Science to policy – Reflections on the South African reality

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Research is a key resource in a knowledge economy and governance system. In order to enable research to benefit the nation and to contribute to growing the knowledge-based economy (the aims of the Global Change Grand Challenge, and specifically the Society and Sustainability Research Programme), the gap between research, knowledge production and policy and management (i.e. the knowing-doing gap[1]) needs to be closed, yet closing this gap remains a complex challenge[2]. This year's annual SANCOR (South African Network for Coastal and Oceanic Research) Forum meeting addressed this gap through consultation with a variety of stakeholders from the coastal and marine science community. Our brief was to provide for reflection and discussion on aspects of the science–policy–management interface within South Africa and this commentary provides a summary of the Forum discussions. We detail some current challenges of integrating coastal and marine science into policy and decision-making in South Africa, highlight 'success stories' and provide some thoughts on maximising overlap and building a sound science–policy interface. Although couched in the context of marine and coastal sciences, our findings will resonate with other scientific disciplines. Similarly, the challenges in and opportunities for creating constructive dialogue for evidence-based decision-making are not specific to South Africa, so we draw on national, international and collective experience to provide an avenue for doing so. In this commentary we highlight current examples of mismatch between science and policy by focusing on barriers resulting from legislation, politics and a general lack of process for better integration. In particular, we focus on the complexities of evidence-based decision-making at different scales, and how international scientific engagement has helped shape policy in South Africa. We finish by providing some perspectives, directions and examples to help narrow the gap and foster better science–policy integration into the future.

The gap between policy support and science: How messy is it really?

The theory behind the gap

With increasing globalisation, the impacts of climate change, the focus on growth economies, food security and increasing (or maintaining) human well-being and livelihoods, there have never been as many challenges in and opportunities for science to inform, contribute to and support decision-making. Science has made meaningful contributions to decision-making processes and several publications have focused on the importance of this relationship. These contributions have impacted fields such as conservation[3,4], fisheries[5] and medicine[6], yet barriers still exist that prevent the ready integration of research into policy. In South Africa, some notable initiatives do exist that try to actively engage across the divide, including the Programme to Support Pro-poor Policy Development under the auspices of the Department of Planning, Monitoring and Evaluation – yet such targeted programmes remain few. All too often the science–policy interface is limited to opportunities during public participation events, rather than allowing for the constructive 'co-creation' or consultative approaches (Figure 1) that lead to overall benefits in the design and implementation of policies.

