

Commentary: on the under-valuing of Australia's expertise in drylands research and practice globally

Graciela Metternicht ^{A,C} and Mark Stafford Smith^B

^ASchool of Biological, Earth and Environmental Sciences, University of NSW, Sydney, NSW 2052, Australia.

^BCSIRO Land and Water, Building 101, Clunies Ross Street, Black Mountain, ACT 2601, Australia.

^CCorresponding author. Email: g.metternicht@unsw.edu.au

Abstract. Global drylands are a significant driver of earth system processes that affect the world's common resources such as the climate. Their peoples are also among the first to be widely affected by global changes such as land degradation and climate change. Yet drylands are a source of many social and technical innovations, globally, as well as in Australia. As a major developed dryland nation, Australia has previously played a major role in extending these innovations to the rest of the world. The nation has reaped reputational and commercial benefits through major research and practice contributions to dryland agriculture, water management and governance, remote area services, indigenous partnerships, dryland monitoring systems, and 'desert knowledge' innovation. Australian researchers continue to contribute to various relevant international processes, yet recognition and support for this within Australia has dropped off markedly in recent years. We analyse the Australian government's investment in research and in overseas aid for drylands over the last two decades, and explore trends in government's active involvement in major international processes related to land. These trends are short-sighted, overlooking potential economic benefits for Australian enterprises, and undermining Australia's stance and scientific leadership in dryland systems globally. In this commentary, we argue that it is time for the trends to be reversed, as this is an area of comparative advantage for Australian diplomacy with significant returns on investment for Australia, both direct and indirect, especially when most emerging economies contain substantial drylands. We identify four major pathways to obtaining benefits from science diplomacy, and four interrelated actions within Australia to enable these – to place a higher emphasis on science diplomacy, to re-forge a bipartisan recognition of Australian drylands expertise, to establish a dedicated Dryland Information Hub, and to create a network of relevant science and technology advisors.

Keywords: comparative advantage, dryland agriculture, research for development, science diplomacy, sustainable development, theory of change.

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Background

Drylands represent ~40% of the world's land surface and are home to 2 billion people, half of whose livelihoods depend on drylands ecosystem services (Reynolds and Stafford Smith *et al.* 2007; Hoover *et al.* 2020). Globally, drylands are a significant driver of earth system processes such as the water cycle, carbon storage and atmospheric effects such as dust plumes. They are also a 'canary in the coal mine' for human disruption. Dependence on ecosystem services means that their peoples are among the first to be widely affected by global changes such as land degradation, climate change and undermined water cycles; hence, many of the world's refugee movements are directly or indirectly linked to resource pressures in drylands (Freeman 2017; Shi *et al.* 2019). In the past, their challenging environments made them a source of many social and technical innovations; this continues today, with persisting traditional linguistic and cultural diversity. The importance and sensitivity of drylands lie behind global moves under the United Nations

related to land (e.g. the Convention to Combat Desertification – UNCCD), as well as investments of the UN Global Environment Facility to reverse degradation in drylands, and the activities of many research-practice networks around the world.

Australia is the continent with the greatest proportion of drylands, which are sensitive and important to the country. Having a developed economy in lightly populated drylands, Australians have made major research and practice contributions globally to dryland agriculture, water management and governance, remote area services, indigenous partnerships, dryland monitoring systems, and 'desert knowledge' innovation. Australian contributions to international dryland governance and research for development (R4D) funding have been influential and highly valued, as documented below and in Supplementary Material Table S1, available at the journal's website. However, recognition and support for this within Australia appears to have dropped off markedly in recent years, under both sides of politics, despite both also claiming to sell

Box 1. Land Degradation Neutrality (LDN)

