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## Designing a new science-policy communication mechanism for the UN Convention to Combat Desertification

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## ABSTRACT

The United Nations Convention to Combat Desertification (UNCCD) has lacked an efficient mechanism to access scientific knowledge since entering into force in 1996. In 2011 it decided to convene an Ad Hoc Working Group on Scientific Advice (AGSA) and gave it a unique challenge: to design a new mechanism for science-policy communication based on the best available scientific evidence. This paper outlines the innovative 'modular mechanism' which the AGSA proposed to the UNCCD in September 2013, and how it was designed. Framed by the boundary organization model, and an understanding of the emergence of a new multi-scalar and polycentric style of governing, the modular mechanism consists of three modules: a Science-Policy Interface (SPI); an international self-governing and self-organizing Independent Non-Governmental Group of Scientists; and Regional Science and Technology Hubs in each UNCCD region. Now that the UNCCD has established the SPI, it is up to the worldwide scientific community to take the lead in establishing the other two modules. Science-policy communication in other UN environmental conventions could benefit from three generic principles corresponding to the innovations in the three modules—joint management of science-policy interfaces by policy makers and scientists; the production of synthetic assessments of scientific knowledge by autonomous and accountable groups of scientists; and multi-scalar and multi-directional synthesis and reporting of knowledge.

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## 1. Introduction

Improving the communication of scientific knowledge to United Nations environmental conventions is vital if global environmental change is to be addressed successfully. In some areas, knowledge flows are well established. For example, the

Intergovernmental Panel on Climate Change (IPCC) has provided scientific advice since before the United Nations Framework Convention on Climate Change was agreed, though there are now concerns about its fitness for purpose (Hulme, 2010; Wible et al., 2014). However, ever since the United Nations Convention to Combat Desertification (UNCCD) came into force in 1996, it has lacked an efficient mechanism through which it can access state-of-the-art scientific knowledge on desertification, land degradation and drought. In 2011, responding to growing critiques

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from scientists, governments and the UN itself (Bauer and Stringer, 2009; Grainger, 2009; Ortiz and Tang, 2005), the Conference of the Parties of the UNCCD decided to convene an international group of twelve scientists and gave them a unique challenge: to design a new mechanism for science-policy communication based on the best available scientific evidence (UNCCD, 2012a). This article outlines the innovative ‘modular mechanism’ which this group proposed to the Conference of the Parties in September 2013, and how the mechanism was designed, by building on insights from the boundary organization model of science-policy communication and the new ‘governance’ literature.

## 2. Background

The UNCCD was agreed in 1994 as the third of the ‘Rio Conventions’ that emerged from the UN Conference on Environment and Development, held in Brazil in 1992. It defines desertification as: “land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities” (UN, 1994). The convention also has a major role to play in implementing the commitment made at the Rio+20 Conference in 2012 to achieve a “land degradation neutral world in the context of sustainable development” (UN, 2012). This accord has been incorporated within the new Sustainable Development Goals by a UN Summit to Adopt the Post-2015 Development Agenda (UN, 2015).

To operate effectively, the UNCCD requires access to evidence-based scientific knowledge which is formatted and communicated in a policy-relevant way to meet decision makers’ needs. The text of the Convention states that its Conference of the Parties should receive scientific advice from the Committee on Science and Technology (CST) (UN, 1994). However, as this committee is also required by the Convention to comprise government representatives, it depends heavily on external inputs of knowledge from scientists. The UNCCD has used various mechanisms to supply these inputs, including ad hoc panels of scientists; a Group of Experts which served for six years (2001–2007); and, most recently, a series of biennial UNCCD Scientific Conferences, which discuss scientific knowledge on a theme chosen by the CST. Yet all of these mechanisms have had limited immediate effectiveness, owing to political constraints, such as giving priority to regional representation over scientific competence when choosing experts, as well as funding problems and communication difficulties within the UNCCD (Grainger, 2009).

The Conference of the Parties responded to this situation in 2009 by asking the CST to undertake another evaluation of how to improve the convention’s access to scientific knowledge. The CST consulted widely on four options: (a) use existing scientific networks; (b) establish a new scientific network; (c) use existing intergovernmental scientific advisory mechanisms, such as the IPCC or the recently established Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (Perrings et al., 2011); or (d) establish a new intergovernmental scientific panel on land and soil (Thomas et al., 2012). When the CST failed to reach agreement on a preferred option, the Conference of the Parties decided in 2011 to establish a twelve member Ad Hoc Working Group on Scientific Advice (AGSA) to develop a fresh approach (UNCCD, 2012a). The present authors include all the members of this group.

## 3. Methods

The AGSA was asked in its Terms of Reference to acknowledge the merits of the four ‘macro’ options considered by the CST, but to go beyond them by taking a ‘micro’ approach, which involved

**Table 1**

Eleven generic components of science-policy communication mechanisms, as analysed by the AGSA.

|     |   |
|-----|---|
| 1.  | Role and objectives   |
| 2.  | Implementation mechanisms and functional modalities               |
| 3.  | Legal and financial implications                                  |
| 4.  | Mandate   |
| 5.  | Legal status  |
| 5.  | Membership  |
| 7.  | Governing modalities and science-policy interface                 |
| 8.  | UNCCD core and essential disciplines and thematic areas           |
| 9.  | Exploiting synergies with existing panels, platforms and networks |
| 10. | Expected outputs and deliverables, and the reporting process      |
| 11. | Non-academic knowledge  |

analysing 11 generic *components* that should be present in any good science-policy communication mechanism (Table 1). These components were identified by the CST Bureau, comprising the five members of the CST who follow up its work between formal sessions (UNCCD, 2012b). To facilitate reporting of the AGSA’s findings in this paper, the components are divided here into five main groups:

1. Components 1 (role and objectives), 2 (implementation mechanisms and functional modalities), and 3 (legal and financial implications), which all refer to an entire mechanism of science-policy communication.

2. Components 4 (mandate), 5 (legal status) and 6 (membership), which refer to each of the constituent bodies of the mechanism.

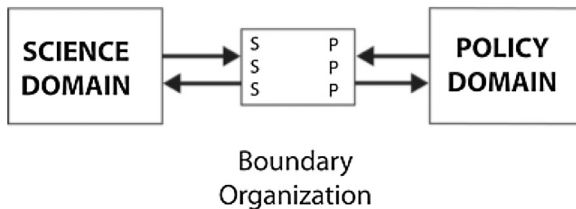
3. Component 7 covers the science-policy interface where scientific knowledge is shared with policy makers, and how the interface and the mechanism as a whole are governed.

4. Component 8 identifies the disciplines to which advisors should belong if comprehensive inputs of scientific knowledge are to be provided by the scientific bodies in the mechanism, while component 9 identifies potential contributions by external science-advisory bodies.

5. Component 10 describes the outputs reported to the CST and to stakeholders within and outside the intergovernmental arena, who may also contribute their non-academic knowledge (component 11).

The AGSA evaluated alternative options for each component and then identified the option that was likely to be the most effective. The preferred options were then pieced together, much like a jigsaw, to construct the overall science-policy communication mechanism that was recommended to the UNCCD.

