Evidence-based policymaking: a review

Wilma F. Strydom, Nikki Funke, Shanna Nienaber,
Karen Nortje and Maronel Steyn

ABSTRACT

The process of facilitating the uptake of evidence, for example, scientific research findings, into the policymaking process is multifaceted and thus complex. It is therefore important for scientists to understand this process in order to influence it more effectively. Similarly, policymakers need to understand the complexities of the scientific process to improve their interaction with the scientific sphere. This literature review addresses those factors that influence the uptake of scientific evidence into policymaking, the barriers to using science in policymaking, as well as recommendations for improved science–policymaking interaction. A visual diagram of the gears of a car is used to convey the message of the complexities around the engagement between science and policymaking. It is concluded that the issue of evidence-based policymaking remains unresolved and questions for future research on the science–policy interface are raised.

INTRODUCTION

The lack of scientific evidence in policymaking is evident and can, to some extent, be attributed to the complicated nature of translating scientific (and other forms of) evidence into policy.[1,2,3,4]

> *In theory, evidence based policy making should work well. Scientists produce evidence, which policy makers then use for decisions. In return, policy makers provide scientists with evidence requirements and resources for research. This approach has an intuitive, common sense logic.*[5]

However, in practice, several problems characterise the relationship between scientists and policymakers due to mutual scepticism and differences that exist between them.[5] In this article, we explore the intricacy of this relationship by discussing the obstacles and barriers to evidence-based policymaking, as well as reviewing recommendations from the literature on how to improve this process. Despite the research on evidence-based policymaking conducted to date, the relationship between science and policy frequently does not result in evidence-based policy or scientific research sufficiently informed by national priorities. This relationship may, therefore, be decidedly more complicated than what has been recognised in much of the literature on the subject. The relationship is also potentially situated within larger issue- and perceptions-based contexts, shaped by a number of actors and influencing factors, which need to be better understood (especially in the developing world). The paper concludes with key questions for consideration in this regard.

What is evidence?

Evidence can be made up of a range of components – not only scientific[6,7,8] – and is never used in isolation.[9] Scientific evidence typically is research/surveys, quantitative/statistical data, qualitative data, and analysis thereof.[10,11] However, evidence also includes economic, attitudinal, behavioural and anecdotal evidence,[10] together with knowledge and expertise of experts, as well as lay persons,[12] propaganda, judgements, insight/experience, history, analogies, local knowledge and culture.[6,9,10,11,13]

Evidence based on scientific research is thus combined with other forms of information to provide evidence for policy development and practice. Combining different forms of evidence creates and acknowledges the context within which knowledge exists and within which it is understood.[12] The policymaking context is full of political, ideological and economic factors that influence policy development and decision-making, often at the expense of scientific evidence,[2,14] and decision-makers and policymakers will source information with a particular agenda in mind.[15]

Why is evidence important for policymaking?

'Policies based on evidence … [are] likely to be better informed, more effective and less expensive' than policies formulated through ordinary time-constrained and politically constrained processes without evidence input.[10] Policy based on evidence is also likely to give policymakers confidence in the decisions that they take.[10] Scientific evidence exposes policymaking to a wider range of validated concepts and experiences, enables policies to be formulated based on solid technical bases and can open up a range of policy options for policymakers to consider. Evidence can play an important role in all three stages in the policymaking process, namely policy agenda setting, formulation and implementation.[1]

THE POLITICAL DECISION-MAKING PROCESS

Scientific findings are one example of a range of sources of evidence and influencing factors that shape policymakers' decisions and actions. It is therefore important that scientists understand the decisionmaking process as it links to policymaking, how evidence can feed into the process, as well as what barriers to the uptake of evidence exist. Such an understanding will enable scientists to develop strategies to influence decision-making more effectively. Conversely, it is also crucial that policymakers make an effort to understand the complexities of the scientific process and how it differs from the policy process, to be able to engage with scientists more effectively.

The process by which science influences policymaking can take many forms. Mitchell[16] distinguishes three ways in which science influences policymaking. Firstly, policymakers request scientific evidence in order to incorporate it into 'current debates' (see Box 1). Secondly, scientific evidence is provided,

BOX 1

The elephant management project

In 2006, the South African Minister of Environmental Affairs and Tourism convened a Science Round Table to advise all involved actors on the still unresolved issue of elephant management in protected areas. The Science Round Table recommended a scientific assessment of elephant management.[17]

This assessment was undertaken in 2007 and is an example of a case where the cooperation of technical experts and various stakeholders assisted in the provision of evidence that addressed various sides of the elephant management issue, ensuring policymaking relevance at all levels.[17] Stakeholders included national and provincial conservation authorities, provincial parks, private managers and owners, conservancies, NGOs, animal welfare groups, academics and individuals involved in the private sector.

The assessment can help to guide future elephant research and monitoring as it identifies gaps in data and information that have thus far prevented policy-relevant questions from being answered.[17]

---

showing decision-makers the 'impacts of their behaviours' and resulting in the changed behaviour of decision-makers and, thirdly, scientific evidence first has to convince policymakers that there is a problem (this can be a lengthy process).

The first two short causal chains as described above are the exception and apply where the policy question is fairly wellstructured and the answer can be known with certainty or, at least, with a reasonable degree of certainty.[18,19,20] In most cases, the influence of science on policy is less direct.[16] It also takes time before the effects of policy changes become evident. Scientific research during the 1970s and 1980s 'failed to produce any significant political action on climate change'.[16] In contrast, the 'ozone depletion' issue is an example where science could prove (i.e. provide 'solid scientific evidence' about) the link between human activities, ozone-depletion and increased levels of ultraviolet radiation and human health. The scientific evidence could, therefore, successfully influence decision-makers.[21]

Despite the availability of guidelines on how to use science in policy, scientists and policymakers often feel frustrated, because clearly presented and robust evidence does not always have the desired effect on policy processes.[11,14,22,23,24,25] Policymakers often have to respond rapidly to badly structured yet challenging problems.[26] Since many actors (including scientists from different disciplines) take part in the policy process, it results in 'conflicting values and facts',[18] opposing conclusions and differing solutions to the same problem.[26]

