



Governing drylands as global environmental commons

Mark Stafford-Smith¹ and Graciela Metternicht²

Recent years have seen growing calls to govern land resources as global environmental commons, delivering benefits to all of humanity in support of the Sustainable Development Goals. Applying this call to drylands – almost half of the world's land – allows responses that are better tailored to dryland attributes. Four key elements for global drylands governance emerge from linking an understanding of drylands attributes with recent global governance scholarship: the need for a *polycentric system with nested goal setting, transparent monitoring and graduated sanctions*. These elements require nuanced application in drylands, with an emphasis on empowering the local. We describe how the present global governance architecture for drylands – the UN Convention to Combat Desertification – provides a partial scaffolding, but falls short in specific areas that deserve attention.

Addresses

¹ CSIRO Land & Water, Canberra, ACT 2600, Australia

² School of Biological, Earth and Environmental Sciences, University of New South Wales, Kensington, NSW 2052, Australia

Corresponding author:

Stafford-Smith, Mark (Mark.staffordsmith@csiro.au)

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Introduction

Global commons are conventionally defined as those parts of the planet that fall outside national jurisdictions and to which all nations have access; international law identifies the high seas, the atmosphere, Antarctica and outer space as resource domains to be guided by the principle of the common heritage of humankind [1]. However, other commons are critical for providing services that are not limited by national boundaries, such as tropical forests, land, soil, biodiversity and climate [e.g. Refs. 2,3]. These, along with oceans and atmosphere, are identified in the latest Global Sustainable Development Report as global environmental commons (GECs), that collectively form

one of six critical entry points to achieving the Sustainable Development Goals (SDGs) [4••].

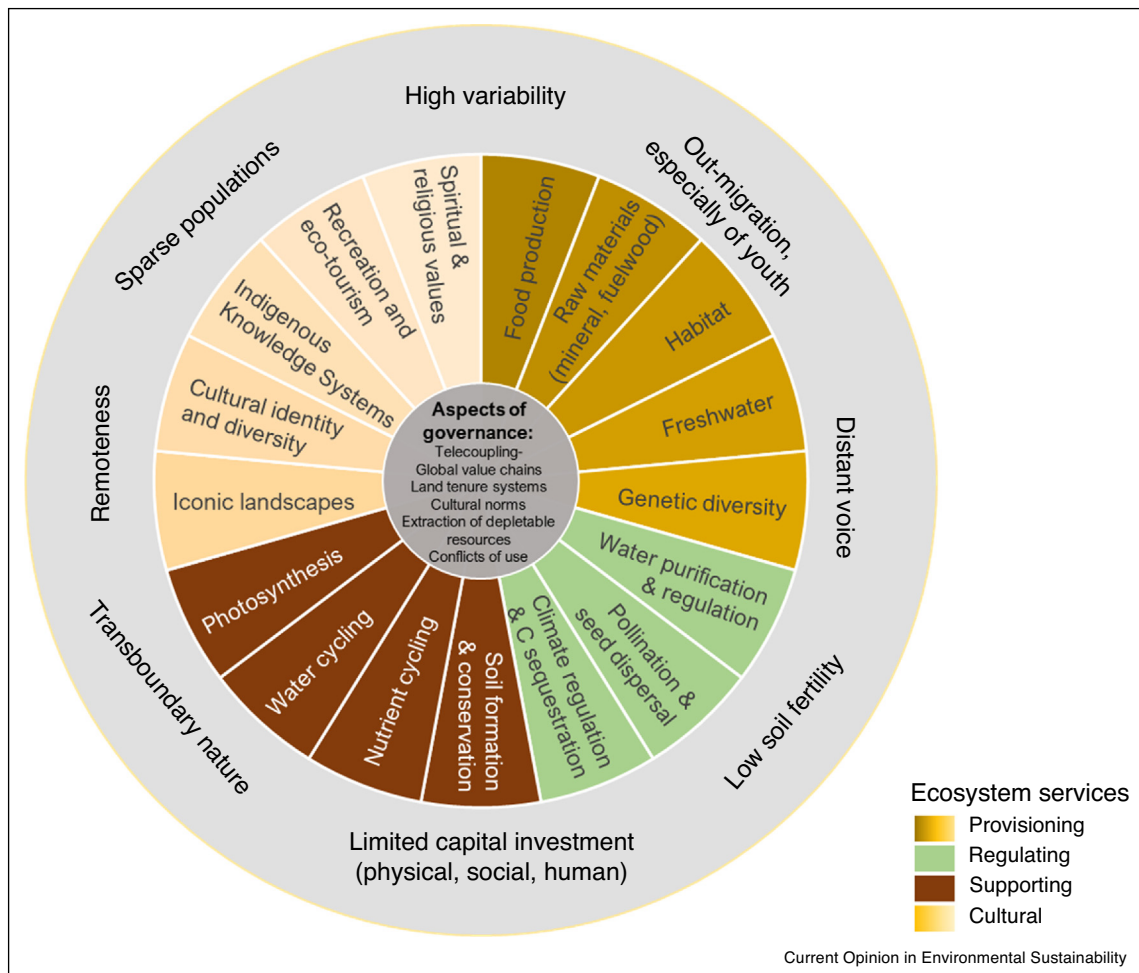
Resources are commons if they are scarce, rivalrous (i.e. depletable) yet non-excludable [5] – that is, their quantity can be depleted to the point where it affects others, and yet it is mostly not possible to prevent others from depleting behavior; they are GECs if they matter globally. Calls to govern land as a GEC [6] are based on land constituting a shared resource (i) that is often traded or controlled beyond national boundaries, (ii) with global consequences for food security and livelihoods, access to fibre and other material resources, as well as greenhouse gas emissions and other impacts on climate. Here we wish to acknowledge these arguments, and focus them on why drylands might deserve attention as a GEC in their own right, and explore the implications of this for improving their governance in the pursuit of achieving the SDGs. At the core of our case is that, while most of the resources and services that make drylands a GEC are similar to those of land more generally, the *responses* to the resulting commons issues need to be distinctive for drylands because of their attributes that differentiate them from other types of land.