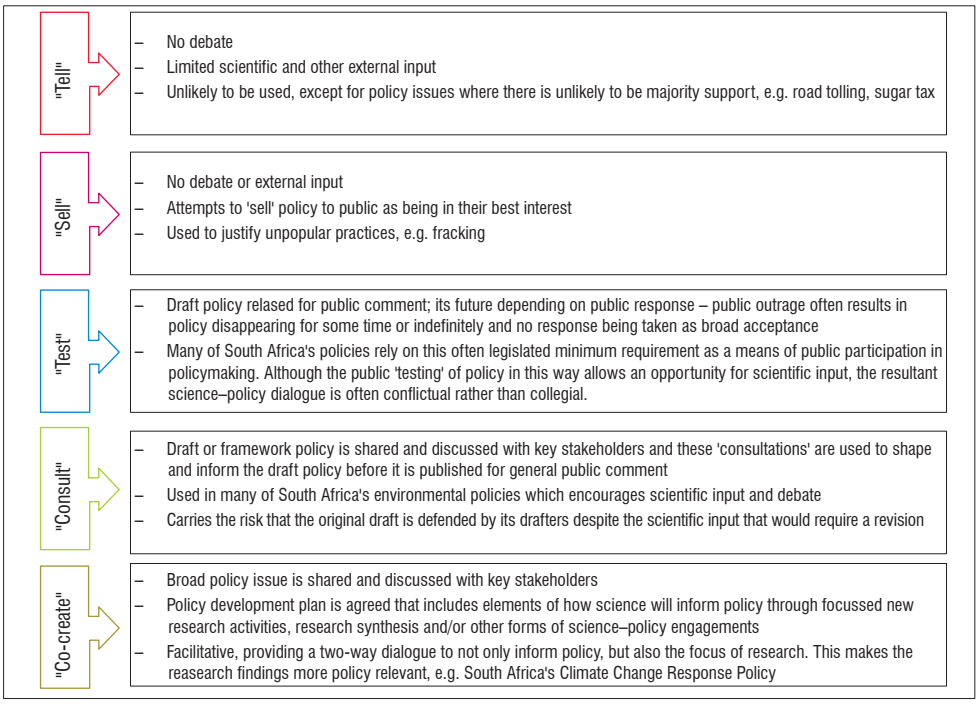


Figure 1: Senge's[11] five decision-making strategies may be used as a framework to describe policymaking in South Africa and the opportunities for evidence-based policymaking associated with each strategy.

Box 1: Common barriers to successful integration of science into evidence-based decision-making and policy

1. A disjunct in timing – a research project from grant application to completion can take several years, whereas policymakers work on much shorter time scales.
2. A lack of training for scientists in navigating the decision-making processes that lead to formulation of policy, as well as in transdisciplinary research.
3. A lack of mutual understanding of the scientific process and the policy cycle, which includes the time scale and characteristics of achieving a successful outcome. Success in science is predominantly measured by academic impact whereas managers aim to achieve positive societal impact. Academic impact, generally speaking, often falls short of providing a timely and appropriate contribution to societal change. Conversely, enduring societal impact is not generally possible without timely access to appropriate knowledge.
4. A lack of understanding of the limitations of scientific findings and equally important the lack of understanding of the multidimensional decision-making required for real-world problems faced by managers and politicians.
5. Presented scientific data being ignored because policymakers have not been convinced of its policy importance, significance, relevance or implications.
6. A lack of opportunities that allow researchers and managers space to engage constructively around the gaps in knowledge production, focusing on policy-relevant data, and to build relationships based on mutual trust and understanding. This includes lack of consultation between policymakers and scientists when policies are being formulated, and can result in scientists being unwilling to engage in science to enable or inform what they consider to be poorly formulated policies.
7. Mismatch in the language and processes used by scientists and policymakers. There is a distinct issue that arises from the difference between the language of probability and significance (as used by scientists), and the language of risk, resource availability and perception, used by managers and politicians.
8. Scientists are often unable or unwilling to provide the certainty and absoluteness required and often demanded by managers and policymakers. On the flip side, there is often a lack of clear policy objectives that would enable policy-relevant science to be undertaken.
9. Lack of data accessibility and capacity to find and evaluate the relevant data and its originators.
10. Poor feedback of scientific impact on policy, which prevents researchers from gauging the actual impact of their work.
11. Lack of accountability (perceived or otherwise) of government and policymakers.

Box 1 provides an overview of some of the common challenges. These challenges are not mutually exclusive, but rather act as multiple, additive obstacles. Surprisingly, however, little research has gone into understanding the contribution that each of these factors makes to science–policy overlap. The question 'What is it that can be done to increase impacts that are transparent, easily applied and consistent?' therefore resonates with both the research community and policy developers. Clearly, evidence-based decision-making will not only benefit policy processes, but also contribute to more effective implementation as it provides a mechanism for ownership and commitment from stakeholders. Put differently, how can the scientific process and the policy cycle be better integrated to create conditions for decision-making based on appropriate and quality scientific evidence, and the needs and desires of communities? Below we focus on four examples.