The uptake of (scientific) evidence: Factors influencing decision-making

Several factors influence the decision-making process. These include, (1) organisational factors such as structure, function and composition, (2) socio-economic contexts,[2] (3) communication and the attributes of the message,[27] (4) the credibility of the information,[16] (5) the credibility of the scientist and (6) the extent to which policymakers and scientists attempt to understand each other's view points,[28] ethics and priorities. Along with these, several human factors influence decision-making, including personal value systems and beliefs,[2] perceptions, limitations of human ability, influence of political power, as well as time constraints.[29]

Both individual and organisational factors have an influence on the uptake of evidence in decision-making processes, which is why compatibility of new evidence with the values and belief systems of both is important. The 'personal qualities and capacities' of the decision-maker, such as values and beliefs, leadership, knowledge and skills, resources, partnership links and networking skills, all play a crucial role in the uptake of evidence.[2] When individuals perceive evidence to be useful, comprehensible and compatible with their past experiences, it stands a better chance of being taken up in policymaking.[2,27]

Barriers to using science in policymaking: The science–policy divide

Despite the intuitive link between science and policy, there are many barriers and divides between politicians and scientists that need to be overcome before effective interaction and inclusion of evidence in policy can take place.

Differing worlds and world views (mental models), cultures, goals and rewards

Scientists and policymakers have different mental models (or differing forms of cultural relevance) that form and regulate the way they see, understand and experience the world and subsequently the way they behave.[30,31,32]

> *This does not imply that people with different mental models cannot communicate. Scientists must just be aware that, when communicating environmental information to* [*policymakers*]*, a deliberate effort is required to ensure that the message is conveyed accurately, since people's interpretation of a piece of information may differ, and their resulting responses may be entirely the opposite to what was anticipated.*[31]

Apart from differing world views, the career structures, cultures and goals of scientists and policymakers also differ,[33] as do the day-to-day operations within which they function.[34] While the goal of the scientist is to advance science, the policymaker aspires to obtain popular support.[5] Policy officers receive recognition from their immediate managers in their own organisation or from influential people such as a Chief Executive Officer or a government minister.[33] The feedback and rewards for policymakers are quick and typically based on their ability to achieve outcomes.[33] Scientists, on the other hand, receive recognition by attending conferences and publishing papers and their reward is typically based on these outputs.[33]

Accountability and vested interests

Scientists are accountable to their funding organisations and editors of peer-reviewed journals. Policymakers need to answer to government, taxpayers and political parties.[5] These differences in the accountability of scientists and policymakers can result in a lack of understanding between them about each other's working environments and responsibilities. Cooperation between the two parties is difficult to achieve, even in a favourable environment, and is not necessarily rewarded by the structures within which they operate.

In setting the agenda for scientific research, governments are increasingly responsible for determining research funding priorities and thus influence the way funding is allocated, placing pressure on scientists to comply with government views.[5,8] Scientific research could also reflect the bias of other sponsors.[27] In addition, a range of personal factors shape the behaviour of both scientists and policymakers. These include economic interests, as well as emotional interests, such as ideological and political interests, which increasingly play a role 'in undermining sound science to achieve desired ends'.[35]

Poor communication and lack of engagement

The 'role of science communication is gaining prominence' in South Africa and internationally.[31] However, communication between scientists and policymakers remains poor[3,9] and is aggravated by scientific evidence having limited relevance to current policy problems, as well as by policymakers insisting on exact answers, even when these are not contained in available evidence.[36] Scientists are often too conservative in communicating their results, especially when this could result in major policy changes,[37] and thus keep waiting for 'enough evidence to communicate'.[38] Scientific evidence is also often used selectively, inappropriately and out of context, albeit unintentionally.[9,39]

Poor communication between policymakers and scientists is worsened by several obstacles to the communication process. These include:

- The inadequate dissemination of scientific research findings,[9,39] which is worsened by a lack of funding for this purpose.[5] Simultaneously, policymakers often need to sift through an overload of low quality scientific information.[40]
- The failure of scientists to relate to the decision-making context[41] and the policymakers' often limited understanding of science,[9,40] which both result in uncertainty and an inability to express policy needs sufficiently.[41]
- The reservations of policymakers about the use of science,[9] along with a lack of incentives for the use of science, technology and innovation in policymaking.[9]
- Organisational constraints[41] and a lack of institutional channels for the incorporation of science, technology and innovation into policy.[9]
- The media's efforts to report a balanced view, which often distorts facts and evidence. A scientific community (as in the case of global warming) often finds itself pitted against some contrarian or non peer-reviewed article in the media. The 'resulting arguments actively hinder people's ability to reach a sound understanding' of the topic at hand.[13]

Uncertainty, credibility and risk

Scientists are often sceptical about how policymakers employ science, when, for example, it is used to further certain political agendas or ideologies.[5,42] Policymakers would rather make uninformed decisions than admit knowledge gaps that could 'reduce support for their programmes'.[5] On the other hand, the information that scientists provide may not seem very credible in the eyes of policymakers.[9] This assumption is made worse by perceptions of arrogance and tunnel vision.[5]

Both the credibility of the information and the credibility of the scientist influence communication between policymakers and scientists. Credibility of information is based on 'expertise and trustworthiness',[16] namely whether the science is realistically communicated,[31] as well as if it is perceived to be 'true' and better than other information.[16] The competence of a scientist depends on knowledge and expertise.[43] Trust between policymakers and scientists can be achieved by 'trying to understand the other's perspective'[28] and is built through 'comfort in the presence of the scientist and developed by spending time together'.[43] In turn, trust will facilitate the communication of risk.

Risk is embedded in cultural/social issues and cannot be 'overcome simply by the application of more and better science'.[13,44] All forms of risk are associated with a spectrum of questions, fears, uncertainties and mistrust that cannot be dealt with by providing scientific probabilities. Fears associated with risk require debate and conversation about alternatives and solutions.[13] In addition, science seldom comes with absolute certainty. This means that the risks associated with scientific uncertainty need to be communicated. Policymakers and the public are seldom at ease with such uncertainty.[9,13]

Pace, timing and time-frames

Science is a slow cumulative process compared to the response times and compromises allowed for policymaking.[5,33,45,46] In contrast to the rigorous, rational and well-planned scientific process,[13,47] the policy world is fast-paced and unpredictable,[47] with limited thinking time. Testing alternative options and verifying answers to questions is a non-existent luxury.[5,13,33]

Very often, scientific advice and answers are not synchronised with the needs of decision-makers and politicians, which results in the dismissal of seemingly appropriate policy responses.[27] Information that is unavailable to politicians at critical times of decision-making cannot be considered available knowledge.[39] Policymakers need credible scientific information to base decisions on and thus it should be the role of scientists to try to provide such information. However, scientific information is seldom available when policymakers need it.[33] Developing credible knowledge takes time (often decades and longer – see Box 2) and this is in conflict with the short-term needs of policymakers, who need to apply such knowledge within much shorter time frames (often months and years).[13,27,39] Although scientific research can be responsive in the longer term, it is, by nature, not a reactive process[5,33] and can therefore be 'uncomfortably ahead of contemporary political agendas'.[39] The predictive and proactive nature of science, whilst in contrast with policy, need not be a handicap and can be used to great effect by means of cooperation between scientists and policymakers to help set political agendas for the future.