Drylands as global environmental commons

Land provides many resources and services beyond that of physical space [7] – provisioning services (e.g. food production, water production, raw materials), regulating services (e.g. carbon storage, climate control, soils), supporting services (e.g. genetic diversity), and cultural services (e.g. iconic landscapes, cultural values). Land resources are generally seen as depletable but excludable physical space, at least at the scale at which nations appear to control their territory — even if the space and some services are privatized, most countries retain collective rights over how land may be used or traded and how an owner may affect others.

However, the use of these resources and services have not just national but global implications [8], and they are being depleted in ways that are increasingly non-excludable at a global scale [9•,10]. Services such as carbon sequestration, biodiversity support, and the provisioning of raw materials affect all humanity. At the same time, food, fibre and mineral production from land is being influenced by global value chains over which nations are losing control [11•,12•,13••], and even the land itself is traded, becoming owned by other nations or corporations in ways that the home nation only regulates weakly [9•,14,15]. This has resulted in calls to recognize that land is a shared common heritage of humankind,

Figure 1



more-or-less depletable services and resources delivered by drylands, loosely classified into the four categories of ecosystem services (wheel spokes), surrounded by key shared attributes of drylands (wheel tyre), and surrounding key aspects of governance needed for a GEC (wheel axle) (note, there is no direct correspondence intended between elements in each layer).

requiring novel approaches to global governance [8,12*,16]. However, these calls are often not taken seriously, partly because of the diverse attributes, uses and stakeholders of land [6], and consequently diverse response needs. There is therefore a powerful case to disaggregate biomes of global significance (especially forests and drylands) to enable more tailored governance and management responses.

Covering about 46% of the world's land surface and home to a third of its population [17*], drylands collectively represent the largest such biome, still diverse but with shared attributes that can focus action. Drylands provide a set of resources or services that are fairly universally important for land global commons, but also operate under a consistent set of contextual drivers, meaning that policy responses to managing different drylands as a GEC are likely to be more similar to each other than to

responses for other GECs, including other forms of land. Many of these resources and services are non-excludable for the same reasons as for land more generally: either because elements such as the functioning of biodiversity, dust or water flows are physically transboundary in nature, so that activities in one country affect another [p.393 in Ref. 18]; or because of increasing exploitation from outside the nation state, through value chains influencing production practices or ownership side-stepping local and national controls [15,19].

