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Research article

Opportunities for adaptive online collaboration to enhance rural land management

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ABSTRACT

Cross-property cooperation has the potential to enhance the effectiveness of environmental management actions that cut across property boundaries. Online tools can facilitate this and overcome barriers to landholder engagement in collaborative management. However, collaborative online tools need to be designed and tailored to users' needs and values, and landholder participation in the development process is critical to ensuring uptake and long-term use.

This article presents a case study from the Central Tablelands region of New South Wales, Australia, where landholders have been involved in participatory development of a new online collaboration tool. The case study results highlight the significance of issues such as internet access, privacy, technical proficiency and differing stakeholder objectives. A landholder survey identified mapping and the uploading of monitoring data as important functions for the online tool, but these were not rated as highly as functions relating to data security, sharing settings and key term searches. Consequently, we recommend that a future online collaboration tool for the region is not framed specifically as a mapping or citizen science tool, but rather as an adaptive collaboration and communication tool that can incorporate a variety of data types and formats and be modified over time in line with changing landholder needs.

1. Introduction

Cross-property cooperation can enhance the effectiveness of environmental management actions that cross property boundaries, including for monitoring (Lawrence et al., 2007), sustaining ecosystem services (Rickenbach et al., 2011) and developing new commercial enterprises (Baumber et al., 2009). However, a tension often exists between the scale at which such collaboration may be required and the scale at which landholders make land management decisions (Wyborn and Bixler, 2013). Online tools have the potential to bridge this gap by enhancing communication, data-sharing and collaborative decision-making (Palomino et al., 2017). In this article, we employ a case study approach to assess interest in online collaboration tools for land and natural resource management in the Central Tablelands region of New South Wales (NSW), Australia.

In Australia, the Landcare movement has been a prominent example of collaborative cross-property land management since the mid-1980s, with local groups engaging in tree planting, erosion control, pest and weed management, riparian zone fencing and other activities for both conservation and production (Compton and Beeton, 2012; Curtis et al., 2014; Lockwood, 2000). However, Landcare activities have been declining in some areas due to changes in government support and demographic shifts, including the migration of rural amenity "lifestylers" into many areas (Tennent and Lockie, 2013). These changing demographics can create challenges for landholders in engaging with neighbours through traditional networks and communication strategies (Meadows et al., 2014).

Online collaboration tools offer new platforms for landholders to store and share monitoring data (Newman et al., 2010), to enhance the speed and scope of engagement with other stakeholders (Rotman et al., 2012) and to participate in planning around landscape-scale issues (Meyer et al., 2016). Furthermore, online tools that allow land managers to collectively record data, plan management trials and modify practices in response to new

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information may enhance their adaptive capacity in line with the notion of "adaptive co-management" (Berkes, 2007). As such, online tools have the potential to enhance not only the level of collaboration amongst landholders, but also to enhance their capacity to adapt land management to changing circumstances.

Section 2 of this article provides a global-scale review of online tools for collaborative environmental management. The case study region is then introduced in Section 3, along with the methods and results of a landholder survey. Section 4 provides a discussion of the implications of the case study research for the broader field of online collaboration tools.

2. Online tools for collaborative environmental management – a global overview

Rural landholders may choose to utilise online collaboration tools for a wide range of purposes, including farm management, planning conservation projects, developing new enterprises and sharing data through citizen science programs. Palomino et al. (2017) argue that advances in geospatial data and tools can facilitate greater collaboration in four main ways: (1) enabling groups to divide up tasks across expansive geographic scales; (2) allowing greater sharing of data and peer review; (3) enhancing communication between stakeholders; and (4) allowing integration of complementary tools, such as mapping and communication tools.

The features of online collaboration tools vary according to their purpose and the characteristics of their users. For example, citizen science websites and apps generally do not require users to have a high level of technical skill and employ a modular system whereby each user completes a small part of the project. In contrast, participatory geographic information systems (PGIS) may require a skilled facilitator to assist users (e.g. Karimi and Brown, 2017; Meyer et al., 2016). Tools that are primarily focused around mapping and designed to allow users with little or no training to create their own maps may be classed as "neogeography" (Turner, 2006). While mapping is a central feature of neogeography and PGIS, other tools may focus more on facilitating communication or sharing non-spatial data such as photographs and case studies.

