613

Mind the gap: Integrating rangeland ecology into management requires more than just knowledge dissemination

Vetter, S[1]

[1]Department of Botany, Rhodes University, Makhanda 6140, South Africa

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Abstract

Rangelands are social-ecological systems that provide multiple ecosystem services, including livestock production. To sustain the services rangelands provide, it is crucial to integrate rangeland ecology into their management. However, the reality is complex, as rangeland management reflects human choices and values, is informed by different kinds of knowledge, and is constrained or enabled by various policy, governance, environmental, social and economic factors. In this context, how can rangeland ecology contribute more effectively to sound rangeland management? For ecological knowledge to guide management, it must be communicated effectively, accepted as valid, and viewed as trustworthy. However, what constitutes "true" knowledge and appropriate management of rangeland systems is very often contested. Reconciling and integrating local or indigenous knowledge with scientific knowledge is important for a shared understanding of management challenges and solutions, but tends to be challenging and unfamiliar for both rangeland ecologists and land managers. Historical legacies and biases among researchers and land managers can also create significant barriers to the acceptance and implementation of new ecological insights. The inherent uncertainty and debate within ecology, while necessary for advancing knowledge, can lead to confusion or mistrust among managers and policymakers. Additionally, the management implications of ecological knowledge in a system may not align with the values, objectives, and perceptions of land users or decision-makers. Integrating rangeland ecology into management thus requires dedicated work and collaboration between scientists and practitioners at all stages of the process from identifying problems, through co-creating and integrating knowledge, to finding solutions.

Introduction

Rangelands are social-ecological systems that provide essential ecosystem services, including livestock production, biodiversity conservation, and carbon storage (Briske & Coppock 2023). Their long-term sustainability thus requires management based on appropriate ecological principles. Rangeland ecology and related ecological fields (e.g., vegetation dynamics, herbivore population and behavioural ecology) are well-developed, and much of this research is motivated by the need to understand and manage the ecological dynamics of rangelands better. Yet many rangelands across the globe and under a variety of tenure and management systems are described as mismanaged, degraded and vulnerable to global change, despite concerted efforts at informing, resourcing and developing their stewardship (UNCCD 2024). The long and ongoing debate around desertification in arid rangelands is a case in point, with powerful crisis narratives persisting and driving the policy agenda, and interventions aimed at stabilising inherently variable systems, despite mounting evidence that the reality is more nuanced (Behnke & Mortimore 2016). I argue that this

disconnect is not simply a matter of communicating knowledge or educating land users, but reflects deeper issues related to how knowledge is produced, perceived, applied, and valued by different stakeholders. Scientific knowledge must not only be disseminated but also accepted, trusted, and considered relevant by those making management decisions Wilmer et al. 2021). Historical biases, institutional inertia, competing values and interests, and substantial power differentials between role players further complicate the process of integrating ecological knowledge into practice (Utter et al. 2021).

When rangeland ecology fails to inform appropriate management

A number of possible scenarios can account for misalignment between rangeland ecology and management. The first step towards better alignment is to identify which scenario we are dealing with, and the reasons for it.

1. Lack of uptake because the knowledge is flawed

There is a long and growing list of cases where the ecological knowledge guiding interventions is inappropriate to the local ecological dynamic, land users' objectives, or altogether. This includes applying models developed for different ecological contexts without testing their validity, or applying altogether outdated and disproven knowledge. For example, the notion that drylands are the result of deforestation by nomadic pastoralists, which resulted in their climate aridifying, was widely held in the 19th century (Davis, 2016). The solution was "reforestation" and other interventions such as irrigation to "green" the deserts. These actions have often caused salinization of soils, lowering of water tables, and invasion of fast-growing exotic tree species such as Prosopis. Ironically, more often than not the "solution" to the resultant resource degradation consists of more cycles of the same misguided interventions (Davis, 2016). Land users resist because the proposed interventions do not work in their context, or because scientists and policy makers make the wrong assumptions about problems that need to be addressed. Often the historical origin of these pervasive narratives has long been forgotten but careful analysis reveals flawed logic that has been transmitted uncritically over generations (Davis 2016; Davis and Robbins 2018).

2. The knowledge is sound, but it is not applied

This is often assumed to be the case when scenario 1 is actually the explanation. In other cases, however, the ecological dynamic and its management applications are well understood and agreed on, but not applied by land users. Possible reasons include lack of trust, or misunderstanding; but very often there are economic, institutional, policy and/or logistic impediments. For example, while flexible stocking approaches are ecologically appropriate in variable climates, the relative optimality of fixed vs tracking strategies depends on a range of factors including climate variability, access to markets, property rights regimes, market stability and prices (Campbell et al. 2006), and requires a supportive policy environment. Land users and policy makers may also prefer simple, rule-based approaches that aim for stability over adaptive strategies that require continuous monitoring and adjustment.