A major advance that has reinvigorated the UNCCD in the past few years has been the development and adoption of the concept of LDN. LDN requires countries to plan, implement and monitor interventions to avoid, reduce and reverse land degradation, to ensure that land degradation is not increasing when analysed *at the level of individual land types, on a set of standardised indicators*. This has broken the political deadlock of inaction at UNCCD, has been adopted as a target into the Sustainable Development Goals (15.3), and, notwithstanding some implementation issues, is seeing many countries now produce concrete plans to manage levels of land degradation (over 120 at time of writing – UNCCD 2020). LDN was developed through a global team, but the concepts and details and leadership drew strongly on Australian inputs [illustrated by key publications – e.g. Orr *et al.* (2017); Cowie *et al.* (2018); Sims *et al.* (2019) and significant Australian contributions to a recent special issue on the topic (Metternicht *et al.* 2019), as well as the drafting of UNCCD documents on this (e.g. Chotte *et al.* 2019; UNCCD 2019; Verburg *et al.* 2019)], and Australians have helped extend LDN into other fora such as the Global Environment Facility funding processes (GEF STAP 2019).

expertise derived from Australian comparative advantages abroad. Therefore, this commentary explores the reality of this decline, documenting some evidence of Australian expertise being influential in drylands internationally; it suggests that this devaluing is in fact a major lost opportunity.

We argue that it is time for this trend to be reversed, and provide four key pathways to capture greater benefits for and from Australian science diplomacy. These could bring huge returns on investment in terms of goodwill, opening of markets, and of genuine contributions to the maintenance of our common global life support system, with direct and indirect flow-on benefits to Australia.

Australian contributions overseas: research, politics and policy

Table S2 shows the levels of Australian researcher contribution (as leading authors, contributors or reviewers) to global reports relevant to ‘land’, land governance, land degradation, and drylands or rangelands over the last two decades. It shows a trend of increased sustained involvement of Australian expertise, from universities and major research centres. This involvement is mostly self-nominated and self- or institutionally-funded. The contributions are often built on Australian leadership in wider intellectual and technical developments, such as the concept of Land Degradation Neutrality (Box 1), wider concepts of drylands functioning (e.g. Box 2), monitoring and remote sensing (Box 3) and practical approaches to collective management of land such as Landcare (Box 4); for some other examples, see Table S1, acknowledging this is a very partial listing. Much of this work was not only internationally leading, but also contributed positively to the management of Australia’s drylands domestically, as well as potentially reducing indirect pressures on Australia, for example from environmental refugees.

To assess Australian research productivity, we searched Web of Science for publications each year 2000–2019 for which the topic included ‘dryland* OR desert* OR rangeland*’, and where the corresponding author’s address was in Australia. This

Box 2. Dryland social-ecological systems theory

In diverse partnerships overseas, Australians have been at the forefront of drylands ecology and management theory for at least 4 decades. Australian land systems mapping led the world in the 1960s (e.g. Perry (1962) (re-issued 2010)) and provided an initial basis for classifying arid lands. The first major arid ecosystems modelling effort in the International Biological Program was led by an Australian, David Goodall, in the 1970s (Goodall 1981; also Noble 1975). In the 1980–1990s, Australian researchers led the development of state and transition concepts in rangelands (Westoby *et al.* 1989; Friedel 1991) (see also virtual issue introduced by Walker and Westoby 2020), and a whole literature on resilience emerged partly from this under the guidance of Brian Walker (Walker and Janssen 2002; Walker *et al.* 2004). The contemporaneous development of landscape function analysis (Tongway and Ludwig 1996; Tongway and Hindley 2004; Tongway 2010) has been widely applied around the world, notably in restoration and mining projects. A landmark Dahlem conference in 2002 (Reynolds and Stafford Smith 2002) led to the Drylands Development Paradigm internationally (Reynolds *et al.* 2007; Stafford Smith *et al.* 2011) and contributed to ‘desert knowledge’ development domestically (McGregor and James 2011). Good work linking theory and application continues, some of it available in this special issue.