To frame the analysis of the eleven components, and of the factors that have limited the UNCCD’s access to state-of-the-art scientific knowledge, two existing conceptual frameworks were used. First, the *boundary organization model*, which has been widely used for analysing science-policy communication in recent decades (e.g. Hoppe and Wesselink, 2014; Lee et al., 2014). According to this model, communication between the science and policy domains is most effective when it flows in both directions. Negotiations within small groups of scientists and policy makers, called *boundary organizations*, can greatly facilitate the translation of scientific knowledge into lay language, and ideal two-way communication is achieved when the scientists and policy makers involved in these negotiations are each responsible to their parent domains (Fig. 1) (Cash et al., 2003). Because the UNCCD’s scientific advisers have previously only been responsible to the UNCCD and



**Fig. 1.** The boundary organization model, showing scientists (S) and policy makers (P) in a boundary organization, each responsible to their respective domains (based on Cash et al., 2003).

not to their fellow scientists, e.g. through peer review, there have been no external checks on the quality of scientific advice given to the UNCCD (Grainger, 2009). Consequently, the two way flows of information and knowledge that are fundamental to the boundary organization model have been absent.

The boundary organization model also proposes that negotiations in boundary organizations optimize the combination of the salience, legitimacy and scientific credibility of the translated knowledge as perceived by policy makers (Cash et al., 2003). According to one analysis, the UNCCD's primary concern when selecting scientific advisers has not been their *credibility*, as determined by their competence, but their *legitimacy*, e.g. whether they are representative of the five regions recognized by the UNCCD (Grainger, 2009). One explanation for this is that politicians often view scientific knowledge as a commodity, and assume that any scientist can communicate it (Thomas, 1997). However, the most competent scientists in any field will not only be recognized as such by their peers, but will also understand the full range of state-of-the-art scientific knowledge, and prevent oversimplifications when this is synthesized for policy makers. The autonomy of scientists is further limited if they regard themselves as representatives of their governments.

The second framework expands the generic description of styles of governing to encompass the recent shift from the conventional government style, in which governments steer society, towards a new *governance* style in which society steers itself through inclusive, multi-scalar and polycentric networked processes, and in which non-state (or civil society) groups are more influential relative to governments than they were in the past (Held and McGrew, 2002; Rhodes, 1996, 2007; Ostrom, 2010).

Evidence for this shift is accumulating. For example, the unidirectional policy instruments which governments have traditionally used to implement their policies, e.g. regulations and grants, have been increasingly superseded by a new family of policy instruments that are multi-directional and less coercive, e.g. voluntary agreements, market-based mechanisms and eco-labels (Jordan et al., 2003). Conventional forms of environmental management which relied on top-down bureaucratic administration are being replaced by more decentralized approaches (Ribot et al., 2010). At local scale, communities are devising their own rules to manage their environments sustainably when management by state organizations proves ineffective (Ostrom, 2005). Non-governmental organizations (NGOs) are substituting for ineffective action by intergovernmental initiatives at global scale too, most notably by establishing the Forest Stewardship Council to accredit groups who determine the sustainability of forest management (Pattberg, 2005). NGOs also had more influence over negotiations on the text of the UN Convention to Combat Desertification than the scientific advisory panel which the UN established to advise the negotiators. For example, by proposing a

distinctive participatory multi-scalar approach to implementing the convention through regional, sub-regional and national action programmes (Corell and Betsill, 2001).

Both frameworks have limitations, though these were not felt to be severe enough to impede their application here. For example, the boundary organization model has been criticized for not covering all forms of boundary arrangements (Hoppe, 2005); specifying all the processes involved in communication between scientists and policy makers (Jacob, 2005; Raman, 2005); and explaining the role of power (Leinhos, 2005). Wider recognition of the transition from the government style of governing to the governance style has been hindered semantically by the common practice of using the term 'governance' as a synonym for governing (e.g. Hoppe and Wesselink, 2014; Mattor et al., 2014). When the boundary organization model was first proposed it did not incorporate the new processes found within this emerging style of governing, and so it assumed that governments could still privilege scientific knowledge over other forms of knowledge (Guston, 1999). Yet the boundary organization model has already been employed together with polycentric governance models (e.g. Grainger, 2012; Lee et al., 2014). Such combinations: (a) help to counter another limitation of the boundary organization model, that it does not include the views of groups other than states and scientists (Bäckstrand, 2003); and (b) support its assumption that the scientific community, like all civil society groups, has the autonomy to communicate its knowledge free of government influence. Such government dominance persists in some arenas, e.g. the Summaries for Policymakers of IPCC Assessment Reports are revised by its member states to ensure political acceptability (Wible et al., 2014). Although the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services will also negotiate and approve Summaries for Policymakers at its plenaries, its rules reflect the realities of the new governance style, by allowing non-governmental stakeholders to participate in nominating a proportion of the experts who produce its reports, and recognizing the value of non-academic knowledge (Borie and Hulme, 2015). A crucial implication of the growing influence of knowledge communicated by other civil society groups in the new governance style is that scientists need to strengthen their interactions with policymakers to ensure that policy formulation is well informed by scientific knowledge.

The AGSA also devised and tested a new *knowledge fingerprinting* method. This is based on the assumption that any major research field can be characterized by the distinctive set of scientific disciplines to which the authors of studies in that field belong, and by the relative percentage contributions of these disciplines to the overall body of knowledge in this field. Any new science-advisory body established to supply comprehensive advice in a given field should therefore contain scientists from the disciplines that constitute the fingerprint of that field. The method can also be used to determine if existing science-advisory bodies can supply this knowledge.

## 4. Results

### 4.1. Component analysis

Addressing the first component in Table 1, the AGSA (2013a) proposed that the *role* of the mechanism should be to: (a) evaluate, synthesize, and serve as a repository for available scientific information and knowledge, and identify information and knowledge gaps on all aspects of desertification, land degradation and drought; and (b) communicate this information, knowledge and policy-relevant (but not policy prescriptive) advice, to the CST and to all stakeholders considered relevant for implementation of the Convention. Six *objectives* would help to fulfil this role: (a)

foster a science-policy dialogue so that the information needs of policymakers and other stakeholders considered relevant for the implementation of the Convention are clearly communicated to scientists; (b) undertake comprehensive assessments of desertification, land degradation and drought on the basis of existing information and knowledge, analyse policy-relevant future scenarios, and alert the Parties to the Convention to new developments and issues; (c) serve as a global think-tank and repository for scientific knowledge and information (including scientifically verified non-academic knowledge); (d) catalyse research initiatives and partnerships to generate and disseminate new knowledge at all scales; (e) develop synergistic relationships with other international science-advisory bodies; and (f) provide guidance on appropriate tools to assess and monitor desertification, land degradation and drought at different scales.