Example 1: 'Too much, too soon'

The *Integrated Coastal Management (ICM) Act* provides one good example of the science–policy disconnect within the context of the science and policy gap. South Africa is among only a handful of countries globally, particularly in Africa, that has a formalised and institutionalised ICM,[7] which includes legal instruments, policy documents as well as guidelines and strategies and the use of state of the coast reporting, among others. The ICM is also strongly and formally institutionalised within the governance system in South Africa. The ICM Act compels the creation of 'coastal committees' at national and provincial levels, as well as a host of other technical and political fora forming part of the coastal management landscape down to local government level. Theoretically, the substantial effort to establish a system of integrated coastal management provides ready and usable science to the policy pathway. It provides feedback mechanisms between spheres of government and also between civil society sectors. However, underlying the 2008 ICM Act is the enormous complexity of its implementation, which has reduced the impact and reach of the strong legislation. Moreover, determining its effectiveness is hampered by the availability of data; the first 5-year policy cycle remains to be evaluated before improving and expanding the initial processes.

Example 2: Individual decisions versus a formal process

Other issues at the messy science–policy interface pertain to the legislative pathways leading to evidence-based decision-making which, in some countries, is regulated by national legal instruments. An extreme example is the *Magnusson-Stevens Fishery Conservation and Management Act* of the United States of America[8], which is highly prescriptive. In contrast, South Africa's *Marine Living Resources Act*[9] is virtually silent on the requirement for integrating research. Nevertheless, the overarching United Nations Convention on Law of the Sea[10], together with various voluntary instruments of the Food and Agriculture Organization, empower the relationship between science and decision-making in fisheries, even in the absence of strong national legislation. Thus, a close connection between science, policy and management has been a long-standing feature of South African fisheries management. The primary weakness of this arrangement is, however, that it can be heavily influenced by the preferences of individual decision-makers and the extent to which scientific information is counter-weighed by less rigorous information relating to social well-being, food security and local economic drivers. Thus the relationship between science, policy and management in legislation, while enabling, may not necessarily impact the decision-making processes effectively.

Example 3: Exclusion of science during policy formulation

Scientists are often not privy to the formulation of policy although ultimately, they are significantly affected by the legislation. For example, the current drafting of the new Marine Spatial Planning Bill did not include input from scientists not affiliated with government in its formulation, although South Africa has a strong background in marine spatial planning with extensive data from multiple disciplines that could richly inform policy; in fact, South Africa is at the forefront of marine spatial planning globally. However, the only opportunity for scientists to comment was during the public participation period which did not allow for the science, knowledge and process to be reviewed and integrated into the bill. This situation falls under Senge's[11] 'test' scenario (Figure 1), in which important stakeholders can only participate after the drafting of the initial legislation. Ironically, once enacted, scientists will be expected to perform policy-relevant science that they had no meaningful input in developing.

Example 4: Political decisions trump 50 years of science

Fisheries around the world provide some of the best-known and clear examples of the 'trumping' of scientific advice by political opinion or expedience. Throughout the history of South Africa's fisheries, such overriding of scientific advice has been a significant contributing factor

leading to the current poor state of many of our nearshore fisheries resources. A pertinent example is Tsitsikamma, South Africa's oldest Marine Protected Area, declared in 1964. Since its declaration there have been several attempts (frequently in periods leading up to elections), to gain access for local communities to fish within the Marine Protected Area. Many years of research have provided solid evidence on the positive impacts of this closed area in protecting certain linefish species not only within the confines of the Marine Protected Area itself, but also over a far wider geographic area where far-reaching positive spillover effects from the closed area contribute to the recovery of depleted fish stocks across their entire range. Research has further demonstrated that associated benefits to coastal communities more broadly (i.e. spanning several hundreds of kilometres on either side of the closed area) outweigh the benefits that could accrue from small and highly localised communities catching fish within the closed area. Despite the availability of such strong scientific evidence to the contrary, access to fish in key areas of the Marine Protected Area was recently granted in response to political pressure from a small group of local residents. Eventually the matter reached the courts, at which time the scientific evidence, and the administrative process used by government to grant the access, was fully considered, and the decision was reversed. This is a clear example of how political influence can be used to override 50 years of scientific evidence.