BOX 2 Oil drilling in Alaska

Yankelovich[13] uses the example of the National Academy of Science's report on its investigation of the consequences of oil drilling in Alaska's North Slope. It took almost 30 years to complete the investigation and during this time 'a great deal of environmental damage' was done and 'political pressure for further exploration in the Arctic National Wildlife Refuge' became increasingly prominent. Thus, by the time the Academy's report was published, 'it had become little more than a political football'.

Knowledge and power

'Scientists are the owners of knowledge' and 'policy officers are the custodians of power'.[33] According to Briggs[33], scientists keep science out of the reach of policy workers to ensure that they retain their control (or 'monopoly'[33]) on the interpretation of science. Simultaneously, political workers do not wish to invite scientists into their circle of 'power and the powerful'.[33] Such attitudes are usually not counteracted by any incentives in the science or policy domains that would encourage cooperation.[33]

Perceptions that scientific knowledge, through science education and the promotion of a more scientific way of thinking, can close the science–society gap tend to place science in a morally and intellectually superior position,[13] thereby increasing the so-called power of scientific knowledge. There is also a difference between truth and power, as exemplified by the fact that scientific information is most likely to be used to support political aspirations and further 'anticipations of gain' (see Box 2).[9,27,48]

WHAT TURNS THE 'WHEELS' OF THE POLICYMAKING PROCESS?

Every contentious issue is influenced by the stances that are taken by the specific controlling actors on that issue. Using HIV/AIDS in South Africa as an example, the pro-anti-retroviral dissemination view is one stance on the issue and the 'there is no HIV/AIDS pandemic' view, is another. A number of actors, each with their own interests, build each stance and form a 'coalition' (Figure 1). This stance, depending on various factors, may be adopted into the policy process (Figure 2).

Borrowing from the concept of car gears, we attempt to explain the intricacy and complex nature of the degree to which evidence may be taken up in the policy process (Figure 3). The input to the policymaking process can be considerable: a large gear (a), which can be compared to a car's first gear, turns the policymaking shaft by turning the corresponding small gear (b). Supplying evidence that is of value, but which does not completely address policy

needs (i.e. evidence that is not completely usable) makes the gears turn slowly but surely, and in a cumbersome way, resulting in an eventual contribution to the policy end result. The input to the policymaking process can also be smaller but more powerful, particularly if it is more directed towards meeting policy needs or usable outcomes – (c) compared to (a) – and this can result in a far more significant effect on the policymaking process (d). However, in some instances, regardless of how 'good' the evidence is (e), it does not affect the policymaking process (f) at all, either because the evidence does not address policy needs or is not usable.

Each of the recommendations below has an input or effort ('gear size') that is needed to achieve results. Similarly, the result or influence on policymaking can be either large or small.

RECOMMENDATIONS FOR IMPROVED SCIENCE–POLICYMAKING INTERACTION Values and evidence

Decision-making is a 'highly value-laden' process and sound science alone is not sufficient to inform it.[21] Scientists limit their experience in decision-making if they do not differentiate between 'rational and sensible decisions' and 'fail to acknowledge the influence of these political and institutional factors'.[6] Scientists and science communicators need to understand how decisions are made, who is involved, what information gets selected and how it is evaluated.[11,23,25,49,50,51] They also need to understand how

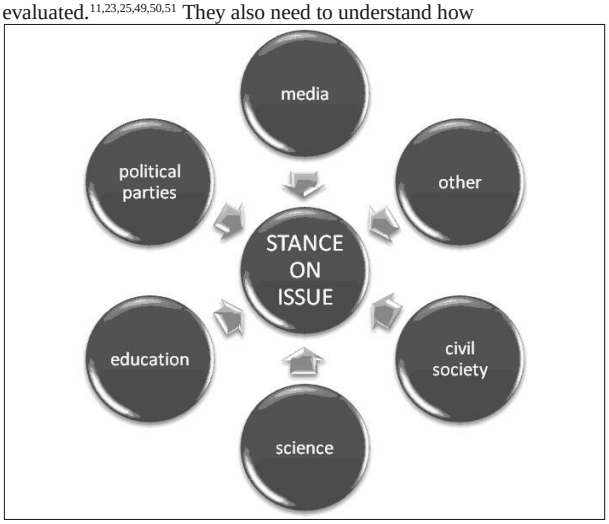

FIGURE 1
Various actors form a 'coalition' on a specific stance

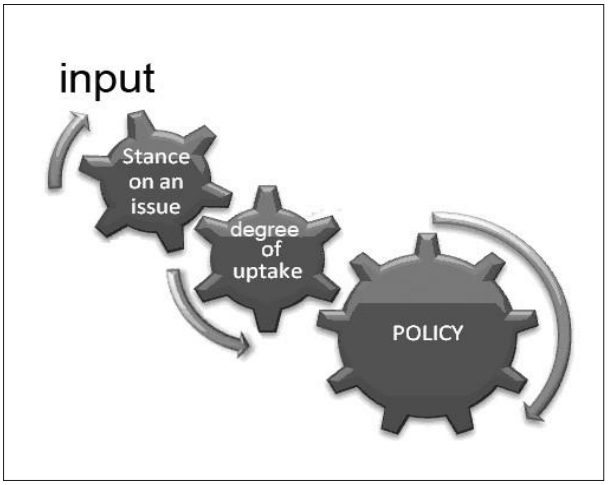

FIGURE 2
The specific stance that is taken on an issue influences the level of uptake into policy