2.1. Participatory geographic information systems (PGIS)

Participatory GIS (PGIS), including related terms such as Public Participation GIS (PPGIS) and participatory mapping, have been used for a range of applications in Australia and many other countries. Karimi and Brown (2017) note that PGIS approaches often differ between developing countries, where PGIS is used to mediate disputes over access to land and natural resources, and developed countries, where PGIS is used to understand competing values and preferences around how land should be used.

Meyer et al. (2016) report the results of two regional case studies in South Australia, where regional planners developed a web-based landscape futures PGIS tool. Government agency staff, community advisory board members and farmers were engaged in the setting of landscape goals and evaluating the outputs of the tool, while project team members with specific expertise undertook the data collation, designed the interface and conducted social research into the tool's effectiveness. Karimi and Brown (2017) report on a similar exercise in Queensland, where government agency staff assigned values to different land uses such as conservation, mining, residential development and tourism. Common features of these two examples are that they were targeted at a regional scale (4000–80,000 km^2), focused primarily on government agency staff and required expert facilitators.

Jankowski (2009) discusses the potential of PGIS to enable groups of local people to participate in decisions shaping their communities, shown through two case studies on the management of water resources in Idaho. As with the case studies of Meyer et al. (2016), Jankowski's case studies involved GIS resources developed by agency staff and experts, with the role of landholders being to identify values, goals and strategies to address regional challenges. Ramsey (2009) argues that a limitation of some PGIS approaches is that they frame the exercise as one of "problem-solving" and present GIS data in a manner that can pre-determine how users should view the problem and which solutions may be appropriate.

2.2. Citizen science, volunteered geographic information and neogeography

Citizen science, or crowd science, seeks to engage volunteers in the collection, analysis and curation of scientific data, with such volunteers typically lacking formal credentials or professional positions in scientific institutions (Rotman et al., 2012). Citizen science projects can be divided into three categories (Bonney et al., 2009): Contributory projects, where scientists design the project and volunteers contribute data; Collaborative projects, where volunteers have input into project design; and Co-created projects, where scientists and volunteers are involved in all parts of the project.

Landholders may be a target group for participation in citizen science projects through the collection and reporting of data on environmental issues in their area (Newman et al., 2010). FeralScan is an Australian example developed by the Centre for Invasive Species Solutions. Branded as "citizen surveillance", it allows landholders and other community members to record and share sightings of invasive species, including foxes, pigs, goats and cats (FeralScan, 2017). In other cases, volunteers are involved in data analysis rather than collection, such as the site www.globalfishingwatch.org, which involves analysis of large datasets on marine vessel movements to monitor compliance and identify illegal activity (Robards et al., 2016).

The internet has provided the opportunity for citizen science to become more widely distributed and practiced (Rotman et al., 2012). The integration of online mapping and citizen science can enhance the ability of landholders to incorporate results into their land management practices (Newman et al., 2017). However, care is required to ensure that participant tasks are suited to their differing skill levels (Franzoni and Sauermann, 2014).

Where citizen science involves the uploading of data via online tools, it overlaps with VGI, or Volunteered Geographic Information (Goodchild, 2007). However, citizen science does not necessarily require an online component and the contribution of VGI is not necessarily motivated by scientific goals (e.g. users uploading photos or marking points of interest). Similarly, citizen science and VGI can overlap with neogeography, defined by Turner (2006, p. 3) as "people using and creating their own maps, on their own terms and by combining elements of an existing toolset". While the philosophy of users defining their own goals and uses for maps makes neogeography a broader concept than citizen science, the extent to which many users are truly able to engage "on their own terms" has been challenged due to issues such as access and education (Haklay, 2013).

2.3. Incorporation of property and landscape data into participatory online tools

Land managers can use participatory online tools in several ways to maximise their relevance for decision-making at the property or landscape scale. One option is to engage landholders in "ground-truthing" GIS-derived data. For example, Al-Wadaey and Ziadat (2014) asked local farmers in Syria to validate GIS-