Converting scientific findings into policy: Differences in scale

Approaches for integrating research into practice and policy differ at local, regional, national and global levels, requiring different workflows and interactions, which adds an additional level of complexity to implementation. In general, at national scales, policies tend to focus on principle-based guidance, providing frameworks for decision-making and broad measures for successful implementation. In a developing nation, the burden is, however, on the state to provide scientific support for decision-making within provinces and local government. Therefore the science to policy pathway differs for the three spheres of government in South Africa and depends on the policy in question. For example, there is virtually no distribution of responsibility outside the national sphere of government when dealing with 'ocean matters'. Fisheries, oil and gas, offshore mining and shipping industries (i.e. big industries with high-value resources) all have a distinctly top-down management design. This allows for a shorter (but potentially heavily politicised) science to policy pathway, with direct relationships between national stakeholders and regulators, as well as the science that supports decision-making at that scale. In these instances, research has a clear and direct pathway to policy. Science supporting these large industries often deals with large, complex and dynamic ecological systems, and science products related to some aspects may be incomplete and rely on expert opinion. So, while the science to policy pathway may be short, the potential impact of decision-making based on partial or incomplete science exists. Conversely, this also provides greater opportunity for the introduction of unfounded opinion and poor science as evidence, as well as opportunities for discrediting good science although it is highly relevant.

In contrast, at finer scales (such as the local government level), science that can contribute to more informed decision-making requires a much longer value-chain, resulting in very specific solutions for equally specific problems. This places greater burden on scientists to understand the flow of evidence-based information through a highly complex stakeholder universe, e.g. municipalities or provincial government. The relationships between stakeholders are complex, often competing and, in many cases, result in the creation of 'wicked problems' that never satisfy all parties. Therefore, while it is possible to design processes that broadly address common issues, the local context (environmental, institutional, etc.) makes it extremely challenging to find a one-size-fits-all solution. For example, climate change adaptation, local resource management and local economic development all require very specific, place-based conditions for local implementation which may not be met with a single solution.

Taking success in informing international policy back to South Africa

South Africa has played important roles at the international level in promulgating global legislation. For example, South Africa's involvement in the Intergovernmental Panel on Climate Change (IPCC) highlights how well South Africans actively engage in a dedicated science–policy dialogue when an efficient and effective platform for this kind of dialogue exists. This international engagement can also have knock-on effects nationally. For example, the Minister of Finance's 2008 budget speech to Parliament provides evidence of how this international engagement impacted on local policy when the Minister noted that '…the United Nations International Panel on Climate Change, in which a South African team led by the Department of Environmental Affairs and Tourism played an active role, has added impetus to the need for policy change'[12]. This high level of engagement has continued with a South African scientist co-chairing IPCC's Working Group II for the compilation of its 6th Assessment Report and provides continuing support for the possibilities of engagement at the national level.

A further example of the inclusion of science in policy and management decisions in South Africa is highlighted by the interactions of fisheries scientists and managers. Fisheries management globally has a long-standing tradition of directly linking science to decision-making and this same close relationship has, for over 100 years, been a feature of South African fisheries management. The existence of this close relationship is confirmed by feedback from international fisheries science experts who participate in the annual international peer review of aspects of South African fisheries science. They frequently indicate that South Africa is on par with respect to international best practice. Similarly, the rigorous audits of the science, policy, management and enforcement landscape that are regular features of fisheries eco-labelling or certification schemes, to which some South African fisheries belong, further confirm the existence of this close relationship.

South Africa has also played a leading international role in integrating science-based biodiversity planning into policy[13], and attracting significant international funding into programmes such as the Cape Action Plan for People and the Environment (CAPE)[14]. CAPE has subsequently underpinned many national and regional biodiversity plans and forms of legislation, and has defined a methodological framework of best practice within a well-networked community of practice (which includes scientists, managers and policymakers who meet annually at the National Biodiversity Planning Forum). Many publications[15,16] have been produced from this work and highlight the important role of stakeholder engagement and user-useful products. This initiative, along with examples from climate change and fisheries management, illustrate how international workflows have positively impacted national agendas, highlighting the continued need for the inclusion of South African researchers in high-level programmes, in roles that will ultimately support local endeavours at all scales.