Figure 1 summarizes dryland resources and services under the four categories of ecosystem services; although many of these are shared with other land biomes, their expression in drylands is at least quantitatively — if not qualitatively — different. For example, carbon sequestration in drylands adds up to a third of global soil organic carbon [20,21], but is dominated by modest concentrations over very large areas,

requiring different management and measurement approaches to, say, forests, where much larger carbon concentrations are stored as tree biomass on smaller areas, relatively more easily measured. The effects on stocks and flows of services may be exacerbated by feedbacks between global and local services — for example, a reduction in soil carbon storage locally may increase climate change globally, thus reducing rainfall locally so that soil carbon is further degraded [20].

Drylands resources and services are depletable — especially semi-arid lands are often distinctly less resilient than higher rainfall landscapes [22] — but share a suite of contextual attributes that should guide governance and management responses [23–25] (Figure 1). They are by definition areas where precipitation is scarce and typically more-or-less unpredictable (*high variability*). Most dryland soils are low in organic matter and have low aggregate strength (*low soil fertility*) and hence are sensitive to degradation. Compared to mesic areas, and a few major desert cities notwithstanding, dryland populations are usually sparsely distributed (*sparse populations*), more mobile, more remote from markets (*remoteness*), and distant from the centers (and priorities) of decision-makers (*distant voice*) [23]. Being sparsely populated, they often receive *limited capital investment* in human capital and infrastructure, and existing capital leaks out, because value adding to locally produced or extracted resources usually occurs in distant metropolises [25]. Limited access to social services, infrastructure, and employment opportunities results in *out-migration* especially among the young to urban centers. It is also harder to deliver services efficiently, and institutional arrangements devised in other regions may be dysfunctional when imposed on drylands [26]. These attributes are quantified globally in the sources cited here.

The nature of drylands has implications for governance at a global level, whether across levels of government from local to global, or across the teleconnections created by private sector value chains [12^{*}], especially given that drylands are anyway often lightly governed within the nation. Global environmental governance regimes, particularly the UN Convention that is most focused on drylands and development — the Convention to Combat Desertification (UNCCD) — have been advocating for land to be treated as global commons for at least a decade [e.g. Ref. 27]; its development of the land degradation neutrality (LDN) framework [28] and other initiatives (see Supplementary Material Box) partially address this. However, the LDN framing does not sufficiently benefit from an integrated SDG framing, leading to gaps in key aspects of governance.

Drylands as a GEC for achieving the SDGs

GECs by definition deliver a set of resources and services that benefit all people. Achieving the SDGs requires that

GECs like the drylands be protected [4^{**}]; and conversely, protecting the drylands requires achieving the SDGs in these regions. At face value, the SDGs mention drylands only in target 15.3, which affirms the UNCCD's commitment to achieve LDN; however, in practice this cannot be achieved without addressing many other SDGs, including poverty, hunger, access to water and energy, climate [see Figure 1 in Ref. 29], not to mention issues of equity, peace and prosperity. Indeed, the SDGs are an ideal framework for thinking about how to manage the potential synergies and trade-offs among the various values delivered by the wide range of resources and services that the drylands provide ([30^{*}], Figure 1). Conceptual approaches to exploring such interactions among SDGs have advanced considerably in recent years [e.g. Refs. 31–34], although there are fewer examples of this type of thinking specifically applied to drylands [but see Refs. 29,35,36^{*}].

Recognising and governing drylands as a GEC helps to clarify the global consequences of managing these lands well, but also the global responsibilities for so doing in ways that achieve both the global and more local benefits relevant to all SDGs. A significant part of the benefits from drylands (whether food, fibre, tourism earnings or mineral resources) flows along value chains controlled by the private sector into the economies of distant nations, which helps to justify mobilizing resources to flow back in to drylands from the private sector and those distant national economies to achieve the SDGs. The current framing of UNCCD does not provide this justification, so that land degradation remains the least financed part of the UN's underinvested multi-lateral environmental agenda.