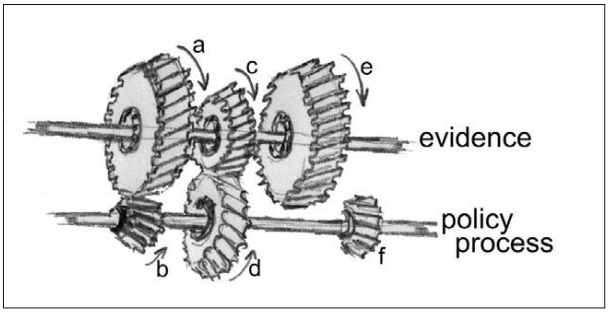

FIGURE 3

science is turned into common knowledge, as well as the value systems that play a role in this transformation of knowledge from the 'scientific' to the 'common'.[6]

In the process of translating scientific research findings to common knowledge for use in policymaking, the supplier of the information is influenced by personal values[6] and the values inherent in the social, cultural and economic context of their time, as well as the evidence they produce. Thus they need to be aware of their own prejudices and values when wanting to influence the policy process.
Understanding the political decision-making process, as well as the underlying values, will help scientists to form an idea of the usefulness of certain findings.[6] Thus, the challenge for scientists is to convert the information they produce into 'usable knowledge'.

Usable knowledge

Knowledge is useful when it is relevant to the current policy or legislative need.[5,9,14,33] Useful knowledge satisfies certain value demands of decision-makers and can be a desired situation, object or condition during interaction between people.[23] Useful knowledge fulfils the demands of salience, credibility and legitimacy[23,52,53] and 'improves environmental decision-making by expanding alternatives, clarifying choice and enabling decision-makers to achieve desired outcomes'.[23]

The political and institutional context needs to be aligned with the scientific findings that are to be used. The bigger picture should be taken into account[5] and other contextual factors need to be added to the scientific findings to allow the knowledge to be usable for decision-making, thereby 'providing a justification for its use or corroborating its value'.[6] For an example of where the South African government commissioned usable knowledge see Box 1. An integrated and broad information base is also less likely to be biased by either a funding organisation or a political sponsor.[27] Policymakers should also develop a means of ensuring the quality, integrity and objectivity of the science they use, perhaps by incorporating scientific peer review into the science advisory process.[54]

The best, or most useful, scientific knowledge will have no effect on policymaking if it does not also contain a successful mechanism of transfer to policymakers.[27]

Communication and engagement

Understanding the decision-making process

Over the past few years, there has been a shift in the policymaking arena that has resulted in a change in the way the policymaking community perceives scientific evidence, as well as the re-evaluation of the role of evidence in policymaking.[55] The progressively greater focus on measuring the impact of outcomes, together with improved communication networks and the resultant information overload, has emphasised the importance of scientific findings that are well disseminated.[55]

A good understanding of the intricacies of the political process is needed in order to know at which stages the relevant evidence should be brought forth.[14] Such an understanding will help scientists and science communicators to determine what information needs to be transferred to policymakers, as well as how to package and present this information, in order to improve the likelihood that it will be used.[23,33,39] Concise packaging of the relevant information is thus needed.[3,5]

However, the responsibility does not lie with scientists alone. Successful dialogue between scientists and policymakers also requires that policymakers obtain higher levels of scientific understanding.[5] Policymakers need to become 'scientifically literate' in order to benefit from the work that scientists produce.[9] Policymakers need to be proactive and actively seek science advice. Thus, scientists and policymakers should be supported and encouraged to establish linkages with each other.[54]

Relationships across boundaries

Decision-makers and scientists should work together to form policymaking communities.[56] This would require knowledge of how to manage relationships across the science–policy interface.[23] Two examples where scientists and policymakers cooperated to produce joint evidence-based, policy-based solutions that were taken up and implemented are described in Boxes 3 and 4. The government–science interface determines the degree to which science and technology form the basis of the political economy, as well as the extent to which science informs decision-making and policymaking at the government level.[58] Understanding the cultural and operational differences between policymakers and scientists will support communication and foster a sustainable working relationship between these two actors.

> 'Attempted partnerships between policy and science often fail because of lack of mutual respect caused by lack of cultural awareness'.[33] All parties should take care not to intimidate (Briggs[33] uses the word 'bully') or dominate others. Policymakers should thus request scientific advice as early as possible, allowing 'time to think'[33] for both groups, thus creating space for the cross-pollination of ideas and knowledge. Policymaking 'proceeds with or without scientific advice … [and] providing comprehensible scientific advice for policy from current knowledge, with some caveats if necessary, is better than providing no advice because of uncertainty'[33] (See Box 5).

> Often an intermediary who knows, understands and engages with the 'audiences' (the key stakeholders) involved in policymaking is needed.[51,60] Lomas[6] refers to such a person as a policy entrepreneur, while others refer to a knowledge broker[25] or science communicator.[61,62] While all three facilitating roles focus on getting the message across, the role of a knowledge broker is to bring scientists and decision-makers together and facilitate interaction between them.[63]

It appears that, in developing countries, personal relationships are a particularly important factor in the uptake of scientific evidence into policy.[9] Thus policymakers often need to personally know and trust a scientist in order to view their work as credible.[45] The efforts of scientists to form personal relationships with policymakers can therefore be crucial to building on, and improving, existing science–policy linkages.[9,49] However, should such a relationship end, the process is disrupted and often comes to a complete standstill (see Box 5).