Box 3. Remote sensing and monitoring degradation

A key concern globally has been to be able to monitor land degradation, distinguishing changes due to natural climate cycles from those caused by humans either locally or globally. Early Australian remote sensing work led the world in moving from simply detecting changes in landcover to untangling management effects from natural variation (e.g. Pickup *et al.* 1994, 1998; Pickup and Chewings 1994; Pickup and Bastin 1997). This led to Australia-wide monitoring approaches culminating in the Australian Collaborative Rangelands Information System (ACRIS – Bastin *et al.* (2009), de-funded in 2014), which subsequently informed the 2011 Australia State of the Environment, and the 2011 UN report on Global Drylands (see Table S1). In parallel, data handling developments at CSIRO and Geoscience Australia advanced the Open Data Cube (ODC) approach to remote sensing data, which Geoscience Australia has made operational at a national level (Digital Earth Australia), and which has now been adopted globally (e.g. Colombia, Switzerland, Austria, Vietnam, Digital Earth Africa) through Australian leadership and contributions in the Committee on Earth Observation Satellites and the Group on Earth Observation (CSIRO Centre for Earth Observation 2020).

underestimates the total Australian contribution, but reflects a consistent level of input. Publications over this period (Fig. 1) show Australia contributing an impressive and increasing proportion of work on drylands to the international literature during the 2000s, reaching a high point around 2012; this has fallen back below its long-term average since 2015. The late 2000s corresponded with a period of strong publication from the Tropical Savannas and Desert Knowledge Cooperative Research Centres and their successors, but the funding support for these contributions tailed off through the 2010s. This reflects periodic resurgence of policy interest in the rangelands, illustrated by the National Rangelands Strategy process in the 1990s (finally downgraded to principles and guidelines – ANZECC and

Box 4. Landcare, showing Australian commitment to global environmental sustainability

The National Landcare movement was established in 1989 under the Hawke Labour Government to resolve environmental issues, and has enjoyed bipartisan support thanks to being driven by both farmers and conservationists. Landcare Australia, the organisation, has worked collaboratively with federal, state and local governments, corporate partners, sponsors, other environmental agencies, community groups and individuals. Landcare has been cited in major international reports dealing with land and development (see Table S1) as an exemplar of multi-stakeholder cooperation and collaboration to care for the land, integrating diverse knowledges. The Secretariat for International Land Care and the Australian Landcare International were established as non-government organisations in 1998 and 2008 respectively to support the adaptation of the Australian Landcare model in other countries (ALI 2020; SILC 2020). In the 30 years since Landcare started in Australia, it has now scaled out to more than 20 nations (Catacutan *et al.* 2009), including an African landcare network, as well as Bangladesh, Canada, Fiji, Germany, Iceland, India, Indonesia, Pakistan, Philippines and USA, among others. As Campbell (2015) rightly observes, 'Landcare is an unsung Australian export success story – a great example of soft diplomacy'.

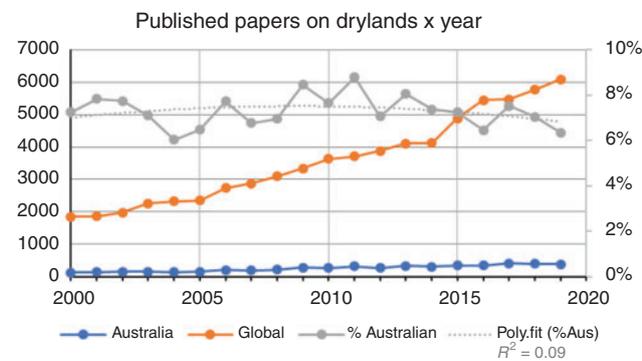


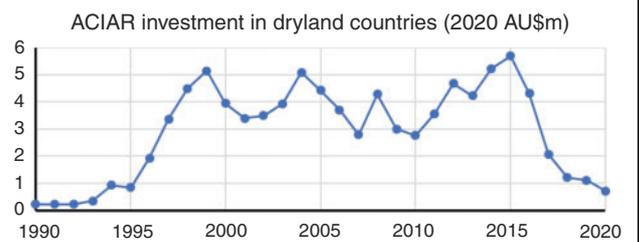
Fig. 1. Publication count of refereed publications on drylands in total globally and with an Australian first author for the past 20 years. Overall, 7.3% were Australian, high on a per capita basis even among OECD countries (1.9% = 25 m of 1.3bn people), though on par by area of drylands (9.0% = 5.5 of 61 m km²). A polynomial fitted to the annual % that are Australian is not significant but suggests a slow decline recently.