Better integration of science into policy: Some perspectives

Research shows that policy- and decision-makers are cognisant of the importance of science and knowledge production. Indeed, in the South African context, although Cronin and Sadan[17] found a relatively poor use of scientific evidence by senior government officials, they also found that these officials desired the use of more scientific evidence in decision-making. Recognising and negating the obstacles (Box 1; Figure 1) is a good start to more integrated decision-making, but this will differ within the context of the management questions asked, as well as the sphere of government in which the integration of data is required. However, the opportunities for evidence-based decision-making can only be fully realised by consultative or co-created approaches, with active engagement at all levels of the policy process by a wide variety of stakeholders. Here we identify some factors that can help smooth the transition between research, policy and management and the successful implementation of evidence-based policymaking.

Box 2: The National Climate Change Response Policy: A case study of doing it differently using co-production

Broadly, 'co-production' is an approach that increases knowledge exchange among scientists and decision-makers. In this approach, managers actively participate in scientific research programmes from the onset, collaborating with researchers throughout every aspect of the study including design, implementation and analysis (Figure 2). This approach fosters a stronger understanding of the research and also increases the ownership and its subsequent communication.[19] Although the development of South Africa's National Climate Change Response Policy may be regarded as a product of co-production, the approach differed from that described by Cvitanovic et al.[19] in that it was the scientists who were actively engaged in the policy development process from the onset, collaborating with policymakers throughout the policymaking process, rather than vice versa.

The initiation of a dedicated climate change response policy development process took place at the National Climate Change Conference held in 2005. At this conference, 'over 600 representatives from government, business, the scientific and academic communities, and civil society considered the science relating to climate change and key responses to the potential social and economic impacts associated with the compelling scientific evidence of climate change'[23]. The conference consisted of two parallel and overlapping sessions, with a dedicated Climate Change and Science Conference hosting African and international scientists that primarily focused on climate change science. Overlapping with this session, was the National Consultative Conference on Climate Change within the context of testing and informing South Africa's policies, strategies and action plans; directing South Africa's international negotiations on climate change; charting the way forward on future commitments; generating inputs for the Second National Communication on Climate Change; revising policies to take into account new scientific developments; and more closely coordinating South Africa's environmental approach with the national energy strategy.[24] Every day the Consultative Conference started with a briefing from the Science Conference based on their previous day's proceedings and this briefing informed and directed the policy discussions of the day.

This strong science–policy dialogue was maintained by having the same official being responsible for the management of the policy development process and as the 'client' for the compilation of South Africa's Second National Communication to the United Nations Framework Convention on Climate Change – what Cvitanovic et al.[19] refer to as the 'embedding' approach to increasing knowledge exchange among scientists and decision-makers.

Furthermore, throughout the policy development process, any issue that was seen as requiring further research to better inform the evolving policy was flagged and, following a second national policy conference in 2009 and the public commenting period on the climate change response Green Paper, specific research was commissioned to inform the final White Paper. That the policy and Second National Communication were approved for publication at the same Cabinet meeting in October 2011 is evidence of how these science and policy processes were closely linked and 'co-produced'.

These factors include better coordination and cooperation between the different levels of government, the use of legislated opportunities to appeal poorly informed decisions, using a 'co-creation' approach to policy development (see Box 2 for an example from the national climate change agenda), and, importantly, provision of opportunities for project planning and research formulation that include multiple stakeholders to jointly identify and plan science (Figure 1).