Scientists can also join networks or 'epistemic communities'[1] in order to inform the policy process. Networks are structures that

BOX 3 Policy on orphans and vulnerable children in South Africa

The Human Sciences Research Council of South Africa and the WK Kellogg Foundation established a project aimed at improving the social conditions, health, development and quality of life of orphans and vulnerable children, as well as supporting the extended families and communities who often have to look after these children following their parents' deaths.[57] Evidence-informed programmes and policy are currently being implemented by a group of scientists, policymakers, non-governmental organisations (NGOs), community-based organisations (CBOs) and donors in several areas in Botswana, Zimbabwe and South Africa. Successful uptake of scientific evidence into policy took place through information gathered in literature reviews and through public meetings attended by the ministers of Social Development, scientists, NGOs, CBOs and donors, which were held to discuss key issues (emanating from scientific research) that have policy implications. The one-on-one encounters between scientists and policymakers that occurred at these meetings proved to be particularly successful and allowed for the development of mutual understanding in the process.[57]

BOX 4
The Children's Institute

The Children's Institute at the University of Cape Town was established for the purposes of informing policies, laws and programmes for children through the use of evidence.[4] Since its formation, the Children's Institute has taken part in several policy processes. According to the Institute, some important factors for the successful uptake of scientific evidence into policy are:

- the collaboration of the various role-players involved (policymakers and scientists, as well as external institutions, such as the Children's Institute in this case)[4]
- a more consistent policy development approach and format, which should comprise a committed driver within government regarding the development of each policy and role definition, as well as an understanding of that role and an appreciation of the potential limitations to the successful completion of a policy from inception to implementation[4]
- an emphasis on high-level political buy-in, as well as cooperation between two national departments, if a proposed policy spans both their mandates (e.g. health and education)[4]
- the need for pragmatism on behalf of the research organisation involved; this means committing to the policy development process but also knowing when to withdraw[4]
- the acknowledgement of research organisations' responsibility to offer their knowledge to government and to interact closely with them, but, at the same time, the necessity for these organisations to not compromise researcher objectivity.[4]

BOX 5
South Africa's freshwater biodiversity project

In 2005, South Africa's Water Research Commission recognised the need to enable the inclusion of the systematic conservation of inland water ecosystems in the strategic planning processes of several sectors impacting on South Africa's freshwater biodiversity.[59] The process involved the participation of several South African government departments and national conservation and science agencies in discussion groups and workshops to debate their respective mandates and strategies for managing and conserving freshwater ecosystems and biodiversity.[59]

Consensus on the resulting cross-sector policy objectives was reached, despite the 'uncertainty and lack of scientific validation' around the 20% benchmark for conservation of major freshwater ecosystem types.[59] While this issue needs to be resolved when implementing the cross-sector policy objectives, it demonstrates that sometimes providing uncertain scientific knowledge is better than not providing any scientific knowledge at all.

This project also demonstrates the importance of buy-in at an institutional level to ensure that the process is not hampered by the untimely departure of an enthusiastic and dedicated senior official from one of the lead participating organisations or government departments, as was the case in this instance.[59]

link individuals and organisations around a common interest or set of values.[64] Member-driven networks are a powerful tool for developing evidence, practice and policy and can help their members to cultivate a single powerful voice that can feed into the policy process.[65] This can be done by bringing good quality evidence into the policymaking process, fostering links between scientists and policymakers and creating an informal and constructive environment for consensus.[64] On a cautionary note, however, networks do need ongoing financial investment to function effectively.[65]

In order for decision-making processes to be effective and transparent all relevant stakeholders should be involved.[21] The relationship across the scientist and society boundaries also needs to be strengthened. A strong 'science–society interface' is essential for good environmental governance to take place[58] and, therefore, it is important to develop an understanding of such a relationship.[23,53]

The role the media plays in the 'science–society interface'

A more informed and engaged public will stimulate policy dialogues, promote inputs into policy development and benefit policymaking. A stronger 'science-society interface',[58] and thus greater public participation in science-related policy debates,[9] suggests that science should be made available to the general public. 'Conditions or enabling environments for communication need to be created'.[66] In addition, government decision-making processes should be open and transparent – both to stakeholders and the public at large. This entails making scientific findings accessible to the public, as well as communicating how these have been used in order to influence decisions and how they fit into specific agendas.[54,67] Such measures will ensure that public concerns are taken into account when decisions are made on science-based issues.[54]

It is in the context of this interface that the media tends to play an extremely important role in knowledge transfer, primarily to the public,[31] but, by default, also to decision-makers, who, despite their decision-making capacity, are also members of the public and are exposed to the same media influences.

Essentially, the media has three roles to play in this interface. Firstly, it reports on and critiques issues of policy and science, as well as the relationship between, or the decisions of, the two actors. Secondly, it should report on the public response to, and perceptions of, various science–policy issues. Thirdly, as Yankelovich[13] suggests, the media is also expected to offer a balanced view of issues where 'both sides' of a story are represented. In the context of these roles the media, therefore, has a powerful educational and informative role to play. However, at the same time, the limitations of the media should be realised; journalists are in the news business and are thus not focused on education or health protection.[68]

Taking part in the process

Scientific research is a process and not a product and, similarly, policymaking is a process and not an event.[6] If this situation is not sufficiently understood, the 'products of processes' become the only stage of both the science and policy processes at which scientists and policymakers have an opportunity for brief interaction, if at all.[6] A way to ensure the generation of end-products that suit policymakers' needs is for policymakers to become involved in all stages of the knowledge creation (scientific research) process, from as early as the conceptualisation phase (see Box 1).[3,6,28,39] Simultaneously, scientists need to be more involved in the policymaking process – interpreting the meaning of scientific evidence,[9,11] as well as in interactive knowledge brokering.[25] An ideal situation would be for decision-makers and scientists to work towards forming a community of policymaking.[56,69] Stewart[70] reports on a series of workshops between scientists and policymakers that were held with the aim of bridging the evidence–practice gap. The workshops focused on providing

policymakers with the evidence and skills to assess scientific findings. Since the act of working together could be criticised by peers, on both sides of the gap, Briggs[33] suggests the implementation of reward system to encourage the cooperation of policymakers and scientists. The integration of such vastly different cultures will only occur if that cooperation is mutually beneficial.[33]

Framing the scientific evidence: Wording, shaping, contextualising and packaging information

In order for scientific information to be useful, it has to be presented in a way that is neither ambiguous nor overly complex. It also has to be 'compatible with existing planning models'.[28] Scientists aiming to influence policy could also draw upon a range of methods, sources of information and theoretical perspectives in order to reveal different versions of the story they are telling.[49]

Framing needs to be done in such a way that scientific information can be incorporated into the understanding of official policymakers, as well as civil society actors.[16] If this information is carefully framed, its chances of overturning an 'existing equilibrium of goals, options and knowledge' are increased due to the probability of convincing audiences that 'current policies and behaviours are no longer the best way to achieve their goals'.[16]

Of equal importance is the dissemination of the scientific information – effective dissemination strategies should therefore be developed and implemented.[49,71] From a practical perspective, individuals and organisations responsible for the commissioning and funding of scientific research projects should encourage dissemination and publication of results and findings.[72] It is recommended that 10% of research funding should be reserved for communicating the results.[73,74]