ARMCANZ 1999); and an Expert Working Group on Science Engagement and Australia's Desert Regions that reported in 2013 (Expert Working Group 2013) but saw little visible follow-up.

We argue that over this same period, a decline in national political interest in supporting global drylands issues can be tracked, to Australia's detriment (see examples in Table S3). In early 2000 Australia was committing A\$32.5 million to overseas development assistance (ODA) to countries affected by land degradation and desertification in dryland-related projects (Commonwealth of Australia 2000). An overall trend to an increasing aid budget in the late 2000s included a particular increased commitment into Africa through the Australian International Food Security Centre (ACIAR Review Panel 2013; p. 49). This investment drew on Australian domestic expertise, both in research and the private sector, though by 2013 an

Box 5. ACIAR investments in drylands R4D projects

An exemplar of how overseas research for development (R4D) aid has varied for dryland countries is the Australian Centre for International Agricultural Research (ACIAR). ACIAR has focussed on funding partnerships between Australian agricultural researchers and developing country researchers for over 3 decades, with many examples of highly respected projects. This has created a cadre of overseas scientists with a connection to Australia, as well as huge returns on investment – for example, Vere (2005) estimated that ACIAR's investment in research into conservation tillage for dryland cropping in China generated benefits of AUD\$579 million with a return on investment of 36 : 1, as well as benefits in Australia itself. This special issue reports recent projects supported by ACIAR (Kemp *et al.* 2020; Badgery *et al.* 2020; Behrendt *et al.* 2020; Campbell 2020). However, the Figure shows how R4D investment from ACIAR into countries with drylands (i.e. the projects include both rangelands and other dryland agriculture, which are hard to separate) has dropped off precipitously since 2015, even though ACIAR's overall budget has not changed greatly.



Source: ACIAR data on projects on drylands, apportioned by year; most projects ran for three years once committed (i.e. the drop off after 2015 resulted from decision-making around 2013). Detailed data and further explanation in Table S6.

independent review of ACIAR commented that this was becoming harder due to the gradual but persistent reduction of state funding to drylands management and research (ACIAR Review Panel 2013; p. 87).

It is difficult to get precise figures for drylands, but since 2013 Australian ODA funding has been dramatically reduced through several decisions, particularly with the focusing of ODA to the Indo-Pacific, resulting in a near-cessation of Australian aid to Africa and the Middle East, the Caribbean and Latin America under the Abbott-Turnbull governments (Bruere and Hill 2016); even in Asia, ODA has been withdrawn from most countries in East, South and West Asia since 2013. These regions have significant proportions of drylands and so this has greatly reduced any opportunities to export Australian expertise; this effect is evident in ACIAR funding to countries with drylands (Box 5). In recent budgets since an estimated \$3.8bn in 2016–2017, total ODA has slowly risen in line with inflation to \$4 billion (DFAT 2019); almost half of the aid is committed to 'infrastructure and trade', and 'effective governance'. However, it is questionable whether this rise will continue after the economic impacts of the pandemic in 2020.

These trends show up also in more subtle policy interactions that affect Australia's influence on global governance of drylands. A detailed history of Australia's interaction with UNCCD,

the pre-eminent UN convention on land and development, is provided in Supplementary materials Box S1 available at the journal's website. It notes that, in moving to ratify UNCCD in year 2000, the Australian Parliament argued that doing so *would enhance Australia's reputation, create commercial opportunities* for Australian businesses, and provide an avenue for Australian influence. Indeed, Australia played a significant role in the negotiation of UNCCD in the 1990s, with Australian scientists in the delegation. After its ratification, the Australian Government has sent representatives to 12 of the 14 Conferences of the Parties (Table S4), but the size, seniority and continuity of the Australian delegation has declined since COP11. Despite the recognition of the potential for Australian influence and opportunity, Australia has never nominated any Australians to UNCCD's Committee of Science and Technology (CST), the politically appointed committee intended to bring research into the convention (Box S1).