One other notable achievement in South Africa is the National Biodiversity Assessment (NBA)[18], led by the South African National Biodiversity Institute. The NBA comprises a series of technical reports that review, synthesise and make accessible, data on biodiversity and ecosystems, anthropogenic pressures on these, as well as the status of knowledge on natural systems. The success of the NBA to a large part is a result of its participatory approach, with the leaders of each NBA component actively engaging with networks of researchers and scientists who provide data and analysis. The NBA has made significant impacts at various levels (Figure 2), notably feeding into evidence-based decision-making through ventures such as the National Biodiversity Strategy and Action Plan. Although these impacts are not direct, they do provide a process of strengthening the uptake of science not only to the highest level of government in South Africa, but beyond into international projects such as the Convention on Biological Diversity.

Solutions of scale, legislation and easily transferred knowledge

Scalable solutions, that cross different spheres of management, are important in narrowing the science–policy gap, particularly in the multiscale coastal and marine domain. For example, the current separation of coastal (terrestrial) and marine planning domains should be reconsidered to include more diverse stakeholder communities, and to recognise land–sea ecological linkages. Currently, municipalities are not included in large offshore industry decision-making, although production and/or benefits flow over municipal domains (as is the case for fisheries, oil and gas, etc.) all with infrastructure, labour and local economic development implications.

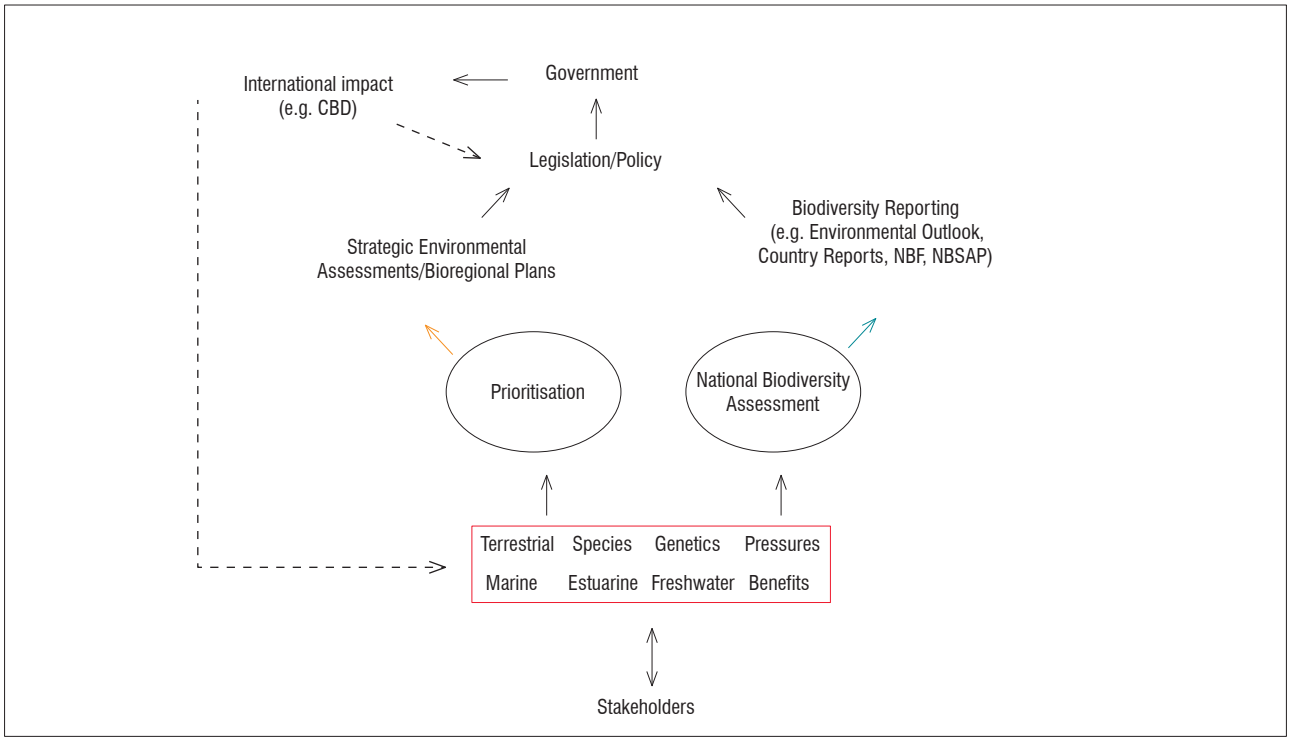
Improving the existing legislation can help bridge the gap between science, policy and management goals, particularly in areas in which such scientific information and advice is routinely and predictably available, and where its use is considered international best practice. This improvement will foster links between stakeholders and procedures, thus facilitating the direct flow of information to policy development, rather than these links occuring on an ad-hoc basis.