LDN can be seen as a tool to help protect the drylands GEC, but by itself does not provide the assurance that benefits flow to the right levels. Proposing that drylands be recognized as a GEC can be perceived as a neocolonial tactic [37], permitting control by powerful lobbies (such as private sector or international organisations [9^{*}]) at the cost of national sovereignty or of the views and values of local actors, especially where drylands may also be commons locally, yet with poorly recognised rights or an active process of privatisation. Such concerns are legitimate, but these neo-colonial effects are occurring anyway due to the non-excludable nature or privatisation of many drylands [e.g. Ref. 38]; explicit recognition as a GEC allows a light to be shined on the good governance principles needed to avoid this outcome, to which we now turn.

Consequences for governing drylands

The governance literature identifies various features relevant to governing global commons, which can be considered in conjunction with a suite of issues (Box 1) that are prioritised by the attributes of drylands noted above.

Box 1 Key principles for analysing drylands

The Dryland Development Paradigm (DDP1 [23]) and its follow up (DDP2 [61]) aim to provide a set of considerations that any analysis of the drylands should consider. The DDP1 principles include (i) taking an integrated approach to coupled human-environment systems, recognizing (ii) slow variables and (iii) thresholds in that coupled system, (iv) taking account of cross-scale dependencies and (v) emphasizing the importance of local knowledge, with all of these argued to be particularly important in drylands compared to other systems. The DDP2, which aims to be 'used to advance sustainable dryland agricultural livelihoods in the context of the 2030 Sustainable Development Goals' (p.1960), adds three additional emphases: unpacking relationships and interactions; traversing scales, sectors, stakeholders, and ways of knowing; and sharing knowledge, learning and experience to empower. It also pays more attention to co-production and distributional issues than DDP1.

The implications of these principles for drylands governance locally can be seen in action through pragmatic local experience. For example, good drylands governance practice in Australia has been argued to entail the following common denominators of particular importance for remote drylands [p.132 in Refs. 26,62]: subsidiarity, connectivity (horizontally and vertically) and accountability (downward and horizontally more than upward, which is more usually in the ascendancy).

Nobel laureate Elinor Ostrom identified principles for managing local commons that might be harder to apply at a global level [39, p.34 in Ref. 40], resulting in four key challenges [6] (Table 1): clearly defining group boundaries; matching rules governing the use of commons to local needs and conditions; providing means for locals to dispute or modify the rules; and imposing sanctions on violators.

As all actors cannot be included on an equal footing globally at once, a *polycentric, subsidiary governance* arrangement is required to provide a nested approach [41], with strong cross-scale elements to allow structured nuancing of rules locally, and tracking of obligations [42], delivering real power at national and local levels to avoid neocolonial tendencies [37]. This is particularly important in drylands with their typical 'distant voice'.

Scholars have recently argued the need to move generally from basing global governance processes on rule-making to goal-setting [43]; at the global level, some form of cap on deterioration of the commons must be set and agreed, along with the intent to share the benefits equitably, if necessary through compensation systems, and legitimate institutions [44]. This implies *nested goal setting*, with global goals framing the maintenance of the GEC values, but allowing local, regional and national levels to set goals that are salient to their levels. These goals may be legislated or aspirational, and in a general sense must add up from one level to the next.

Achievement of these goals must be tracked with *effective, scalable and transparent monitoring systems* that provide

credible, independent information for accountability among peers at each level against their expressed goals at that level [42]. Like the goals, the metrics need to add from one level to the next, though indicators may change across scales [cf. 45]. Dryland principles highlight how these metrics must focus on slow variables and their thresholds, since more visible fast variables are often misleadingly driven by short term variability in drylands [46].

Then accountability needs to be supported by *graduated, multi-level sanctions* (or withdrawal of incentives) where indicators suggest actors are not meeting their commitments [5]; because most of these commitments are voluntary, the sanctions are likely to be reputational or based on moral suasion, in turn dependent on the clear goals and transparent, credible monitoring. For nations, sanctions could extend beyond reputational impacts to banning imports of unsustainable products or pricing greenhouse gas emissions; more locally, private sector actors may lose their licence to operate or have regulatory standards imposed [13**].