The boundary organization model and governance framework were employed together in analysing components 4–7. Concerning component 7, the generic term *science-policy interface* is now increasingly used to refer to communication processes between scientists and policy makers (e.g. López-Rodríguez et al., 2015). Building on insights from the boundary organization model, which indicate that the effectiveness of any mechanism of science-policy communication depends on how its interface is governed, the AGSA (2013b) evaluated two main governing style options derived from the governance framework: (i) a *government* option, in which the CST would decide the rules of the science-policy interface, thus maintaining the status quo; and (ii) a *governance* option, in which the science-policy interface would be jointly managed by UNCCD representatives and scientific advisers representing an independent international group of scientists. The AGSA (2013b) concluded that option (ii) was preferable, based on the large body of empirical evidence for the existence of political constraints on scientists under previous UNCCD mechanisms consistent with option (i); and also on theoretical grounds, since option (ii) would replicate an ideal boundary organization and leave scientists free to communicate to policy makers all available scientific knowledge. The choice of components 4–6 for the science-policy interface should therefore be consistent with the governance option for its governing style. The AGSA recommended that the science-policy interface should receive a *mandate* from the UNCCD, its *legal status* should be consistent with this, and its *membership* should comprise representatives of the scientific community and the UNCCD.

Selecting the governance option for the science-policy interface also had implications for the choice of components 4–6 for the self-governing *scientific group* which would provide it with synthetic assessments of global scientific knowledge. The AGSA (2013b) concluded that the scientific group should have non-governmental legal status, be responsible to fellow scientists through peer review, and its members should be individual scientists selected on the basis of their scientific credentials.

Specifying the *disciplines* which the members of this scientific group should represent (component 8) was challenging, for two reasons. First, the UNCCD has traditionally relied on a relatively small number of scientists who generally adhere to the convention's definition of desertification as "land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities" (UN, 1994). Many other scientists who study 'land degradation' either do not recognize the validity of "desertification" (Thomas and Middleton, 1994) or they define it differently (Safriel, 2009), yet it is vital that the UNCCD benefits from the knowledge of this broader scientific community too if the science-policy interface is to achieve the ideal two-way communication portrayed in the boundary organization model. The more inclusive term of "desertification, land degradation and drought" helps to bridge this linguistic divide, and

also expresses the UNCCD's aspirations to address degradation both within and outside dry areas. These aspirations have recently been supported by a decision by the 12th Conference of the Parties in 2015 to assist member states in meeting the new land degradation neutrality goal outside dry areas (UNCCD, 2015). The second challenge is that desertification, land degradation and drought are investigated by many disciplines, as together they comprise a highly complex phenomenon linked to multi-scalar social and environmental processes (Reynolds et al., 2007).

To identify the disciplines that would be essential if this scientific group were to provide the UNCCD with comprehensive knowledge the AGSA (2013b) used the new knowledge fingerprinting method, described above, to analyse the actual sources of scientific knowledge on desertification and land degradation. A sample of 140 papers with 'desertification' in their titles and published between 1977 and 2012 were found to be written by scientists from 19 disciplines (or sub-disciplines). Another sample of 165 papers published in the journal *Land Degradation and Development* between 2008 and 2011 had authors from 18 disciplines. This particular journal was chosen because it was assumed that contributors to it associate their research with the field of 'land degradation'. The four volumes were chosen to provide a sample that was close in size to that of the sample of papers on 'desertification'. Based on these two samples, the AGSA concluded that the UNCCD would need to draw on scientists from 23 disciplines to gain comprehensive knowledge on desertification, land degradation and drought (Table 2). The specialities reported by 1767 members of the UNCCD Roster of Experts placed them in 16 of these disciplines, which indicates that each of these disciplines is recognized as essential by at least one Party to the UNCCD.

The fingerprint for knowledge on land degradation is distinguished by five core disciplines: 62% of authors of the sample of papers in this field belonged to agronomy, geography, environmental management, soil science and ecology, while in the corresponding fingerprint for knowledge on desertification 68% of authors of papers in that field were from these disciplines plus remote sensing (Fig. 2A).

The AGSA then used fingerprinting to check if existing science-advisory bodies could provide the UNCCD with all the knowledge that it needs. As the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services had not published any assessment reports by the time of the AGSA's research, the AGSA (2013b) used samples of papers on biodiversity and ecosystem services to produce a fingerprint for this joint field, and found that this fingerprint is very different from the desertification and land degradation fingerprints (Fig. 2B). Four disciplines – biology, plant

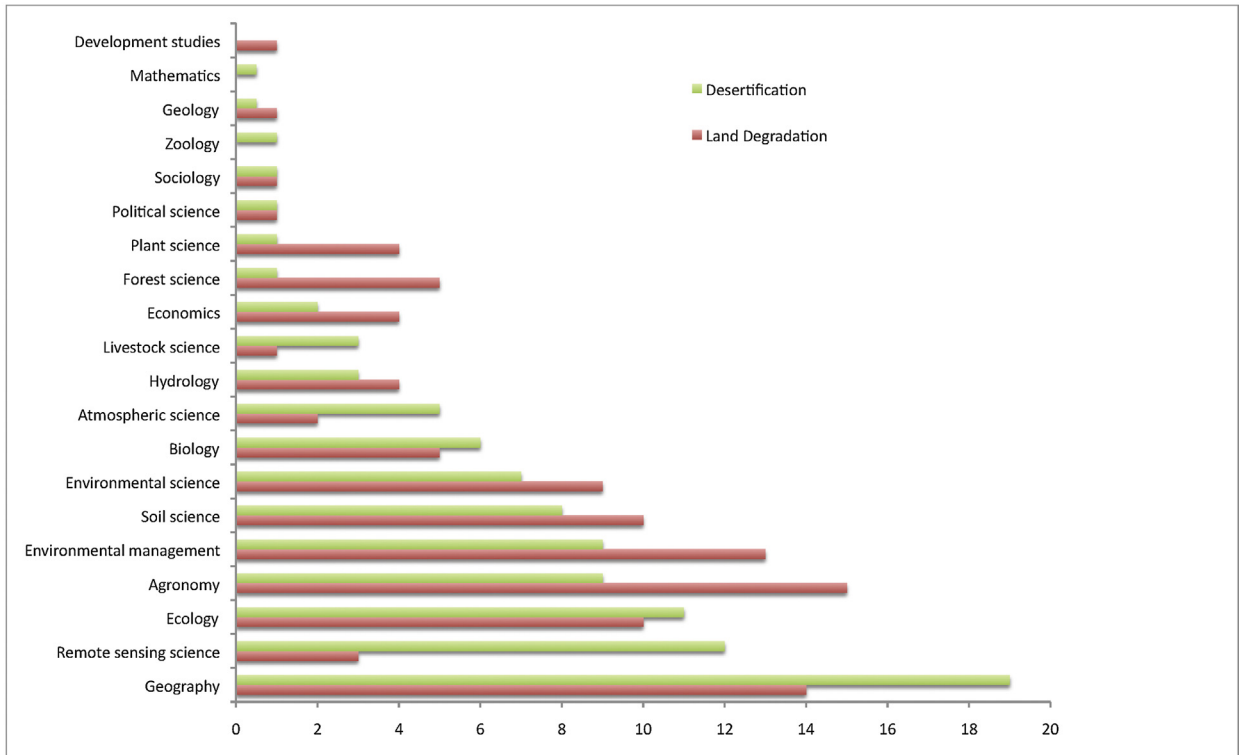
**Table 2**

The 23 essential disciplines and sub-disciplines which study desertification, land degradation and drought, as identified by the AGSA.

