Chapter 51
Collaborative Knowledge in Catchment Research Networks:
Integrative Research Requirements for Catchment Systems Science

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ABSTRACT

Catchments are increasingly used to structure collaborative knowledge to advance understanding and management of terrestrial and freshwater natural resources. To produce collaborative knowledge of catchment systems requires greater levels of integrative research based on networks of researchers, policymakers, and practitioners. To enable increased levels of integrative research depends on development and application of digital technologies to improve collection, use, and sharing of data, and devising new knowledge infrastructures. Catchment observatories that integrate existing and novel physical, social, and digital networks of knowledge infrastructures are urgently needed. This chapter presents three leading international examples of collaborative networks of catchment researchers. In particular, the digital infrastructures they have developed to support collaborative knowledge in catchment research networks. This chapter provides future research directions required for the production, sharing, and use of collaborative knowledge in catchment research networks based on catchment systems science.

INTRODUCTION

There is a need to improve the production, sharing and use of collaborative knowledge of catchment systems through networks of researchers, policy makers and practitioners. This requires greater levels of systems based integrative research. Over a decade ago, Falkenmark (2001) stated that the greatest water related problem was our inability to link water, food and environmental security. Current mismatches in the demand for and supply of local to regional resources is leading to water, food and energy insecurity.

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Solutions are required that integrate interactions between water security (Bogardi et al., 2012), food security (Godfray et al., 2010) and energy security (Bazilian et al., 2011). These solutions need to be built on systems nexus based thinking (Hoff, Iceland, Kuylenstierna, & te Velde, 2012). We require systems based approaches to understand and manage these complex unstructured 'messy' socio-ecological situations (Ackoff, 1974). Systems based approaches are well established in several disciplines that range from systems biology, operational research to earth systems science. Lessons learned from these approaches include: the importance of problem structuring; the need to integrate qualitative and quantitative approaches; the need for network based approaches; and the requirement to increase the sharing and use of data (Macleod, 2010). These lessons highlight the importance of enabling integrative research in scientific research networks to produce, use and share collaborative knowledge. Catchments are increasingly used to structure our collaborative knowledge to improve our understanding and management of terrestrial and freshwater resources under environmental change.

In parallel to the growing realization that greater levels of collaborative knowledge in scientific research networks are required, a digital revolution has been taking place. This has been driven primarily by the emergence of distributed networks of computers and standards-based interoperability. "The Internet has changed not only the way society operates, but also how scientists work. There has also been a step change in the quantity of data that scientists routinely amass and need to analyse" (Thorpe, 2009). More recently, Nielsen (2012) in his book 'Reinventing discovery' sets out how the Internet is fundamentally changing how we are carrying out collaborative scientific research. How knowledge is generated and used are being changed by the presence and use of the Internet (Weinberger, 2011). Developments in web 2.0 internet technology have enabled a wider range of applications that involve contributions of data from networks of researchers and non-researchers e.g. (Frame et al., 2009; Rinner, Kessler, & Andrulis, 2008). Current developments with the semantic web (web 3.0) are enabling greater discovery and sharing of linked data (Hall, De Roure, & Shadbolt, 2009). There are calls for a greater understanding of collective knowledge systems, where the semantic web meets the social web (Gruber, 2008). A vision for the Internet is where we can create social machines (web 4.0) that enable people e.g. researchers, to be creative, whilst the machines carry out more of the administrative tasks (Hendler & Berners-Lee, 2010). Catchment systems based integrative research must harness developments in digital technologies to enable networks of researchers and non-research stakeholders produce, share and use collaborative knowledge to better understand and manage catchment systems.

The objective of this chapter is to present the status and research needs for greater levels of systems based integrative research for the production, sharing and use of collaborative knowledge in catchment research networks. To enable increased levels of integrative research depends on development and application of digital technologies to improve collection, use and sharing of data and devise new knowledge infrastructures. This chapter focuses on the requirements for catchment observatories that integrate existing and novel physical, social and digital networks of knowledge infrastructures. To support this focus, I present three leading international examples of collaborative networks of catchment researchers and their development of catchment observatories. In particular, the digital infrastructures they have developed to support collaborative knowledge in catchment research networks. I conclude by discussing the future research directions required for greater levels of production, sharing and use of collaborative knowledge in catchment research networks based on catchment systems science.