3. The knowledge is poorly supported but popular among land users and policy makers

When knowledge is poorly supported, land users are generally less likely to embrace it than policy makers and advisers; but there are examples where land users adopt management based on poorly or incompletely supported science. Again, reasons for such a scenario can vary. It may be a case of very persuasive and dedicated proponents or incentives. The practice may have proven successful in some contexts and applied in contexts where it is not appropriate; or rooted in tradition but no longer suited to current contexts.

For example, despite scientific criticisms, holistic planned grazing (Butterfield et al 2006) remains popular in many regions. Its compelling narrative offers a hopeful solution to land degradation, it aligns with ranchers' economic interests, and it appeals to conservationists and agriculturalists (Bennie et al 2024). Anecdotal success stories from individual practitioners have reinforced its credibility, even in the absence of consistent scientific validation (Hawkins 2017). The success of this approach in gaining widespread acceptance highlights the role of active promotion, personal experience, and economic incentives in shaping management decisions.

4. The appropriate solution is unknown or uncertain

Sometimes management problems defy current understanding of the system. Fires are known to suppress woody vegetation, yet a regularly burned rangeland is steadily becoming more encroached. An invasive species has taken over and nothing seems able to bring it under control. Years of resting have failed to improve the condition of a rangeland dominated by unpalatable grasses and shrubs. Often the reason is that the situation is novel – for example, elevated atmospheric CO_2 has changed the frequency and intensity of disturbance required to suppress shrubs (Bond & Midgley 2012; Ripley et al. 2022), and the formerly open grassy vegetation would require management actions that are no longer feasible or economical.

When rangeland ecology informs management

For all of the above possibilities, there is also the possible – and ideal – scenario that the available knowledge is ecologically sound and is applied successfully, whether in the form of a traditional system that has managed to maintain its desired features, or in the form of management consciously adapting in response to changing conditions and scientific input. This raises the question of what the factors are for success, especially if applying such knowledge means changing land users' practices substantially.

In the ideal scenario, the land manager understands and trusts the proposed management actions, a scenario that becomes more likely if they played an active role in identifying the problem and co-producing the knowledge underpinning the solutions (Wilmer et al 2021). This scenario is also more likely if management draws on land managers' existing practices and own knowledge, or is at least compatible with their knowledge system, and less likely if the management intervention is provided by outside experts with little local knowledge. Local knowledge can also help bridge separate and at times antagonistic fields of scientific knowledge, as in a case where herders' knowledge of cattle foraging behaviour helped integrate rangeland ecology (concerned with animal nutrition) and conservation ecology (concerned with avoiding biodiversity loss) by developing herding strategies that harmonized these different objectives (Molnár et al 2020).

The inherent uncertainty and debate within ecology, while necessary for advancing knowledge, can lead to confusion or mistrust among managers and policymakers. Success in solving management problems is more likely if risk and uncertainty are (or are perceived to be) low, or at least balanced by the benefits; land users in an already precarious economic situation, and who lack reliable safety nets are likely to be more risk averse and wary about adopting management practices that they have no direct experience of. Land users who have the agency and resources to implement the changes are more likely to adapt and succeed; communally managed rangeland with poorly functioning governance institutions, or where conflicts over land use exist, face much greater challenges, especially where factors such as dispossession, resettlement or constraints to mobility have heightened local conflicts over resources (Vetter 2013).

Ideally, management actions yield benefits quickly, providing the feedback that stimulates their continued implementation. The unpredictable and climatically variable nature of many rangelands tends to obscure trends and can cause setbacks (or apparent success in a good year that is not sustained in other years) and this can make evaluating and adapting management challenging. Rangeland ecologists can draw on data and literature from long-term studies to provide evidence while designing local studies and the communication around them in ways that are appropriate to their dynamic nature.

Integrating knowledge systems, knowledge co-creation and transparently negotiating trade-offs

Despite this complexity, a few general important lessons emerge.

1) It is important to be clear about the objective(s) of the land management and to ensue that the solutions actually aim to achieve these. This requires a common shared understanding of the social and ecological dynamics and constraints of the rangeland system, and achieving this requires sustained engagement, trust, and knowledge co-creation (Wilmer et al 2021).

2) Trade-offs are inevitable (e.g. plant biodiversity vs beef production vs carbon sequestration) and need to be transparently addressed. Misleading narratives of unrealistic win-win scenarios may impress donors and the

global public but can leave pastoralists losing out to carbon forests or "fortress" conservation (Fleischman et al. 2021).