The institutional context

Managing the policymaking process (strategies, mechanisms and conditions) has several pitfalls. For example, involving the best qualified scientists to enhance the credibility of the process might undermine its legitimacy and salience, due to concerns about the potential lack of political and economic representation. However, if non-scientists are brought on board to enhance legitimacy or salience, this can undermine credibility with other audiences.[16] Nonetheless, policymakers should aim to expand on the number and variety of participants, as well as be willing to take risks and admit errors.[16]

Other important qualities that should characterise the policymaking process are openness towards learning, as well as self-reflection.[16] Both the policymaking and scientific research processes could also benefit from actors taking into account local contexts, as well as the problems and challenges that characterise these contexts.[9,75] Scientific research should be of local relevance and demonstrate social impact. If science is, to some extent, informed by policy then the reverse should be true for policy as well.[75]

CONCLUSION

In this paper, we have sought to explore the barriers or obstacles to evidence-based policymaking by reviewing and summarising existing literature on the topic. This has been done with the aim of identifying solutions and facilitating the practical improvement of evidence-based policymaking.

In light of this literature review, a number of points have arisen. Firstly, over the last decade, a large body of literature from both academic and policy environments has emerged around the issues of evidence-based policymaking and how to address the challenges that characterise this process. Secondly, within existing literature on this topic, there is a fairly high level of overlap and agreement in terms of basic recommendations regarding how to improve the uptake of evidence within policymaking arenas. These recommendations predominantly focus on the role of scientists and policymakers as two groups of actors engaging in a one-on-one relationship and, as such, do not necessarily always take into account the myriad of other influences, actors, issues and perceptions that affect and impact the process of evidence-based policymaking, nor the intricate and complex nature of the context within which the process is situated. Thirdly, the continuing lack of policy that is based on sound evidence, as well as the ongoing debate around this issue, is indicative of the fact that this issue is far from being resolved. The South African River Health Programme is an example of where the scientific information was targeted at policymakers and communicated effectively, yet still did not result in the uptake of the information.[31] Fourthly, the literature that has been produced on this issue thus far is noticeably lacking in terms of a developing world voice or output.[9] Finally, it would appear that the dominant school of thought in terms of evidence-based policymaking is situated within a positivist paradigm, which encourages the application of a model where 'a policy problem is defined and research evidence is used to fill an identified knowledge gap, thereby solving the problem'.[76] There appears to be very little challenge to this paradigm and, as such, very little consideration is given to the idea of the social construction of policy problems and the inherent subjectivity of moral judgements involved in these problems and related decision-making.

These five concluding observations allow us to discern an agenda for further research in this field. These ideas are laid out below in the form of a number of questions that remain to be considered:

- Firstly, why are existing recommendations, by and large, not yielding sufficiently effective results within science and policymaking communities? Important issues to consider in this regard are, (1) the impact of positioning evidencebased policymaking thinking within a positivist paradigm, (2) the linearity or non-linearity of the relationship between policymakers and scientists and (3) the context and intricate relationships at play between policymakers, scientists and civil society within the policymaking process.
- Secondly, why do some policy issues seem to respond to sound evidence whilst others do not? Notions of power, politics and influence all require careful consideration in this regard.
- Thirdly, do evidence-based policy issues function in the same way in developing countries as they do in more mature democracies? What effect does a lack of evidence have on this process? Answering these questions, which requires a clear understanding of the uniqueness of a developing world context, is critical to moving to a place where relevant and impactful recommendations can be made regarding the improvement of evidence uptake in South Africa.

These are all issues that require careful consideration, but which are beyond the scope of this paper. However, in order to make progress in this field in future, it has become crucial to move beyond objective and somewhat removed recommendations about how to improve evidence uptake into policy, to a place where deep, real and nuanced understandings of the context in which policy decisions are made can be reached.

A version of this article appeared in the South African Journal of Science.