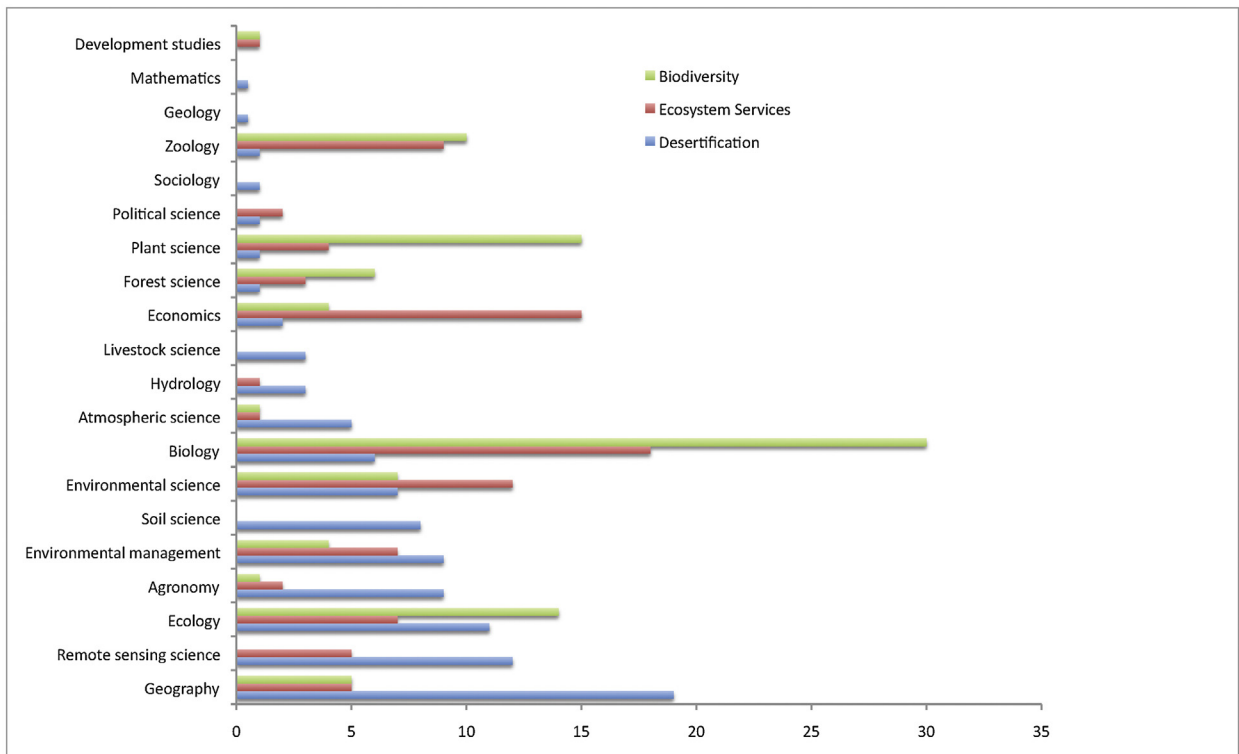
|  |
|--|
| Agronomy, anthropology, atmospheric science, biology, development studies, ecology, economics, environmental management, environmental science, forest science, geography, geology, hydrology, livestock science, medicine, plant science, political science, rangeland management, remote sensing science, sociology, soil science, water management and zoology. |
|--|

NB. The AGSA (2013b) made four discretionary additions to the list of disciplines and sub-disciplines identified by the fingerprinting method: anthropology and medicine were represented in the disciplines of the UNCCD Roster of Experts, while rangeland management and water management were considered to be important sub-disciplines of environmental management. The AGSA concluded that mathematics was fundamental to many essential disciplines but not essential in its own right.

A



B



**Fig. 2.** The disciplinary fingerprints of scientific knowledge on (A) desertification and land degradation; (B) biodiversity and ecosystem services (to simulate the potential for knowledge which could be supplied by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services); and (C) climate change (to represent the knowledge which could be supplied by the Intergovernmental Panel on Climate Change).

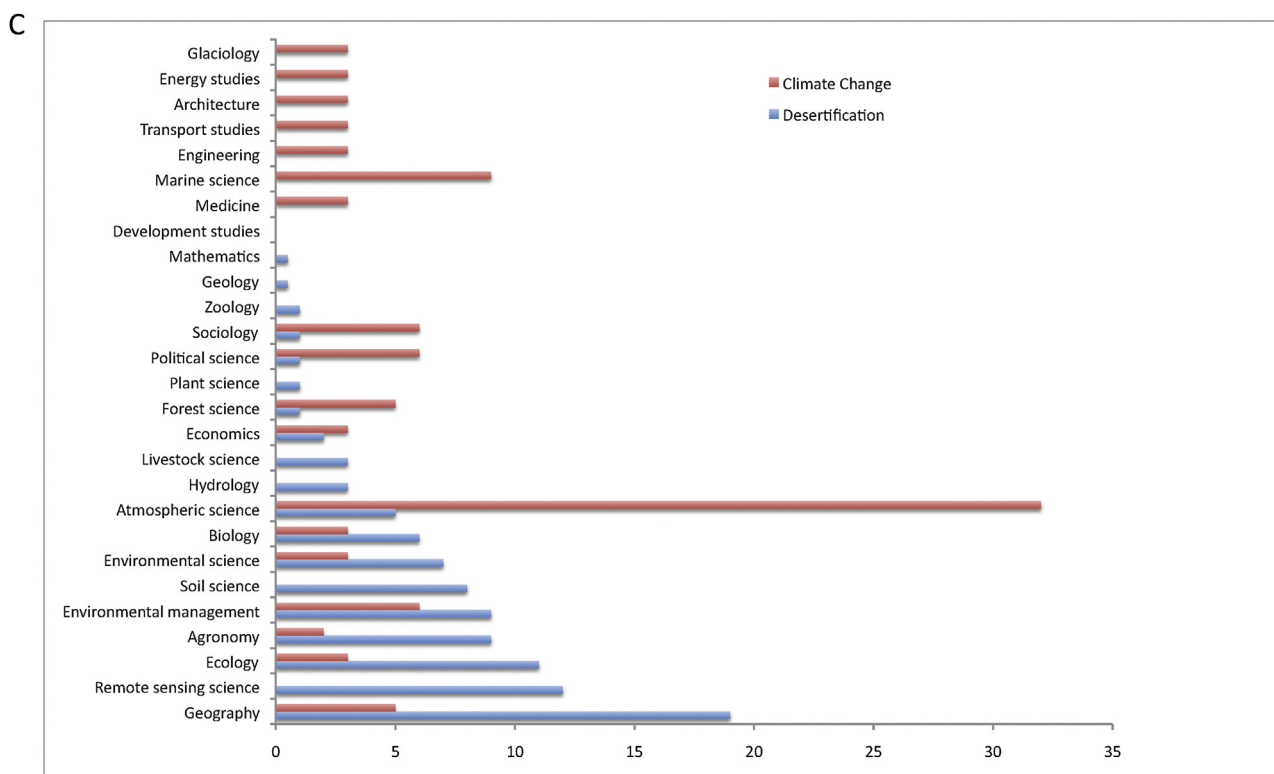


Fig. 2. (Continued)

science, ecology and zoology – accounted for 69% of the authors of a sample of 60 papers on biodiversity, while another set of four disciplines – biology, economics, environmental science and zoology – accounted for 54% of a sample of 60 papers on ecosystem services. Two core disciplines in the desertification and land degradation fingerprints – agronomy and geography – have very low rankings in the biodiversity and ecosystem services fingerprints, and soil science is totally absent.