3) Different stakeholders and role players often have very different objectives and understandings of the ecological dynamics of the system; differentials in economic and political power often influence which objectives and paradigms hold sway, and these are very often not the pastoralists' own objectives or knowledge system, leading to failed or unsuccessful implementation (UNCCD 2024).

Reconciling and integrating local or indigenous knowledge with scientific knowledge is important for a shared understanding of management challenges and solutions, but tends to be challenging and unfamiliar for both rangeland ecologists and land managers. Rangeland users – such as pastoralists, ranchers, and indigenous communities – rely on experiential and traditional knowledge systems that may differ from scientific interpretations. These knowledge systems may be rooted in cultural practices and long-term observations of the land, but which almost everywhere have had to adapt to drastically changing circumstances including climate change, land dispossession, restriction of mobility, stock reduction schemes and other interventions. Successful integration of ecological insights into practice thus requires active collaboration starting with problem identification, an openness to multiple knowledge systems, and an appreciation for the values and constraints that influence land users' choices (Utter et al. 2021; van Ewijk and Ros-Tonen 2021). The International Year of Rangelands and Pastoralists (IYRP) aims to address these issues, through raising awareness of the diversity and value of different pastoralists systems, and by giving greater voice and prominence to pastoralists and the organisations that represent and support them.

References

Behnke R, Mortimore M. 2016. The End of Desertification: Disputing Environmental Change in the Drylands. (Dordrecht: Springer).

Bennie A, Naidoo L, Bowman A, Sandi A. 2024. Opportunities and Challenges for a Just Transition in the South African Food System: Insights from the beef industry. Institute for Economic Justice and East Cape Agricultural Research Project Working Paper.

Bond WJ, Midgley GF. 2012. Carbon dioxide and the uneasy interactions of trees and savannah grasses. Philosophical Transactions of the Royal Society B 367: 601–612.

Briske DD, Coppock DL. 2023. Rangeland stewardship envisioned through a planetary lens. Trends in Ecology and Evolution 38: 109–12.

Briske DD, Vetter S, Coetsee C, Turner MD. 2024. Rangeland afforestation is not a natural climate solution. Frontiers in Ecology and the Environment doi:10.1002/fee.2727

Butterfield J, Bingham S, Savory A. 2006. Holistic Management Handbook: Healthy Land, Healthy Profits. Island Press, Washington DC.

Campbell B, Gordon I, Luckert M, Petheram L, Vetter S. (2006) In search of optimal stocking regimes in semi-arid grazing lands: one size does not fit all. Ecological Economics 60: 75-85.

Davis DK. 2016. The Arid Lands: History, Knowledge, Power. Cambridge, MA: The MIT Press.

Davis DK, Robbins P. 2018. Ecologies of the colonial present: Pathological forestry from the taux de boisement to civilized plantations. Environmental Planning E: Natural Space 1: 447–469

Hawkins H-J. 2017. A global assessment of Holistic Planned Grazing™ compared with season-long, continuous grazing: meta-analysis findings. African Journal of Range & Forage Science 34: 65-75.

Molnár Z, Kelemen A, Kun R, Máté J, Sáfián L, Provenza F, Díaz S, Barani H, Biro M, Máté A, Vadász C. 2020. Knowledge co-production with traditional herders on cattle grazing behaviour for better management of species-rich grasslands. Journal of Applied Ecology 57:1677–1687.

Ripley BS, Raubenheimer SL, Perumal L, Anderson M, Mostert E, Kgope BS, Midgley GF, Simpson KJ. 2022. CO_2-fertilisation enhances resilience to browsing in the recruitment phase of an encroaching savanna tree. Functional Ecology 36: 3223-3233.

UNCCD. 2024. Global Land Outlook Thematic Report on Rangelands and Pastoralism. United Nations Convention to Combat Desertification, Bonn.

Utter A, White A, Méndez VE, Morris K. 2021. Co-creation of knowledge in agroecology. Elementa: Science of the Anthropocene 9:1 doi:10.1525/elementa.2021.00026

van Ewijk E, Ros-Tonen MAF. 2021. The fruits of knowledge co-creation in agriculture and food-related multistakeholder platforms in sub-Saharan Africa – A systematic literature review. Agricultural Systems 186: 102949

Vetter S. 2013. Development and sustainable management of rangeland commons – aligning policy with the realities of South Africa's rural landscape. African Journal of Range & Forage Science 30: 1-9

Wilmer H, Schulz T, Fernández-Giménez ME, Derner JD, Porensky LM, Augustine DJ, Ritten J, Dwyer A, Meade R. 2021. Social learning lessons from Collaborative Adaptive Rangeland Management. Rangelands 44:316-326.