REFERENCES

1. Hanney SR, Gonzalez-Block MA, Buxton MJ, Kogan M. The utilisation of health research in policy-making: Concepts, examples and methods of assessment. Health Res Policy Syst. 2003;1:2.
2. Bowen S, Zwi AB. Pathways to 'evidence-informed' policy and practice: A framework for action. Policy Forum [serial online]. 2005 [cited 2008 Oct 27]; 2:e166. Available from: http://www.plosmedicine.org/
3. Mubyasi GM, Gonzalez-Block MA. Research influence on antimalarial drug policy change in Tanzania: Case study of replacing chloroquine with sulfadoxine-pyrimethamine as the first-line drug. Malar J. 2005;4:51.
4. Shung-King M. The ebb and flow of child health policy development in South Africa: Three case studies reflecting the role of the Children's Institute at the University of Cape Town in shaping child health policy in South Africa. Cape Town: Children's Institute, University of Cape Town, 2006; p. 44.
5. Choi BCK, Pang T, Lin V, et al. Can scientists and policy makers work together? J Epidemiol Community Health. 2005;59:632–637.
6. Lomas J. Using 'linkage and exchange' to move research into policy at a Canadian foundation. Health Aff. 2000;19:236– 240.
7. Solesbury W. Evidence based policy: Whence it came and where it's going? ESRC UK Centre for Evidence Based Policy and Practice: Working paper 1. London: University of London; 2001.
8. Zussman D. Evidence-based policy making: Some observations of recent Canadian experience. Soc Pol J New Zeal. 2003;20:64–71.
9. Jones N, Jones H, Walsh C. Political science? Strengthening science-policy dialogue in developing countries. Working paper 294. London: Overseas Development Institute (ODI); 2008.
10. Campbell S, Benita S, Coates E, Davies P, Penn G. Analysis for policy: Evidence-based policy in practice. London: Government Social Research Unit; 2007.
11. Wilson DC, Smith NA, Blakey NC, Shaxson L. Using research-based knowledge to underpin waste and resources policy. Waste Manag Res. 2007;25:247–256.
12. Juntti M, Russel D, Turnpenny J. Evidence, politics and power in public policy for the environment. Environ Sci Policy. 2009;12(3):207–215.
13. Yankelovich D. Winning greater influence for science. Issues Sci Technol. 2003;XIX(4):7–11.
14. Young J. The impact of research on policy and practice. Capacity.org [serial online]. 2008 [cited 2010 May 11]; 35:4– 7. Available from: http://www.capacity.org/en/journal/feature/impact_of_research_on_policy_and_practice
15. Cookson R. Evidence-based policy making in health care: What it is and what it isn't. J Health Serv Res Policy. 2005;10:118–121.
16. Mitchell RB, Clark WC, Cash DW, Alcock F. Science, scientists, and the policy process: Lessons from global environmental assessments for the Northwest Forest. In: Arabas K, Bowersox J, editors. Forest futures: Science, politics and policy for the next century. Lanham: Rowman & Littlefield, 2004; p. 95–111.
17. Scholes RJ, Mennell KG, editors. Elephant management: A scientific assessment for South Africa. Johannesburg: Wits University Press; 2008.
18. Hisschemöller M, Hoppé R. Coping with intractable controversies: The case for problem structuring in policy design and analysis. In: Hisschemöller M, Hoppé R, Dunn WN, Ravetz JR, editors. Knowledge, power and participation in environmental policy analysis and risk assessment. New Brunswick: Transaction Publishers, 2001; p. 47–72.
19. Snowden DJ, Boone ME. A leader's guide to decisionmaking. Harvard Business Review November 2007. Rev. ed. Boston: Harvard University Press; 2007.
20. Shaxson L. Who's sitting on Dali's sofa? Evidencebased policy-making. A Public Management and Policy Association (PMPA)/National School of Government practitioner exchange report. London: PMPA; 2008.
21. Watson RT. Turning science into policy: Challenges and experiences from the science-policy interface. Philos Trans R Soc Lond B Biol Sci. 2005;360:471–477.
22. Environment Research Funders' Forum (ERFF). Using research to inform policy: The role of interpretation. ERFF report no. 3, August 2007 [document on the Internet]. Swindon: ERFF; c2007 [cited 2008 Jan 5]. Available from: http://www.erff.org.uk/reports/reports/reportdocs/interpretstudy070919.pdf
23. McNie E. Reconciling the supply of scientific information with user demands: An analysis of the problem and review of the literature. Environ Sci Policy. 2007;10:17–38.
24. Nutley SM, Walter W, Davies HTO. Using evidence: How research can inform public services. Bristol: The Policy Press; 2007.
25. Bielak A, Campbell A, Pope S, Schaefer K, Shaxson L. From science communication to knowledge brokering: The shift from 'science push' to 'policy pull'. In: Cheng D, Claessens M, Gascoigne T, Metcalfe J, Schiele B, Shi S, editors. Communicating science in social contexts: New models, new practices. Dordrecht: Springer, 2008; p. 201–226.
26. Turnhout E, Hisschemöller M, Eijsackers H. Ecological indicators: Between the two fires of science and policy. Ecol Indic. 2007;7:217–228.
27. Haas PM. When does power listen to truth? A constructivist approach to the policy process. J Eur Public Policy. 2004;11:569–592.
28. Roux DJ, Rogers KH, Biggs HC, Ashton PJ, Sergeant A. Bridging the science-management divide: Moving from unidirectional knowledge transfer to knowledge interfacing and sharing. Ecol Soc. [serial online]. 2006 [cited 2009 April 6]; 11:4. Available from: http://www.ecologyandsociety.org/vol11/iss1/art4/
29. Cloete F, Wissink H, De Coning C. Improving public policy from theory to practice. 2nd ed. Pretoria: Van Schaik Publishers, 2006; p. 366.
30. Limoges C. Expert knowledge and decision-making in controversy contexts. Public Underst Sci. 1993;2:417–426.
31. Strydom WF, Hill L, Eloff E. The role of communication in governance: The River Health Programme as a case study. In: Turton AR, Hattingh J, Maree GA, Roux DJ, Claassen M, Strydom WF, editors. Governance as a trialogue: Government-society-science in transition. Berlin: SpringerVerlag, 2007; p. 281–304.
32. Pohl C. From science to policy through transdisciplinary research. Environ Sci Policy. 2008;2:46–53.
33. Briggs SV. Integrating policy and science in natural resources: Why so difficult? Ecol Manage Restor. 2006;7:37–39.
34. European Commission. Scientific evidence for policy making. Directorate General for Research, Socioeconomic Sciences and Humanities. EUR 22982 EN. Brussels: European Commission, 2008; p. 36.
35. Rosenstock L, Lee LJ. Attacks on science: The risks to evidence-based policy. Am J Public Health. 2002;92:14–18.
36. HM Government. Guidelines on scientific analysis in policymaking [document on the Internet]. c2005 [cited 2008 July 1]. Available from http://www.berr.gov.uk/files/file9767.pdf
37. Raffensperger C, DeFur PL. Implementing the precautionary principle: Rigorous science and solid ethics. Hum Ecol Risk Assess. 1999;5:933–941.
38. Glasgow RE, Emmons KM. How can we increase translation of research into practice? Types of evidence needed. Annu Rev Public Health. 2007;28:413–433.
39. Owens S, Petts J, Bulkeley H. Boundary work: Knowledge, policy and the urban environment. Environ Plann C Gov Policy. 2006;24:633–643.