The fingerprint for knowledge supplied by the IPCC proved more difficult to map. While the IPCC listed the names of the thousands of scientists who contributed to the latest Assessment Report available to the AGSA – the Fourth Assessment Report published in 2007 – the departmental affiliations of scientists were only listed in the reports of one of the three IPCC Working Groups (Working Group I). The AGSA (2013b) therefore constructed an interim proxy fingerprint by assigning to one or more disciplines each of the 33 non-introductory and non-regional chapters of all three volumes of the Fourth Assessment Report (Solomon et al., 2007; Parry et al., 2007; Metz et al., 2007). This suggested that climate change has a distinctive fingerprint, with 32% of knowledge coming from atmospheric science alone. This and four other disciplines – marine/freshwater science, environmental management, political science and sociology – accounted for 59% of all knowledge (Fig. 2C). Environmental management is the only core discipline in the desertification and land degradation fingerprints that features prominently in the IPCC fingerprint, but it only has a 6% share.

Further research is needed to produce a definitive fingerprint for the IPCC, but the AGSA (2013b) concluded that this proxy fingerprint was sufficient to indicate that the IPCC was unlikely to be able to provide all the knowledge that the UNCCD needs. The fingerprint of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services indicated that it could not do so either. The Intergovernmental Technical Panel on Soils (FAO,

2014) was not yet operational when the AGSA undertook its research, but its potential to offer comprehensive advice can easily be evaluated in hindsight using the same fingerprinting method, since all of its 27 current members are specialists in soil science, which is just one of the 23 essential UNCCD disciplines listed in Table 2. So this would not change the AGSA's (2013b) conclusion that the UNCCD needed a new science-advisory body.

To ensure consistency with the choice of options for components 4–7, described above, the AGSA (2013b) considered that the most desirable options selected for components 10 (*outputs and reporting*) and 11 (*non-academic knowledge*) should be consistent with features of the governance style of governing, and that consequently they should be linked to multi-directional flows of information and knowledge. Since the intensity of desertification, land degradation and drought varies greatly from place to place, even within the same area (Warren, 2002), when evaluating component 10 the AGSA inferred that global peer-reviewed knowledge was insufficient to assist the UNCCD and stakeholders in planning programmes to combat desertification, land degradation and drought in the UNCCD's five regions: Africa, Asia, Central and Eastern Europe, Latin America and the Caribbean, and the Northern Mediterranean. Consequently, the AGSA (2013a) concluded that to obtain all the knowledge that it needs the UNCCD should also: (a) make direct use of the expertise of scientists in each of the UNCCD's five regions, since much reliable scientific knowledge never makes the transition from research institute publications to well-cited academic journals; and (b) draw on non-academic local knowledge (component 11), whose importance is recognized in the text of the Convention. New regional bodies would be needed in each region to facilitate these flows of knowledge, and the AGSA (2013a) decided that their mandate, legal status and membership (components 4–6) should be chosen by representatives of each region.

**Table 3**  
Conclusions on the best option for each of the eleven components divided into four functional groupings, the three modules of the resulting modular mechanism, and the generic principle (in italics) associated with each module.

| Component                                | Functional grouping  | Best option for component   | Module (and principle)   |
|--|--|---|--|
| <b>Entire Mechanism</b>                  |  |   |  |
| 1.                                       | Role & objectives  | See text  | –  |
| 2.                                       | Implementation mechanisms & functional modalities          | Sequential implementation   |  |
| 3.                                       | Legal & financial implications                             | Sequential implementation is feasible   |  |
| <b>Science-Policy Interface</b>          |  |   |  |
| 4.                                       | Mandate  | From the UNCCD  | <b>Science-Policy Interface</b><br><i>Science-policy interfaces are jointly managed by policy makers and scientists</i>  |
| 5.                                       | Legal status   | Consistent with UNCCD status  |  |
| 6.                                       | Membership   | Representatives of UNCCD and scientific community   |  |
| 7.                                       | Governing modalities & science-policy interface            | Science-policy interface is jointly managed by scientists and policy makers   |  |
| <b>Scientific Group</b>                  |  |   |  |
| 4.                                       | Mandate  | Accountable to scientific community   | <b>Independent Non-Governmental Group of Scientists</b><br><i>Unbiased and peer-reviewed reports that synthesize available scientific knowledge are produced by autonomous groups of scientists who are accountable to the wider scientific community and are selected on the basis of scientific competence</i> |
| 5.                                       | Legal status   | Non-governmental  |  |
| 6.                                       | Membership   | Individual scientists are selected on the basis of their scientific competence  |  |
| 8.                                       | UNCCD core/essential disciplines                           | 23 essential disciplines  |  |
| 9.                                       | Exploiting synergies with existing panels etc.             | Synergies with existing science-advisory bodies are important, but a new scientific group is needed   |  |
| <b>Multi-Directional Knowledge Flows</b> |  |   |  |
| 10.                                      | Expected outputs & deliverables, and the reporting process | Outputs are peer-reviewed. Reporting is multi-scalar and multi-directional, involving new regional science-advisory bodies, whose mandate, legal status and membership (Components 4–6) are chosen within each region | <b>Regional Science &amp; Technology Hubs</b><br><i>Knowledge synthesis and reporting are multi-scalar and multi-directional, so they are salient to the needs of stakeholders at all spatial scales, who may also share their own knowledge with other decision makers</i>                                      |
| 11.                                      | Non-academic knowledge                                     | Regional science-advisory bodies promote use of non-academic knowledge  |  |

The AGSA's recommendations on components 2 and 3, which are concerned with practical aspects of implementation, are discussed in the next section.

#### 4.2. Modular mechanism

When the AGSA (2013a) had identified its preferred options for each component, it found that the eleven components could be assembled into four 'functional groupings'. One of these groupings (components 1–3) referred to the whole of the new mechanism of science-policy communication. Three other groupings, which referred to components 7–11, divided the mechanism into three modules, each of which could also be characterized by components 4–6 (Table 3, Fig. 3):

1. A Science-Policy Interface (SPI), which would comprise policy makers and scientists and be jointly coordinated by them. The SPI would identify the UNCCD's needs for knowledge on desertification, land degradation and drought; meet this demand by discussing and synthesizing available scientific knowledge; and channel its synthesis reports, together with policy-relevant advice, to the CST. Members of the SPI could include the members of the CST Bureau; representatives of UNCCD member states with relevant knowledge; and representatives of the other two modules outlined below. Representatives of UN organizations, other science-advisory bodies and civil society groups could attend SPI meetings as observers to support collective understanding and action. Joint coordination of the SPI by scientists and policy makers would reduce current political constraints on science-policy communication, and help to ensure that information and knowledge flow in both directions, as the boundary organization model requires.