Australian research has had a big impact on UNCCD through the development of the Land Degradation Neutrality concept (Box 1), but this has been through scientists appointed to the Science Policy Interface without Australian Government involvement or any coordination with foreign policy (Box S1). By comparison, the US and China have been regular members of the CST and successfully driven the direction of the convention to use their research and create influence and opportunities. In a similar way, Australia has not sent representatives to the UN Environment Assembly, which is now paying attention to drylands (Table S5). These levels of disengagement send a signal of Australian disinterest to the international community.

In summary, the data suggest that Australian contributions to global processes do not depend greatly on political interest in the short term; however, long-term disinterest and declining investment in drylands research in Australia inevitably reduces the pool of expertise and new knowledge for Australian researchers to take out to the world. A lack of political communication about this expertise and knowledge contribution means that the reputational benefits accrue more to individual researchers than to Australia as a global contributor. We do not argue that this decline is aimed actively at drylands, often being collateral damage of other trends; indeed, one reviewer noted that they were unaware of how the history outlined here has crept up on the nation. This absence of an active awareness of the value of Australian drylands expertise results in a failure to capture the resulting comparative advantage, to which we now turn.

Why reverse this trend?

The original vision of Australian involvement in UNCCD in 1999 – that it would enhance Australia's reputation and create opportunities to apply Australian experience in research and business, and consequently provide spin-off benefits back to Australia domestically – remains true for engagement in drylands issues globally. As ACIAR noted in a submission in 2018 (ACIAR 2018), *'Australian agricultural science helps ...improve food security...[and] lift people out of poverty... in turn contribut[ing] to regional security and peace.'* ACIAR also highlighted how this helps *'Build Australia's own agricultural climate change capabilities through trialling innovative approaches overseas'* because

'Australia shares comparable agro-ecological conditions with parts of the developing world, both drylands and tropical.' The trend away from seeing Australia's global comparative advantage in addressing drylands has been bi-partisan, but accelerated since 2013 in conjunction with reduced ODA and less multilateralism in general. Yet really the logic from 1999 remains compatible with the desire to create new markets for Australian knowhow, with positive consequences back in Australia.

We outline our view of how this logic should work in Fig. 2. We see four key pathways: (1) thriving domestic research provides a source of internationally-recognised dryland researchers who may be drawn into international processes for their expertise but who are not there as representatives of the policy process; (2) Australian aid and R4D develops partnerships for Australian knowhow in developing countries, and engages them with Australian solutions; (3) active diplomatic interventions in international processes put Australian researchers in formal science policy positions of influence; and (4) an aligned trade policy promotes Australian business expertise (whether as providers of goods or services) in drylands to create new export opportunities and partnerships. At present the domestic research base (Pathway 1) is declining though still active (Fig. 1); these researchers are still involved influentially in some global processes but without the involvement being leveraged nationally (Table 1); and policy at the national level seems entirely unaware of the potential benefits and certainly not organised to capitalise on them. We suggest the heavier arrows on Pathways 2 and 3 are especially important links for achieving business benefits but are particularly weak at present. Overseas aid (Pathway 2) has been focussed to the nearest parts of Asia-Pacific where there are few drylands; and Australia is inactive in the multilateral fora which highlight drylands (Pathway 3). Where comparable trade policy seeks to open up markets for Australia at present (Pathway 4), it is often for technologies in which Australia does not have a sustained comparative advantage against other dynamic economies. By comparison, the experience of living with drylands in a developed economy is an Australian structural comparative advantage that cannot be outcompeted by other countries.

