Take the long view

At the end of a difficult year for evidence, Ian L. Boyd, a chief scientific adviser to the UK government, draws lessons for making research more relevant.

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The post-truth politics of 2016 has made it a difficult year for those of us who like to see decisions guided by evidence. As a chief scientific adviser to the UK government, I would caution against any disengagement by the science community from policymaking. Science remains an integral part of the processes of government, and its outputs are increasingly needed.

In the areas for which I have responsibilities — food and environment — there is an obvious need to maintain momentum in finding solutions, such as for mitigating climate change. The deeper we dig, the more we understand the important role of the environment for human health and welfare, including for inequality. Achieving the United Nations' Sustainable Development Goals requires a strong and unified approach by the science community, irrespective of populist politicians and policies.

In reality, government is mostly preoccupied with reacting to acute events. Strategy swings with the political whim, the urgent crowds out the important and policymaking can become a displacement activity — a survival strategy that creates the impression of progress against a background of intractability. As a result, it is often only scientists in and around government who carry the baton for confronting the brutal realities of environmental challenges.

There is a danger that, in the maelstrom of day-to-day policy delivery, scientific input will be reduced to a mere technical instrument. To be more involved in creating policy, scientists need to focus on different research priorities from those normally seen as important to their careers.

HARDEST QUESTIONS

This different posture is both structural and intellectual. Structurally, to become trusted components of the policy process, scientists have to develop a heightened appreciation of how government works. Working in government-related science needs to be valued as equal in importance to working in academia. (Having done both, I can say that this is not currently the case.) The constraints on how government scientists behave, and on what they can and cannot say at any particular time, need to be appreciated much more sharply by scientific colleagues and press intermediaries.

Intellectually, we need to frame the challenges faced by government using language that reveals their intrinsic value to scholarship and academic progress. We have perceptions of what ‘excellent’ science looks like, but often, almost by definition, this does not include many of the local, urgent and multidisciplinary questions being addressed in government.

Yet governments tackle some of the most difficult questions facing people and the planet — from what particular price for carbon might affect employment to what portion of the health budget should be spent on prevention. Costing environmental degradation in to the decisions made in everyday life stands out as one of the greatest challenges. Feigning to ignore these, or focusing on only one component of them to the detriment of building a broader understanding of how they might be solved, happens too often in academic science.

SYSTEM CHANGE

In practice, governments manage systems — farming, say, or transport. These include many interacting processes and actors, natural and social. In general, governments have little control over the components of these systems. What they most need scientists’ help with is understanding which parts can be managed, and studying the behaviour of whole systems in response to those changes, often through data about system indicators and research into their dynamics.

For example, scientific advice about fisheries tends to wrongly assume that fisheries management is about managing fish, when we can normally only manage those who fish. Similarly, the solution to the bovine tuberculosis epidemic in Britain is more about managing farmer behaviour than it is about applying well-tried epidemiological solutions.

The contribution made by supplyside innovation — that is, inventing new materials, devices or structures, or probing the complexity of nature — is undoubtedly a good thing. It is often touted by politicians as the main way in which research adds value in civil society. As scientists, we often acquiesce to this linear view because it is the route through which money tends to flow. Politicians like it because it supports market activity and economic growth, and gives people more of what they want.

However, for most policies to work, equal strides are needed in demand-side innovation (research that answers specific, pragmatic questions). In food and environment, this often involves increasing system efficiency and reducing demand.

For example, many countries have now legislated for the use of low-energy lighting, stimulated by supply-side innovation that increased light-bulb efficiency by at least an order of magnitude. But a lack of simultaneous demand-side innovation, such as through behaviour change, has meant that the overall power usage has continued to rise — we just use more lights. The same goes for the fuel efficiency of cars. Arguably, by focusing on one part of the problem, science has only added to its intractability.

PROBLEM-SOLVING

Tackling many of the environmental grand challenges will need large-scale investments in system models. Climate science has emerged from the need to forecast weather and so provides a template for how this could be done. It involves high levels of organizational design, including a global environmental-observation network providing large data flows linked to ocean and atmospheric models run on high-performance computers.

Many other areas of environmental science — air and water, food, waste, and biodiversity — need a similar scale of effort and investment. The data flows from observational networks are emerging, but there is insufficient coordination of system-model development to capitalize on these data.

Achieving this requires changes in policy for science and social science to incentivize the research community to participate in government. This means reassessing the relative value of game-changing discoveries (supply-side innovation) over the organizational, system-based solutions that are needed (demand-side innovation).

If researchers want to play their part in solving major problems, such as decoupling economic growth from resource consumption, they need to change their focus. This requires greater prioritization of behavioural and operational research, a discipline that gets scant coverage in academic circles but which encompasses systems analysis and modelling. It also requires greater value to be placed on synthesis as a tool in discovery because of its power to describe system level behaviour. Often it is the simple solutions applied well that make the difference rather than new technologies.

This is not the world of the laboratory bench or the individual theoretician. It is one in which system models are being continually refined on the basis of big, open data about the system's state and its responses. This will blur the boundaries between experimentalists and those who run the policies — because a policy becomes a hypothesis. And it will turn science back from the path of being perceived as an irrelevant domain of the intellectual elite. Recent growth in anti-science views on both sides of the Atlantic suggests that this change is imperative.

WISH LIST

So, what are the really big systems challenges in my areas of responsibility? First, in my view, we need to know much more about the future of resources. Raw materials drive the global economy; if they cannot be grown, they need to be mined. In response, we have invented solutions such as the circular economy. Although no one doubts the wisdom of driving up the productivity associated with the materials already in the economy, their reuse may divert attention from difficult decisions about reduction. Better systems-based models of resources and materials are needed to help frame the policy options.

Similarly, we need to know the level of assurance of our worldwide food supply. It is difficult for policymakers to estimate how much reserve is needed to create resilience to different kinds of shocks, natural or human-made. Most governments currently leave this crucial function to the market, but is this wise? Little is known, beyond what equilibrium economic models tell us, of the stability and resilience of food-supply networks. Many human-made and natural networks show nonlinear behaviour and have a capacity to reach a tipping point. Could this happen to global food supplies?

An extension of this question concerns the future of livestock. This has very low levels of material efficiency, so shifting away from livestock production might simultaneously address concerns about future food supplies and resources. Although livestock production can be the best use of marginal land and is important in some developing countries, it is also a significant contributor to greenhouse gases, exacerbates the problems of antimicrobial resistance, causes pollution, increases the risks from diseases that are spread from animals to humans, and drives the destruction of tropical forest. Furthermore, current levels of meat consumption in the developed world are unhealthy. Are there different systemic solutions to meat production and consumption that address these kinds of problem?

There are other priorities, of course. But in the interests of focusing on finding simple solutions and applying these well to achieve maximum effect, these examples could address many of the large-scale and long-term environmental challenges facing the planet. Intellectual resources need to be deployed where they will make the biggest difference, and this requires leadership and vision.

Politicians who are willing to listen may say this is all too difficult. However, scientific leadership can help policies and the systems they are designed to influence to evolve together. Pointing to small changes in key variables and introducing changes incrementally can have big effects over time.

This is illustrated by how some countries, including Britain and several other European nations, are on track to eliminate sending waste to landfill. Incremented taxation of landfill waste has changed behaviours and encouraged investment in recycling and reuse. A simple tax applied in the right place and appropriately scaled has shifted the whole system state. It has changed behaviours without stranding assets and, importantly from a political perspective, it has not upset the electorate.

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