2. The SPI's principal source of global knowledge would be a new international self-governing and self-organizing Independent

Non-Governmental Group of Scientists (IGS). Its members would be drawn from the 23 essential disciplines identified by the AGSA, and would be selected based on their scientific credentials. An IGS would prepare, and deliver to the SPI, comprehensive peer-reviewed reports that provide synthetic assessments of peer-reviewed knowledge and provide policy-relevant advice. Outputs could, for example, include regular assessment reports. Supplementary knowledge could come from three existing science-advisory bodies: the IPCC, Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, and Intergovernmental Technical Panel on Soils. As in an ideal boundary organization model, scientific advisers would be responsible to their peers and scientific credibility would be given a high priority. The IGS would also allow scientists to take advantage of the greater autonomy available to them in the new global environmental governance.

3. Regional Science and Technology Hubs would be established in each UNCCD region to enable existing scientific networks to meet together to collate and synthesize regional knowledge on desertification, land degradation and drought. They would then communicate their reports to the SPI, IGS, governments and other stakeholders, such as non-governmental organizations which undertake sustainable development projects. Knowledge from these regional hubs would complement that from the IGS; enhance research and science-policy communication in each region; and also help every region to make full use of its own scientific and non-academic knowledge, as well as corresponding knowledge from other regions, when designing programmes to combat desertification, land degradation and drought. The hubs would also help to meet the requirements of the many stakeholders in global environmental governance for multi-scalar knowledge in this field.

The regional hubs would play an important role in ensuring the multi-directional and multi-scalar flows of knowledge in the

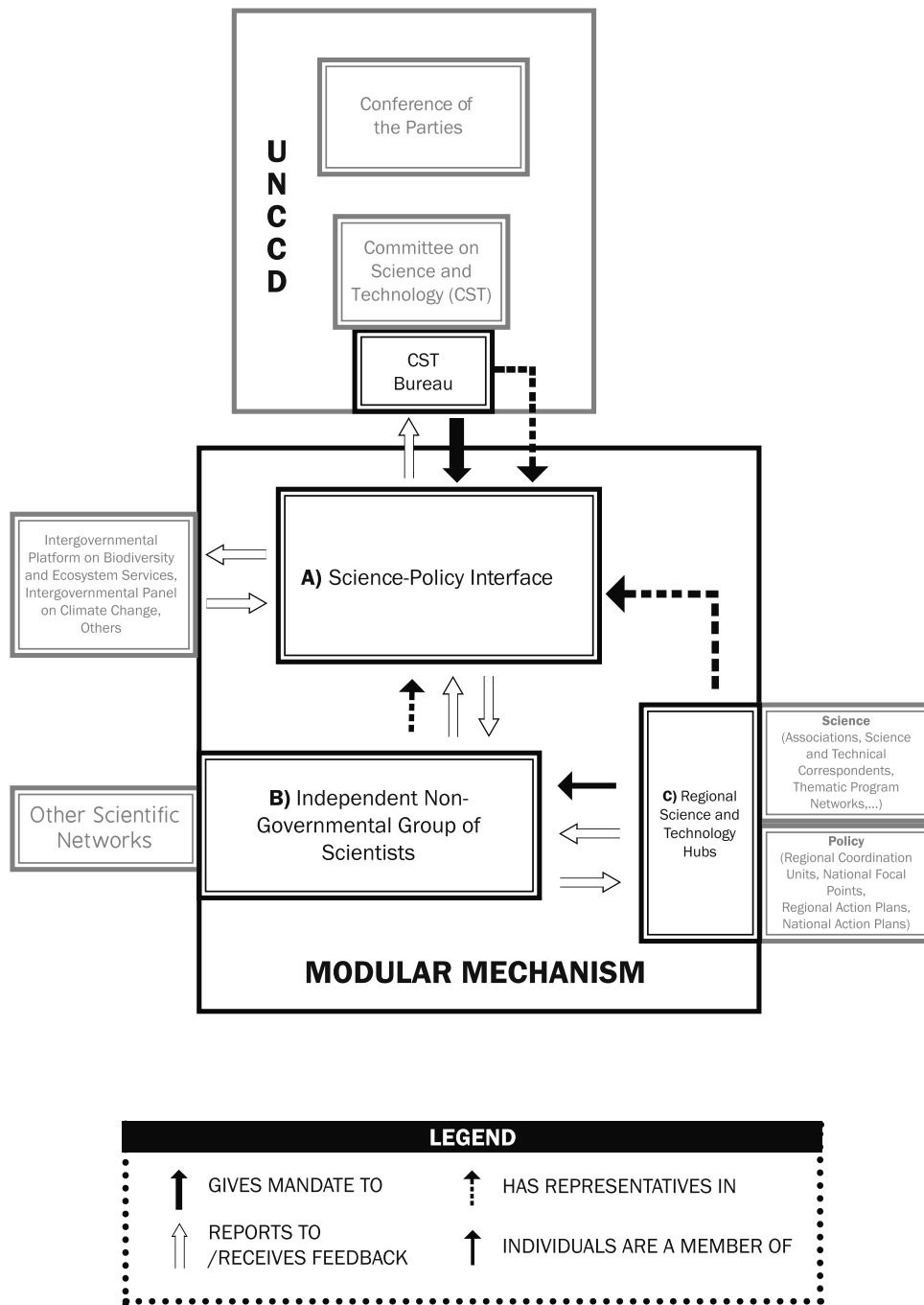


Fig. 3. The modular mechanism proposed by the AGSA to provide scientific advice to the UN Convention to Combat Desertification.

modular mechanism. Two-way exchanges of information and knowledge would occur between the SPI and the IGS, between the SPI and the hubs, between the IGS and the hubs, and between the hubs and regional scientific networks and policy-oriented bodies, including the UNCCD’s Regional, Sub-Regional and National Action Programmes. The hubs would carry out regular assessments to fill information and knowledge gaps in their regions, as well as disseminating scientific knowledge synthesized by the IGS and hubs in other regions. According to the text of the Convention, governments are responsible for documenting non-academic

knowledge in their countries, but the hubs could provide scientific support for using non-academic knowledge in each region.

When the AGSA evaluated options for components 2 and 3 in relation to the modular mechanism it concluded that to facilitate feasible implementation and funding, the SPI should be launched first, as it will play the central role in channelling to the CST knowledge from the other two modules. The IGS would be established next, and then each UNCCD region could design and launch a Regional Science and Technology Hub at its own pace to meet its needs.



## 5. Implementation

After discussing the AGSA's report, the 11th Conference of the Parties held in Namibia in September 2013 agreed to establish the SPI, and to fund it from the Convention's core budget, thereby demonstrating the strong commitment of the UNCCD. The SPI comprises the 5 members of the CST Bureau, 10 scientists selected by the Bureau after an open call to scientists worldwide, 5 scientists nominated by the UNCCD regions, and 3 observers. It is co-chaired by the chair of the CST Bureau and a scientist chosen by SPI members (UNCCD, 2013), and held its first meeting in Bonn on 24–26 June 2014. Three subsequent meetings were held in 2015.