The logic outlined in Fig. 2 depends on the political and policy recognition of drylands as this source of inalienable comparative advantage, flowing through all four pathways to deliver outcomes internationally and at home (left to right in Fig. 2). Looking forwards, this becomes a critical missed opportunity. Eight of the 10 main emerging economies globally are countries with significant proportions of drylands (Table 1 – six of the next eight biggest economies after these are also dryland dominated). So what could be done to better position Australia to take advantage of this, at the same time as playing a constructive role globally?

How could the trend be reversed?

We suggest several actions that should be taken to revalue Australian expertise in dryland research and practice globally, and to reinvigorate the model emphasised in Australia's justification for signing the UNCCD, represented by the pathways in Fig. 2. In many cases, these pathways have been pursued successfully by Australia in the past; in essence, these actions aim to

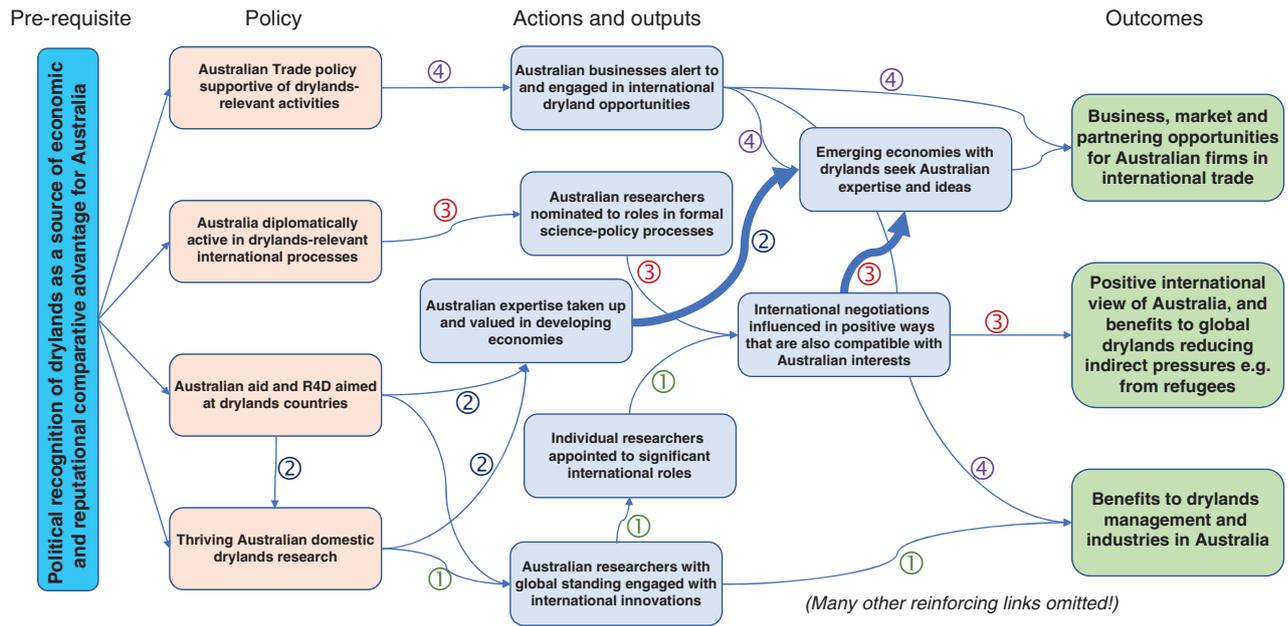


Fig. 2. Simple systems analysis of how Australia may obtain trade and reputational benefits from recognising and acting on its drylands comparative advantages (see text for further explanation).

Table 1. Drylands (excluding hyper-arid lands) in countries with emerging economies (whether classified as ‘BRICS’, ‘MIKT’ or ‘MINT’ (MIKT with Nigeria instead of Korea))

Group	Country	Drylands (m km ²)	% Area of country
BRICS	Brazil	1.31	15%
	Russia	3.90	23%
	India	0.83	25%
	China	2.99	31%
	South Africa	0.81	67%
MIKT	Mexico	1.40	71%
	Indonesia	0.06	3%
	Korea	0.00	0%
	Turkey	0.60	76%
MINT	Nigeria	0.49	53%

re-activate known benefits of linking the integrated impact pathways with world-leading drylands science.

