A multi-disciplinary approach to research for the development of northern Australia

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Abstract

Research to underpin the green-field development of northern Australia requires the integration of science from a wide range of disciplines. Data and information on natural resources for most areas of northern Australia is at insufficient resolution to support green-field agricultural development. Socio-economic information is similarly depauperate, particularly at the scales with which development is likely to occur and in relation to the specific types of development that might be locally possible. The combination of the biophysical, social, cultural and institutional environments in northern Australia is different to that found elsewhere and requires that research considers these factors in a coherent way.

We report on one such body of research that examined the scale of opportunity for agricultural development in the Flinders and Gilbert catchments in the Gulf region of north Queensland, the Flinders and Gilbert Agricultural Resource Assessment (FGARA). The assessment included input from a very broad range of scientific disciplines including those concerned with soil property and land suitability mapping, climate variability, climate change, surface hydrology, groundwater systems, flood frequency and extent, geophysics, agricultural productivity, water storage and transmission, irrigation, Indigenous water values and aspirations, social impacts, local and regional scale economics and aquatic ecology. The assessment was truly multi-disciplinary in its approach, and included scientific input from over 100 people. The advantages to this multi-disciplinary approach are many but it does increase the transaction costs. Similarly, there are advantages to taking a more inter-disciplinary approach in some circumstances. For projects of this scale, size and timeline a mixed approach is appropriate – balancing the need to minimise transaction costs and make the most efficient use of resources with the need to provide a well integrated and coherent synthesis to stakeholders.

Introduction

Increasingly, research organizations are adopting multi-, inter- and even trans- disciplinary approaches in order to address complex national and global issues. As an example, over the last 15 years Australia's national science agency, CSIRO, has profoundly re-organised its internal structures in order to better deploy its capability to multi-disciplinary research efforts aimed at key national challenges (Hatton and Young 2011). Like many such organisations, CSIRO has a long history of mono-discipline research and this new operating model requires organisational learning, including the realisation that success does not come without high transaction costs associated with time, physical distance, changing research paradigms and other "inefficiencies" (Roux *et al.* 2010).

In this paper we use a recently completed project, the Flinders and Gilbert Agricultural Resource Assessment (FGARA), as an example to reflect upon the practice of going beyond mono-disciplinary approaches. We explore the comparative value of integrating and not integrating in different elements of the project. We provide this reflection in order to inform future activities in northern Australia and elsewhere, particularly those in which the project design brings many disciplines together.

Disciplinarity

The literature remains unsettled on the definition of different forms of disciplinarity. Here we use Stember's typology (Stember 1991). Multi-disciplinarity involves multiple disciplines who each bring a different perspective to a problem. Inter-disciplinarity seeks to integrate the contributions of multiple disciplines. Trans-disciplinarity concerns the "unity of intellectual frameworks" beyond disciplinary perspectives.

The Flinders and Gilbert Agricultural Resource Assessment (FGARA)

Sustainable regional development is a long-standing priority for all Australian governments. While there are many opportunities for increasing agricultural production in northern Australia it is well recognised that risk attends each opportunity. FGARA provided a comprehensive evaluation of the feasibility, economic viability and sustainability of water resource development in the Gulf catchments of the Flinders and Gilbert rivers in north-west Queensland.

The assessment sought to address the; (a) soil and water resources available for irrigated agriculture; (b) existing ecological systems, industries, infrastructure and values; (c) opportunities for irrigation; (d) economic viability of irrigated agriculture and (e) ways in which the sustainability of irrigated agriculture could be maximised.

The assessment was large in scale and short in time. It comprised 13 separate bio-physical and socio-economic activities (Petheram *et al.* 2013). More than 80 CSIRO staff were deployed into the project and more than 100 people overall. From the time the project was announced to its delivery to government was a little more than 24 months.

The reporting products provided a staged approach of information delivery to end-users. A set of 16 Technical Reports, each several hundred pages in length, provided detailed scientific results from the individual activities. These were synthesised into two catchment reports, one for each catchment, of about 400 pages each. A set of case studies within these reports allowed information from multiple activities to be integrated. Summaries of major findings for each catchment (16 pages each) were also produced in 'glossy format' along with a two page 'fact sheet style' publication. This staged delivery allowed the project team to present in-depth mono-discipline scientific information along with information that became progressively more synthesised and integrated for a different set of end-users.

In doing the project, there were many instances where taking a multi-disciplinary approach to an aspect of the problem being addressed provided great benefit, common in issues of natural resource management (Janssen and Goldsworthy 1996). For example, there was close interaction between those scientists working on the river modelling, economics, agriculture, irrigation, climate and water storage activities. While there was benefit in integrating these activities, particularly when examining specific case studies of development, there were also high transaction costs to this.

There were also instances where more integration across the project would have been counter-productive. One example is the integration of flood modelling with land suitability assessment. While it would have been possible to provide final products which included land suitability masked by areas prone to flooding, this would have dis-empowered end-users to work through their own solutions to development that may have included upstream water storages, or flood levees, thereby rendering the FGARA products less useful. Similarly, applying community values to areas of lower or higher prospectivity for development in terms of conservation value may have provided a more accurate assessment of the prospect for development in 2015, but would become out-dated if community values changed. The preferred approach was to recognise that community values have a major influence on development potential and to provide products that can be integrated in the future to allow contemporary values to be matched to biophysical opportunity.

Reflections from FGARA

Some reflections emerge from the experience of managing such a large, complex and time-bound project.

Large projects will almost certainly involve many people from a range of disciplinary backgrounds. The temptation will be to adopt an integrated approach as default practice. However, this will require careful thought and management since there are constraints to such integration. It is likely that the scientists working on the project will be widely dispersed, in FGARA's case at 10 CSIRO sites across Australia. They are not likely to have a history of working with each other in a team and therefore won't have built the kind of relationships that allow people of different discipline backgrounds to communicate effectively and to understand each other's perspective or philosophical basis (Moon and Blackman 2014). Keeping teams together, over multiple projects, would address this. Bringing the scientists together is expensive and time consuming. Time constraints for project delivery are likely to mean that the opportunity for the multiple iterations required for true integration is unlikely, or at least difficult. While there are many frameworks provided to enable best-practice disciplinary integration (e.g. Janssen and Goldsworthy 1996; Strang 2009) they are not always practical given the constraints within these types of projects.

Conclusions

Overall, we found that a mixed-model approach was most appropriate, rather than attempting to integrate across many disciplines as default practice. Some elements of projects like FGARA require a stronger emphasis on multi-, inter- and even trans- disciplinary approaches than other elements. In very large projects this will lead to a model whereby some elements are simply added together, some are integrated and some have the potential to be truly trans-disciplinary.

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