The Conference of the Parties also "encouraged" the formation of the other two modules. It could not go further than this, because if the IGS is to be independent, only scientists can establish it. Similarly, the Regional Science and Technology Hubs must be founded by scientists and governments in each region. Although the Conference of the Parties referred to the IGS and Regional Science and Technology Hubs as "an independent consortium of scientific networks" and "regional science and technology platforms" (UNCCD, 2013), respectively, the functions of these modules remain consistent with those in the AGSA's proposal, and their actual names may differ, as they will be chosen by those who establish them.

As the 11th Conference of the Parties responded positively to the AGSA's challenge by establishing the SPI, it is up to the worldwide scientific community to deliver its part by taking the lead in establishing the other two modules. This paper is intended to support such action. The AGSA proposed that the initial membership of the IGS could come from existing networks, e.g. those established to produce reports for the first two UNCCD Scientific Conferences, and expand from there, using innovative sources of funding. Although the Regional Science and Technology Hubs are equally novel, the Latin American and Caribbean Initiative on Science and Technology performs similar functions as an information clearing house, thereby showing that such hubs are feasible.

Two obstacles could affect early establishment of the IGS. First, scientists are generally happy to serve as experts on UN advisory panels, but have so far been much less willing than non-governmental organizations to operate autonomously in the international arena. Second, establishing the IGS would involve an initial financial risk prior to the award of contracts from the UNCCD. The AGSA (2013b) did not provide an indicative annual budget for the IGS in its report, though it did examine the annual budgets of existing science-advisory bodies, such as the IPCC, and concluded that operating the IGS would be less expensive, and would rely on external funding sources. The cost to the UNCCD would be reduced because the AGSA envisaged that the IGS could also offer advice to bodies other than the UNCCD. The first session of the SPI discussed various novel procedures for funding the IGS and making it more attractive to scientists. For example, regular assessments of the state-of-the-art of scientific knowledge in this field could be published commercially in a dedicated scientific journal, e.g. "Annual Reviews of Desertification, Land Degradation and Drought", which would be consistent with existing journals of this kind.

## 6. Model for other conventions

Other conventions could improve their own access to scientific knowledge by taking advantage of the AGSA's analysis, the modular mechanism design, and three generic principles which represent its innovations in designing science-advisory bodies so that they are consistent with the new governance style of governing (Table 3):

- 1 Science-policy interfaces are jointly managed by policy makers and scientists.

2. Unbiased and peer-reviewed reports that synthesize available scientific knowledge are produced by autonomous groups of scientists who are accountable to the wider scientific community and are selected on the basis of scientific competence.

3. Knowledge synthesis and reporting are multiscalar and multidirectional, so they are salient to the needs of stakeholders at all spatial scales, who may also share their own knowledge with other decision makers.

The IPCC continues to be criticized for political bias introduced by governments when finalizing its Summaries for Policymakers (Wible et al., 2014); for neglecting social science perspectives (Bjurström and Polk, 2011; Hulme and Mahoney, 2010) – a problem experienced by the UNCCD too; and for poor communication (Beck, 2012). So while the IPCC agreed in Nairobi in February 2015 to make only minor changes to its current procedures when preparing the Sixth Assessment Report (IPCC, 2015), more fundamental structural changes seem inevitable. Proposals by Zorita (2010) that it should be replaced by an independent International Climate Agency, with its own staff of 200 scientists, and by Price (2010) that governments should no longer select lead authors and that all scientists should be chosen according to their competence, are consistent with the AGSA's second (autonomy) principle. A proposal by Hulme (2010) for a tripartite structure – a Global Science Panel, Regional Evaluation Panels and a Policy Analysis Panel – has interesting parallels with the modular mechanism. If the Global Science Panel had non-governmental status (one of two options considered by Hulme (2010)) it would resemble the IGS. The Regional Evaluation Panels are similar to Regional Science and Technology Hubs, and satisfy the AGSA's third (multiscalar) principle in being decentralized and responsible to governments, civil society organizations and businesses (Hulme, 2010).

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services shares many features of the IPCC, but its design is consistent with the AGSA's third (multiscalar) principle, as it allows non-governmental stakeholders to participate in nominating the experts who produce its reports, and it recognizes the value of non-academic knowledge. Although the functioning of the new platform has already come under critical scrutiny (e.g. Borie and Hulme, 2015), the present authors believe that since the platform is still evolving it will take time to determine if its design will give the Convention on Biological Diversity and other conventions the scientific advice they need.

## 7. Conclusions

This is a pivotal moment for scientists studying global environmental change. In the two decades since the three Rio Conventions came into force, progress in tackling global environmental problems has not been as great as many hoped for back in 1992. However, if scientists can take advantage of the fresh opportunities which the new global environmental governance offers for autonomous action by civil society generally, then they could serve as catalysts for faster progress.

Scientists belonging to the 23 disciplines that study desertification, land degradation and drought have a major role to play in this. The AGSA has already succeeded in gaining approval from the UNCCD for establishing one of the modules in the modular mechanism, in what is perhaps the first example of a UN convention using scientific principles as the basis for determining how it receives scientific knowledge. If the world's drylands scientists can now assert their autonomy and take the lead in establishing the remaining two modules then, as well as bringing about a quantum leap in the UNCCD's access to scientific

knowledge, they could inspire similar initiatives in other international environmental conventions too.

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## Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.envsci.2016.03.009>.