- (i) Place a higher emphasis on science diplomacy to underpin all the pathways in Fig. 2, especially the business Pathway 4: this has been the case in the past, for example under Foreign Minister Downer (2000–2006). There are entry points in many multi-lateral agreements and resolutions adopted by UN Agencies where Australian expertise on drylands can provide leadership (Table S5) and urgently needed solutions for country or regional initiatives working towards sustainable use and management of drylands. A stronger Australian presence in the UN Convention to Combat Desertification (including its Committee on Science and Technology and innovations like the ‘3S’ initiative and the Intergovernmental Working Group on Drought (IWGD) – Table S5) is key to enabling Australia to play a role in shaping UNCCD’s

priorities, and to take more leadership in combating land degradation; we have the expertise to assist other countries, including many emerging economies with drylands (Table 1). There is now an Australian policy presence on the UNCCD IWGD but without a systematic approach to drawing on research expertise.

- (ii) Forging [again] bipartisan support on highlighting Australia’s drylands management successes to the world to support the demand for Australian expertise. Landcare (Box 4) and policies Australia has developed since the 1990s in areas such as sustainable land management, drought, water management and governance (Table S1) are examples of the impact that good science and bipartisan support (in both politics and the community) can achieve nationally and internationally. This contrasts with recent trends of partisan politics that translate into ongoing budget reductions for ‘caring for land’, as well as a lack of continuity of expertise in agencies, and a lack of the financial continuity and sustained efforts that are needed to obtain systemic benefits from these investments. Another good example is the Indigenous Rangers Program (Mackie and Meacham 2016), which still has bipartisan support, but there are many others such as those noted in the Boxes herein.
- (iii) Establish a dedicated Drylands Information Hub to consolidate Australian expertise and knowledge in drylands, as a go-to source for interested overseas governments and prospective business partners. A major problem is the now-fragmented nature of the Australian offering, in terms of research expertise, as well as traditional knowledge and private sector capability. This is needed to enable Pathways 3 and 4 in Fig. 2 to find and promote the right people and knowledge easily in a context where there is inevitable turnover of diplomatic corporate memory. This used to partially

exist in the ‘Australian Actions to Combat Desertification and Land Degradation’, which existed in 2002 at the Department of Environment (DEH 2002) and has some international parallels (e.g. the International Network for Government Science Advice under the auspices of the Integrational Council for Science, which has mobilised science advice for emergencies and strategic international policy interventions such as the current COVID-19 event). Such an Information Hub would also keep track of Australian expert roles in international processes, currently very uncoordinated, and help to network private sector interests with trade policy. It could also have a role in foresighting trends and windows of opportunity for Australian businesses that converge with fulfilling our international environmental obligations. This initiative would require some public funding and formal standing but is probably best based outside government, for example potentially convened by the Australian Rangelands Society, with its lengthy stable history.

- (iv) Establish a network of Science and Technology advisors to the Department of Foreign Affairs and Trade, and other government agencies that represent the nation in key international processes that deal with drylands. This approach is known to help with science-based evidence for policy (Independent Group of Scientists 2019), and would ensure that Australian expertise is rapidly mobilised and can be used for science diplomacy. It could also support current initiatives such as ‘Soils for Life’, and work cooperatively with bodies that inform DFAT about policy development (e.g. the Expert Panel for the New International Development Policy) or investment priorities, such as the science advisory council of ACIAR.

Australian scientific and experiential knowledge in drylands research and practice has been identified and valued internationally; though evidence shows that over the last decade that expertise has been under-valued domestically. We have outlined recommendations that would help to better value and make use of that knowledge, while simultaneously fostering national institutional change through options that are politically feasible. And all of this would benefit Australia’s credibility and international reputation for sustainable management and use of drylands, at the same time as delivering global benefits in natural resource management, food security and political stability.

Conflicts of interest

The authors declare no conflicts of interest.

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