Further, successful links between science and decision-making are to a large extent enabled by structures and procedures which are in place to ensure a direct flow of scientific information into policy development and management. Examples of these structures are the scientific working groups of the fisheries management agency (currently the Branch Fisheries Management of the Department of Agriculture, Forestry and Fisheries), which generate targeted, management-relevant advice, with well-established procedures for transfer of the scientific information and advice to decision-makers. The role of these groups in facilitating the transfer of scientific advice and information cannot be overemphasised.

Finally, whether taking a path of 'embedding', 'co-production' or through knowledge brokering in an enabling environment[19], the inclusion of multiple stakeholders from the outset will go some way in uniting disparate entities that have common goals. It is clear that differences exist in the extent to which science is translated in decision-making across different 'disciplines' in South Africa. We need a range of options that can be tailored to assist in bridging the gap between science, policy and management and ultimately to facilitate evidence-based decision-making.

A knowledge base built on transdisciplinary research

One of the approaches for reducing the length of the science to policy pathway is the evolving definition of what is known as transdisciplinary research – the highest form of integrated research.[20-22] Transdisciplinarity involves not only the natural, social and health sciences in a humanities context, but also incorporates participants from outside of scientific fields (e.g. land managers, user groups and the general public) and it is this level of integration, combined with participatory approaches, that transcends traditional disciplinary boundaries. Unlike multidisciplinary research that shares knowledge across disciplines in thematically based investigations with multiple goals (but does not generate new integrative knowledge), trans- or interdisciplinary research synthesises and harmonises links between disciplines in a coordinated and coherent whole that focuses on 'real-world' system problems. The difference between multi- and transdisciplinarity is the level of integration and cooperation with the added imperative of bridging disciplinary viewpoints.



CBD, Convention on Biodiversity; NBSAP, National Biodiversity Strategy and Action Plans; NBF, National Biodiversity Framework

Figure 2: The National Biodiversity Assessment is a multistakeholder report[18] and assesses the state of South Africa's biodiversity, across terrestrial and aquatic environments, emphasising spatial (mapped) information for both ecosystems and species. It has direct and indirect impacts, with the latter feeding into both national and international policy through various other strategic and reporting mechanisms.

This is important for several reasons, particularly because science and the knowledge industry is increasingly being challenged by funders and stakeholders to demonstrate impact beyond academic excellence, with the concept of societal impact firmly embedded in the language of funders, stakeholders and civil society. Transdisciplinary processes will help improve understanding between those generating the scientific information and advice, and those using it. On the one hand, decision-makers require an understanding of the scientific information and how it has been generated. On the other hand, scientists require an understanding of the type of scientific information that is useful to decision-makers, of the time frames on which scientific information and advice is required, and of the nature of inputs (other than the scientific inputs) that may also inform the decision-making process. If the end-user forms part of the project team (and both receives science products and makes substantive conceptual input), the science to policy pathway is shortened. For example, resource groups in which scientists and managers work well together tend to be subject to the least arbitrary decision-making, resulting in the best-managed, most optimally exploited fisheries, and thereby have the most impact.

As a community, SANCOR is cognisant of the potential of transdisciplinary research, but the cost and complexity of such projects and programmes will require new methods and attitudes before transdisciplinarity will become a mainstream research approach. Importantly, in whichever disciplines South African researchers engage, there needs to be more intentional planning of pathways from science activities to outputs, outcomes and impacts.

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