40. Jewell CJ, Bero LA. 'Developing good taste in evidence': Facilitators of and hindrances to evidence-informed health policymaking in state government. Milbank Q. 2008;86(2):177–208.
41. Eppler M. Knowledge communication problems between experts and decision makers: An overview and classification. Electron J Knowl Manag. 2007;5:291–300.
42. Wolfe R, Behague D. Improving evidence-based policymaking in maternal and neonatal health. Strategies for researchers and policymakers. Briefing paper 1. London: Department for International Development; 2008.
43. Rogers EM. Diffusion of innovations. New York: The Free Press; 1995.
44. Jamieson D. Scientific uncertainty and the political process. Ann Am Acad Pol Soc Sci. 1996;545:35–43.
45. Harries U, Elliot H, Higgins A. Evidence based policymaking in the NHS: Exploring the interface between research and the commissioning process. J Public Health Med. 1999;21:29–36.
46. Jones N, Walsh C. Policy briefs as a communication tool for development research. ODI background note. London: ODI; 2008.
47. Lavis J. Research, public policymaking, and knowledge translation processes: Canadian efforts to build bridges. J Contin Educ Health Prof. 2006;26:37–45.
48. Parsons W. From muddling through to muddling up – Evidence based policy making and the modernisation of British Government. Public Policy Adm. 2002;17:43–60.
49. Crewe E, Young J. Bridging research and policy: Context, evidence and links. Working paper 173. London: ODI; 2002.
50. Jacobs K, Garfin G, Lenart M. More than just talk: Connecting science and decisionmaking. Environment. 2005;47:7–21.
51. Reardon R, Lavis J, Gibson J. From research to practice: A knowledge transfer planning guide. Toronto: Institute for Work & Health; 2006 [cited 2009 March 11]. Available from: http://www.iwh.on.ca/kte/images/
52. Cash D, Clark W. From science to policy: Assessing the assessment process. John F. Kennedy School of Government Harvard University Faculty Research working papers series, November, RWP01-045. Cambridge: Harvard University; 2001.
53. Cash D, Clark W, Alcock F, Dickson N, Eckley N, Jäger J. Salience, credibility, legitimacy and boundaries: Linking research, assessment and decision making. John F. Kennedy School of Government Harvard University Faculty Research working papers series, November, RWP02-046. Cambridge: Harvard University; 2002.
54. Government of Canada. A framework for science and technology advice: Principles and guidelines for the effective use of science and technology advice in government decision making. Ottawa: Government of Canada; no date.
55. Lawrence R. Research dissemination: Actively bringing the research and policy worlds together. Evid Policy. 2006;2:373–384.
56. Allen P, Peckham S, Anderson S, Goodwin N. Commissioning research that is used: The experience of the NHS Service Delivery and Organization Research and Development Programme. Evid Policy. 2007;3:119–134.
57. Shisana O, Louw J. Translating research into policy: The case of orphans and vulnerable children in South Africa. SAHARA J. 2006;3(2):450–456.
58. Turton AR, Hattingh HJ, Claassen M, Roux DJ, Ashton PJ. Towards a model for ecosystem governance: An integrated water resource management example. In: Turton AR, Hattingh J, Maree GA, Roux DJ, Claassen M, Strydom WF, editors. Governance as a trialogue: Government-societyscience in transition. Berlin: Springer-Verlag, 2007; p. 1–29.
59. Funke N, Roux D. Evaluating environmental policy integration and policy coherence across service sectors: The case of South Africa's inland water biodiversity. Africanus. 2009;39(2):18–30.
60. Shaxson LJ. Cost-effective tools for managing the SCP evidence base: Taking a knowledge brokering approach to policymaking. Report of DEFRA project EV0410 [homepage on the Internet]. c2009 [cited 2009 May 13]. Available from: http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=15656#RelatedDocuments
61. Lewenstein BV. When science meets the public. Proceedings of a workshop organised by the American Association for the Advancement of Science Committee on Public Understanding of Science and Technology; 1991 Feb 17; Washington DC, USA. Washington DC: Committee on Public Understanding of Science and Technology, Directorate for Education and Human Resources Programs, American Association for the Advancement of Science; 1992.
62. Saywell DL, Cotton AP. Spreading the word: Practical guidelines for research dissemination strategies – Interim findings. Loughborough: Water, Engineering and Development Centre, Loughborough University; 1999.
63. Canadian Health Services Research Foundation (CHSRF). The theory and practice of knowledge brokering in Canada's health system. A report based on a CHSRF national consultation and literature review, December 2003. Ottawa: CSHRF; 2003.
64. Court J, Mendizabal E. Networks: More than just the latest buzzword. Opinion 57. London: ODI; 2005.
65. Mendizabal E. Supporting networks: Ten principles. Opinion 105. London: ODI; 2008.
66. Meyer H. Communicating science to rural communities requires boundary crossing. Proceedings of the 7th International Conference on Public Communication of Science and Technology; 2002 Dec 5–7; Cape Town, South Africa [document on the Internet]. c2002 [cited 2006 May]. Available from: http://www.saasta.ac.za/scicom/pcst7/ meyer.pdf
67. Natural Environment Research Council (NERC), Environment Agency (EA) and Department for Environment Food and Rural Affairs (DEFRA). Science meets policy 2005 – Next steps for an effective science-policy interface. Report of London Conference held as part of the UK's Presidency of the European Union; 2005 Nov 23–25; London, United Kingdom [document on the Internet]. c2006 [cited 2006 April 21]. Available from: http://www.defra.gov.uk/science/ news/documents/SMP2005.pdf and c2006 [cited 2007 Jan 6]. Available from http://www.sciencemeetspolicy.eu/site/ files/SmP_London_2005_report.pdf
68. Sandman PM. Mass media and environmental risk: Seven principles [document on the Internet]. c2002 [cited 2009 April 20]. Available from: http://www.piercelaw.edu.innopac.up.ac.za/risk/vol5/summer/sandman.htm
69. Black N. Educate and debate. Evidence-based policy: Proceed with care. Br Med J. 2001;323:275–279.
70. Stewart R, Wiggins M, Thomas J, Oliver S, Brunton G, Ellison GTH. Exploring the evidence-practice gap: A workshop report on mixed and participatory training for HIV prevention in southern Africa. Educ Health. 2005;18:224–235.
71. Strydom WF. The impact of State-of-Rivers reporting on people's attitudes towards river conservation: A case study of the Buffalo and Hartenbos & Klein Brak catchments in South Africa. MSc thesis, Stellenbosch, University of Stellenbosch, 2009.
72. Walter I, Nutley SM, Davies HTO. Research impact: A cross sector review. St Andrews: University of St Andrews Research Unit for Research Utilisation; 2003 [cited no date]. Available from: http://www.standrews.ac.uk/~ruru/ publications.htm
73. Huberman M. Linking the practitioner and researcher communities for school improvement. Sch Eff Sch Improv. 1993;4:1–16.
74. Cousins JB, Simon M. The nature and impact of policyinduced partnerships between research and practice communities. Educ Eval Policy Anal. 1996;18:199–218.

75. Funke N, Nortje K, Strydom W, et al. Understanding the dynamics of the uptake of research and development results in a developing South African context. Report done for the National Research Foundation CSIR/NRE/WR/ ER/2008/0422/C [homepage on the Internet]. c2008 [cited 2009 May]. Available from: http://www.nrf.ac.za/
76. Greenhalgh T, Russel J. Evidence based policy making: A critique. Perspect Biol Med. 2009;52:304–318.