It is important to recognise the role of key facilitating factors that modulate the likelihood of large scale collective action, such as the links among trust, reciprocity and reputation, the sense of visible fair play, and the ability to communicate [47*], many of which require transparency and procedural equity. The resulting four key governance design elements are summarised in Table 1. Although many of these elements are relevant to all GECs, their implementation in drylands must respond to the typical contextual attributes noted above — *high variability, low soil fertility, sparse populations, remoteness, distant voice and limited capital investment*. For example, challenges of stakeholder networking within and across governance levels are particularly great, and metrics for monitoring need to be cheap per unit area. However, technological advances have provided tools to assist in many areas — such as promoting communications and the flow of information, enabling remote sensing and 'radical transparency' [13**] of key metrics [48–50], and potentially re-balancing power inequities among actors through 'crypto-governance' measures [51].

Authority to govern a GEC only emerges from multi-lateral agreements, representing widespread consensus across the community of nations; similarly local authority over local commons requires widespread local community consensus. Comparing these 4 design elements to current arrangements for drylands as framed by UNCCD, Table 1 suggests that some key elements are in place, but these, at best, imperfectly satisfy what is needed. In its approach to LDN, the UNCCD identified seven principles related to good governance [p.64 in Ref. 28]: effectiveness; efficiency; trust and engagement; sustainability and local responsiveness; legitimacy and equity; transparency,

Table 1

Key governance design elements for global environmental commons, as applied to drylands, and the extent to which they are met by current arrangements

Design element	Why (and theory basis ^a)	Elaboration in principle	For drylands in practice – progress and gaps
1. A polycentric, subsidiary system	Impossible to have all actors at all levels everywhere, engaging all the time. (Ostrom: group boundaries, rights; DDP1 and 2: engage local knowledge, traverse scales)	• Nested polycentric governance system that allows for local specificity with some higher levels of guidance, and appropriate horizontal connectivity at different levels [54,55] – peer-to-peer supra-nationally, across localities within a nation, and among individuals locally; • On the basis of subsidiarity (ceding rights upwards rather than devolving them downwards) [e.g. Ref. 56], to allow locals to develop goals and sanctions within guidelines; • Legitimacy of representation should be a concern at all levels.	• National membership of the UNCCD provides a global-level to national-level architecture of subsidiarity; some countries consult levels down to local. • If not genuinely subsidiary, governance may end up being neo-colonially imposed from the global and national levels – this is particularly important in drylands with distant voice, as central governments tend to be insensitive to local inputs; • Private sector actors (value chains, etc) need to be engaged, but their power managed.
2. Nested goal setting	Top down regulatory goal setting loses ownership and local salience, but some guidance is needed to obtain a global outcome (Ostrom: local ability to modify rules; DDP1 key variables and thresholds)	• Two-pronged approach: establish global goals that satisfy the maintenance of the GEC values, then allow articulation of national goals, compatible with the sum of goals created domestically at a more local level. • Goals might be legislated or aspirational [43], but need to ensure local salience and legitimacy; • Bottom-up multi-level aggregation, and compatibility between levels (i.e. meeting local goals should deliver a national goal; with the sum of national goals delivering a global goal), • Goals should address key drivers and thresholds for drylands; • Strong equitable ownership of the process should be a process-goal at all levels; • Goals at all levels should include targets.	• Collectively Parties to the UNCCD have set the global goal of LDN, and countries have increasingly committed to national LDN plans with goals and targets [57]; • Local engagement in defining goals for particular land types has occurred in some countries, but this is not common or consistent. • Targets for satisfactory local engagement are usually missing. • With changing actors (e.g. private sector value chains, distant investors) goals for new sets of peers may be needed.

Table 1 (Continued)

Design element	Why (and theory basis ^a)	Elaboration in principle	For drylands in practice – progress and gaps
3. Effective, scalable and transparent monitoring system(s)	Need to know when goals are not met at all levels (Ostrom: triggers for sanctions; DDP1 and 2: emphasis on slow variables and learning)	- Identify key indicators and metrics; and monitor them with transparent access to the results; - Indicators and metrics should be context-relevant, enabling locals to assess whether their peers are meeting expectations, and suited for transparent aggregation to allow evaluation among peers at higher levels (e. g. nation or value chain or global); - Metrics can vary with scale, for as long as aggregation into simpler indicators at higher levels is possible [45]; - Metrics should encompass both environmental and social attributes, including equitable local empowerment; - Actors at all levels must contribute sufficient resources to allow good monitoring, whilst avoiding diminishing returns on investment; - Indicators and metrics of drylands should focus on slow variables with important thresholds, related to relevant capitals and services [23], whilst limiting cognitive burden [42].	- UNCCD's LDN framework commits nations to monitor 3 core indicators, spatially resolved to different land types, and it consolidates these into success or failure in achieving LDN on an areal basis (which is an indicator that can then be aggregated to any level) [28]. It caters for inclusion of locally relevant, complementary metrics. In principle, these provide a framework to achieve this design element providing (i) the data is resolved to local areas, (ii) the monitoring system is adequately resourced, and (iii) the results are transparently accessible. - The LDN framework at present does not require comparable social elements measuring local ownership and empowerment, though these could be accommodated [58,59]. - Not all countries with drylands (including high income countries) have LDN plans, nor (resources for) adequate environmental monitoring systems as yet.