## References

- AGSA, 2013a. Conclusions and recommendations of the ad hoc working group to further discuss the options for the provision of scientific advice focusing on desertification/land degradation and drought issues. ICCD/COP(11)/CST/3. UN Convention to Combat Desertification, Bonn.
- AGSA, 2013b. Report by the ad hoc working group to further discuss the options for the provision of scientific advice focusing on desertification/land degradation and drought issues. ICCD/COP(11)/CST/INF.2. UN Convention to Combat Desertification, Bonn.
- Bäckstrand, K., 2003. Civic science for sustainability. *Global Environmental Politics* 34, 24–41.
- Bauer, S., Stringer, L.C., 2009. The role of science in the global governance of desertification. *J. Environ. Dev.* 18, 248–267.
- Beck, S., 2012. Between tribalism and trust: the IPCC under the 'public microscope'. *Nat. Cult.* 7, 151–173.
- Bjurström, A., Polk, M., 2011. Physical and economic bias in climate change research: a scientometric study of IPCC Third Assessment Report. *Clim. Change* 108, 1–22.
- Borie, M., Hulme, M., 2015. Framing global biodiversity: IPBES between mother earth and ecosystem services. *Environ. Sci. Policy* 54, 487–496.
- Cash, D.W., Clark, W., Alcock, F., Dickson, N., Eckley, N., Guston, D., Jager, J., Mitchell, R., 2003. Knowledge systems for sustainable development. *Proc. Natl. Acad. Sci. U. S. A.* 100, 8086–8091.
- Corell, E., Betsill, M.E., 2001. A comparative look at NGO influence in international environmental negotiations: desertification and climate change. *Glob. Environ. Polit.* 1 (1), 86–107.
- FAO, 2014. Report of the Second Session of the Intergovernmental Technical Panel on Soils, Rome, Italy, 7–11 April 2014. United Nations Food and Agriculture Organization, Rome.
- Grainger, A., 2009. The role of science in implementing international environmental agreements: the case of desertification. *Land Degrad. Dev.* 20, 410–430.
- Grainger, A., 2012. The role of forest sustainability indicator systems in global governance. *Glob. Environ. Change* 22, 147–160.
- Guston, D., 1999. Stabilizing the boundary between US politics and science: the role of the Office of Technology Transfer as boundary organization. *Soc. Stud. Sci.* 29, 1–25.
- Held, D., McGrew, A., 2002. Introduction. In *Governing Globalization*, Held, D., McGrew, A. (eds). Polity Press Cambridge, pp. 1–21.
- Hoppe, R., 2005. Rethinking the science-policy nexus. *Poiesis Praxis* 3, 199–215.
- Hoppe, R., Wesselink, A., 2014. Comparing the role of boundary organizations in the governance of climate change in three EU member states. *Environ. Sci. Policy* 44, 73–85.
- Hulme, M., Mahoney, M., 2010. Climate change: what do we know about the IPCC? *Prog. Phys. Geogr.* 34, 705–718.
- Hulme, M., 2010. Split into three panels. *Nature* 463, 730–731.
- IPCC, 2015. IPCC takes decisions on future work. Press Release, 27 February. Intergovernmental Panel on Climate Change, Geneva.
- Jacob, M., 2005. Boundary work in contemporary science policy. *Prometheus* 23, 195–207.
- Jordan, A., Wurzel, R.K.W., Zito, A.R., 2003. New instruments of environmental governance: patterns and pathways of change. *Environ. Polit.* 12 (1), 1–24.
- Lee, E., Jung, C.S., Lee, M.-K., 2014. The potential role of boundary organizations in the climate regime. *Environ. Sci. Policy* 36, 24–36.
- Leinhos, M., 2005. The US national bioethics advisory commission as a boundary organization. *Sci. Publ. Policy* 32, 423–433.
- López-Rodríguez, M.D., Castro, A.J., Castro, H., Jorroto, S., Cabello, J., 2015. Science-policy interface for addressing environmental problems in arid Spain. *Environ. Sci. Policy* 50, 1–14.
- Mattor, K., Betsill, M., Huayhuaca, C., Huber-Stearns, H., Jedd, T., Sternlieb, F., Bixler, P., Luizza, M., Cheng, A.S., 2014. Transdisciplinary research on environmental governance: a view from the inside. *Environ. Sci. Policy* 42, 90–100.
- Metz, B., Davidson, O.R., Bosch, P.R., Dave, R., Meyer, L.A. (Eds.), 2007. *Climate Change 2007: Mitigation of Climate Change*. Cambridge University Press, Cambridge.
- Ortiz, E.F., Tang, G., 2005. Review of the Management, Administration and Activities of the UN Convention to Combat Desertification (UNCCD). Joint Inspection Unit, United Nations, Geneva.
- Ostrom, E., 2005. *Understanding Institutional Diversity*. Princeton University Press, Princeton.
- Ostrom, E., 2010. Polycentric systems for coping with collective action and global environmental change. *Glob. Environ. Change* 20, 550–557.
- Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J., Hanson, C.E. (Eds.), 2007. *Climate Change 2007: Impacts, Adaptation and Vulnerability*. Cambridge University Press, Cambridge.
- Pattberg, P., 2005. What role for private rule-making in global environmental governance? Analysing the Forest Stewardship Council (FSC). *Int. Environ. Agreem.* 5, 175–189.
- Perrings, C., Duraiappah, A., Larigauderie, A., Mooney, H., 2011. The biodiversity and ecosystem services science-policy interface. *Science* 331, 1139–1140.
- Price, J., 2010. Produce more reports faster. *Nature* 463, 732.
- Raman, S., 2005. Institutional perspectives on science-policy boundaries. *Sci. Publ. Policy* 32, 418–422.
- Reynolds, J.F., Stafford Smith, D.M., Lambin, E.F., Turner, B.L.I.I., Mortimore, M., Batterbury, S.P.J., Downing, T.E., Dowlatabadi, H., Fernández, R.J., Herrick, J.E., Huber-Sannwald, E., Jiang, H., Leemans, R., Lynam, T., Maestre, F.T., Ayarza, M., Walker, B., 2007. Building a science for dryland development. *Science* 316, 847–851.
- Rhodes, R.A.W., 1996. The new governance: governing without government. *Polit. Stud.* 44, 652–667.
- Rhodes, R.A.W., 2007. Understanding governance: ten years on. *Org. Stud.* 28, 1243–1264.
- Ribot, J.C., Lund, J.F., Treue, T., 2010. Democratic decentralization in sub-Saharan Africa: its contribution to forest management, livelihoods, and enfranchisement. *Environ. Conserv.* 37, 35–44.
- Safriel, U., 2009. Deserts and desertification: challenges but also opportunities. *Land Degrad. Dev.* 20, 353–366.
- Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K.B., Tignor, M., Miller, H.L. (eds), 2007. *Climate Change 2007: The Physical Science Basis*. Cambridge University Press, Cambridge.
- Thomas, D.S.G., 1997. Science and the desertification debate. *J. Arid Environ.* 37, 599–608.
- Thomas, D.S.G., Middleton, N.J., 1994. *Desertification: Exploding the Myth*. John Wiley, Chichester.
- Thomas, R.J., Akhtar-Schuster, M., Stringer, L.C., Marques, M.J., Escadafal, R., Abraham, E., Enne, G., 2012. Fertile ground? Options for a science-policy platform for land. *Environ. Sci. Policy* 16, 122–135.
- UN, 1994. *Elaboration of an International Convention to Combat Desertification in Countries Experiencing Serious Drought And/or Desertification, Particularly in Africa*. United Nations, New York.
- UN, 2012. *The Future We Want*. Outcome document adopted at Rio + 20, UN Conference on Sustainable Development, Rio de Janeiro, Brazil, 20–22 June 2012. United Nations New York.
- UN, 2015. *Transforming Our World: The 2030 Agenda For Sustainable Development*. Finalised text for adoption (1 August). United Nations New York.
- UNCCD, 2012a. Report of the Conference of the Parties on its tenth session, Changwon, 10–21 October 2011. Addendum. Part 2: Action taken by the Conference of the Parties at its 10th Session. ICCD/COP(10)/31/Add.1. UN Convention to Combat Desertification, Bonn.
- UNCCD, 2012b. Terms of reference for an ad hoc working group to further discuss the options for the provision of scientific advice focusing on desertification/land degradation and drought issues (AGSA). UN Convention to Combat Desertification, Bonn.
- UNCCD, 2013. Report of the Conference of the Parties on its eleventh session, ICCD/COP(11)/23/Add.1. UN Convention to Combat Desertification, Bonn.
- UNCCD, 2015. Report of the Conference of the Parties on its twelfth session, ICCD/COP(12)/20/Add.1. UN Convention to Combat Desertification, Bonn.
- Warren, A., 2002. Land degradation is contextual. *Land Degrad. Dev.* 13, 449–459.
- Wible, B., Victor, D.G., Gerlagh, R., Baiocchi, G., Dubash, N.K., Fleurbaey, M., Kartha, S., 2014. IPCC lessons from Berlin. *Science* 345, 34–36.
- Zorita, E., 2010. Independent agency needed. *Nature* 463, 731.