously by the regulation of ecohydrological parameters, using nature-based solutions and circular and bio-economic considerations. The fourth principle points out that regulating hydrological features is the first task, and then ecosystem restoration can begin once an adequate water supply has been established. Principle five says that the involvement of ethno-engineering solutions (local indigenous solutions) is highly recommended during the management phase. Principle six states that building a green-(semi) grey infrastructure (planned network of natural and seminatural features) as an „eco-hydrological systemic solution" is the way to reach the dual regulation of water and ecosystems in the landscape. Principle seven emphasises the need for adaptive learning, replication and up-scaling of successful actions to further improve the practice and concept. At the end of the chapter, the new concept was compared to the existing approaches to represent its wider scope.

Chapter 3 describes the conceptual plan for the proposed green (semi-)grey infrastructure construction based on ecohydrological considerations and presents the possible implementation of the concept in different landscapes. The conceptual plan was elaborated for a sloping environment, where the first objective is to regulate the hydrological factor which can be achieved by increasing water retention. Water retention can be realised in many ways depending on the conditions of the area. The author focused on capturing surface runoff, as it is the main water source under the Ethiopian climatic and topographical conditions. In the given example, surface runoff is controlled by semi-permeable wooden barriers in a gently sloping environment. This solution allows water retention and ensures water and nutrient cycling for ecosystems. The processes involved in the intervention will firstly regulate overland flow to ensure a more stable water supply to vegetation and improved infiltration. The second step is to plant vegetation in the area adapted to the water availability and local conditions. As a final step, the dual regulation of the water system and ecosystem can build up. This process can also work in different environments and landscapes. The book considers those, which are typical in Ethiopia, as hillslopes, sloping farmlands and gullied landscapes. To find the possible solution for these environments, a decision supporting flowchart was compiled.

In the following chapters from 4 to 8, the implementation of the concept is presented in the abovementioned landscapes. In Chapter 4 Negussie, J.Z. and his collaborators summarise the experiences of the application of the green-(semi)grey infrastructure in a hillslope environment. The applied practice follows the run-off-run-on theory of Ludwig, J.A. *et al.* (2005) where the surface runoff is controlled to retain and conserve water and nutrients on the hillslope. It is solved by wooden structures with bamboo mats

(grey infrastructure) constructed along the topographical contours. This way water is captured in run-on patches, where vegetation is planted (green infrastructure) and the established ecosystems will be able to regulate the surface runoff and increase infiltration. The effectiveness of this solution was proved by a case study from Ethiopia with a landscape functionality analysis.

Chapter 5 focuses on the sustainable management of farmlands with the EcoLAR approach. In this case, the basis of the solution is the sustainable land management (SLM) concept, which is combined with the terrestrial ecohydrological principles. The system has two elements, the physical structure – bamboo matted wooden cross-slope barriers – as in the conventional solutions and the place-based and need-driven plantation. First the biota benefits from the structure, later – when the plantation overtakes the regulation role of the physical barriers – dual regulation will form. The solution is presented in a case study, where the appropriate distance between the physical structures was calculated based on the shear strength, slope length and seepage saturation.

Chapter 6 concentrates on gully networks, gully erosion and landslide problems in gullied landscapes. Gully head, gully bed and gully bank are proposed to be treated differently. In the case of the gully head, a plunge-pool system is suggested, where the energy dissipation and the vegetation growth are happening together – it can be implemented by bamboo-matted plunge-pool construction and vegetation planting. In gully beds, a step-pool system is proposed, which operates as a spontaneous, self-organized system of high stability in the stream bed environment – check dams in stream beds try to simulate this natural phenomenon. In the case of curving systems, spurs (dykes, groynes) can rehabilitate the sharp curves to decrease erosion, control flow direction, create an erosion-free zone, and help biota establishments. In the case of wide gullies in-stream plantations are proposed to narrow the gully and the gully bank becomes a plantation site.

Chapter 7 is a literature study on the role and possible use of vegetated riparian buffer zones as the „last line of defence" regarding water resources in landscape management. The benefits and optimal design of these zones are detailed from different perspectives. Based on the proposal, the main elements of the system, i.e. the width of the area and the vegetation zonation need to be adapted to the investigated area and the objectives to be achieved.

Chapter 8 deals with wetlands and wetland ecosystems as parts of the landscape. Wetland protection, management and restoration is a key activity worldwide. As several concepts and proposals exist in the literature, a comprehensive wetland management framework was established to characterise and synthesise wetland management strategies and actions. This is the PREE (Preservation, Restoration, Enhancement, Establishment) framework, where different stages of wetland management and the connected activities are distinguished. It provides help for actors, especially in developing countries, to find the most appropriate solution or combination of solutions for sustainable wetland management.

Chapter 9, the final chapter, summarises the whole content of the book and the EcoLAR approach and methodology highlighting its novelty in landscape management.

In summary, the book provides a detailed insight into the problem of landscape degradation and possible solutions in water-limited African landscapes, where surface runoff is the most important source of water. The authors place great emphasis on explaining the theoretical background of their new concept and demonstrating the significance of the ecohydrological approach. This part seems a bit long and detailed compared to the chapters on case studies, which are more focused and illustrate the proposed interventions well. In my view, the proposed EcoLAR concept is a synthesis of existing theories and methodologies rather than a completely new approach, however, it offers a novel combination of existing concepts. The application of ecohydrological knowledge in the rehabilitation of water-dependent ecosystems or wetlands is a well-known practice (e.g. Wassen, M.J. and Grootjans, A.P. 1996). Still, for water-limited degraded landscapes, the involvement of ecohydrology, in particular, the dual regulation effect of water and ecosystem in landscape management is novel and forward-looking. The practical solutions presented in the book are based on these considerations, illustrated in a variety of African landscapes. It would have been interesting to read more about the sustainability of the proposed systems, especially the long-term maintenance of water supply under changing climatic conditions, which is necessary for the survival of ecosystems. Although the proposed practices have been developed in typical arid environments in African countries, the theory can be applied to other climatic and environmental conditions. Nevertheless, in humid climates, the groundwater conditions need to be better considered, and the main water-related challenges are also different.

Overall, the book is highly recommended for both scientists and practitioners who are interested in landscape restoration, as this combined methodology can provide good ideas for comprehensive and effective solutions in every part of the world.

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