Table 1 (Continued)

Design element	Why (and theory basis ^a)	Elaboration in principle	For drylands in practice – progress and gaps
4. Graduated multi-level sanctions	There must be a cost to failing to meet goals and targets, that must be actioned by relevant peers at different levels but may also act across levels (Ostrom: graduated sanctions; DDP2 co-production and distributional outcomes)	• Graduated, peer-based sanctions – or their inverse, incentives – on actors failing to meet their expressed goals and associated targets [60]; at national or supra-national levels, likely to be reputational measures, but could graduate to loss of licence-to-operate for commercial interests, or trade access controls for nations. • Locally, the polycentric system should facilitate local definition of sanctions, which may be reputational, but could also use a wide range of more regulatory or financial measures. • Cross-level sanctioning actions may also be needed (e.g. where citizens hold national governments to account or local failures caused by value chain teleconnections need action globally); these may need enabling by third party observers) [47*]; • Transparent, trusted monitoring is critical.	• Parties reporting to UNCCD on national progress of LDN plans provides the principal current means of public assessment at the global level (its Performance Review and Assessment of Implementation System). • This reporting has credibility, as some of the metrics can be independently measured – though at present there is no independent mechanism for quality control of what is reported. • Some countries have systems to encourage local compliance, but this is an underrated part of the nested polycentric system that is needed • Appropriate mix of sanctions and incentives needs further development. Some of these could arise through market-based mechanisms, though it is important to assure equity and avoid perverse incentives.

^a sources for theory being drawn on: ‘Ostrom’ for Elinor Ostrom’s oeuvre and more recent commons work, as cited in the main text; ‘DDP1’ and ‘DDP2’ for principles argued to be particularly important in drylands by JF Reynolds, *et al.* [23] and LC Stringer, *et al.* [61] respectively – see Box 1.

accountability and predictability; and integrity. We argue that clear-eyed attention to the implementation of the 4 design elements in drylands contexts will help to achieve most of these, and that all of them are needed for success. Most notably, empowering the right actors at a local level into the nested governance system, monitoring and reporting on this, and encompassing the growing role of the private sector in the non-excludability of drylands requires more attention. Here the SDGs provide a useful framing for the suite of social and biophysical outcomes (such as food security and greater income equality) that will engender support in local populations.

Conclusion

Drylands are GECs because, in the context of growing pressures from humanity, they are scarce, depletable and increasingly non-excludable, yet they provide vital services to the Earth's life support system. Whilst this is true for land in general, a focus on the largest land biome enables responses to be tailored to the distinctive attributes of drylands. However, the drylands will not be sustained by protecting them from locals: rather, by supporting local livelihoods within a framework which ensures global benefits are also delivered [52], an approach which is readily linked to an SDGs framing. To achieve the SDGs locally and globally in drylands requires attention to the principles of governing GECs, delivering a polycentric arrangement with nested goals, that are transparently and credibly monitored and which drive suitable sanctions when the goals are not met. The UNCCD and its approach to LDN fulfils part of this system, but the analysis highlights areas which need more attention, particularly in ensuring that local actors have an equitable role in the system, and that the growing impacts of the private sector are accounted for. Research could support these outcomes by better inventory and valuing of drylands as a GEC, drawing on integrated modelling of SDGs [e.g. Ref. 53], and improvements in monitoring and models for linking local to global governance in support of building trust in governance [18], according to the design elements highlighted here.

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Declaration of Competing Interest

The authors report no declarations of interest.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.cosust.2020.12.006>.

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