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Social learning: a knowledge and capacity building approach for adaptive co-management of contested landscapes

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Social learning: A knowledge and capacity building approach for adaptive co-management of contested landscapes

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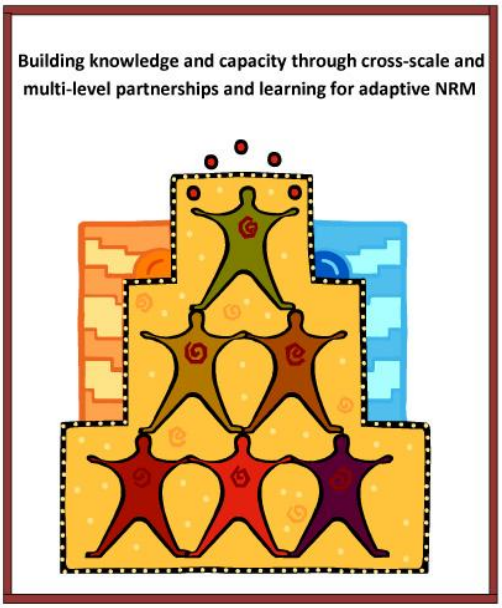
Graphical abstract



Abstract

There is increasing recognition in the field of natural resource management that transformative adaptation to climate and policy change requires cross industry learning and cooperation at the landscape scale. This can be supported by the development of systematic methodology on learning models for adaptive co-management between diverse and conflicting landscape managers. Our example of land-use change to hardwood plantation forestry in sub-tropical Australia illustrates an innovative implementation framework for a social learning process that helped build knowledge and community capacity for adaptive co-management of dynamic and shared landscapes. The action research methodology relied on deliberation over local knowledge, existing and emergent scientific findings, resulting in attitudinal change. Processes required facilitation and mediation by a bridging organisation, in this case a research institution, to support cross-scale communications. Reflections suggest that attention is required to manage risk and support stakeholder analysis, particularly in understanding contested values and overcoming power differentials between industry and self-interest groups. Resolving funding issues will require greater consideration by governments and industry groups of their social responsibilities to communities and the environment; particularly as this social learning model is posited for more broad-scale use in providing multi-level governance linkages and as a basis for targeting interventions to address policy gaps or failure.

Keywords: Bridging organisations; land-use conflict; plantation forestry; stakeholder analysis; evaluation; governance.

Introduction

Adaptive co-management has emerged as an interdisciplinary method to foster improvements in ecosystem management and help resolve multi-scale society-environment dilemmas (Olsson et al., 2004a, b; Plummer and Armitage, 2007; Armitage et al., 2009). Methods depend on building trust in the formation of social networks between landscape managers, communities, researchers and policy makers for collaboration and learning through complexity and change. Transformation of social-ecological systems is often involved in response to policy failure that can be triggered by resource crises or shifts in societal values (Walker et al., 2006). The focus of adaptive co-management has moved towards incorporating social learning methods for an integrated methodological approach as reported in a wealth of studies including Guijt (2007), Mostert et al. (2007), Pahl-Wostl et al. (2007), Steyaert and Jiggins (2007), Muro and Jeffrey (2008), Berkes (2009) and Woodhill (2010). Yet little focus has been given to the development of institutional frameworks for implementing and evaluating these learning based approaches in adaptive co-management (Woodhill, 2010; Diduck, 2010).

According to Woodhill (2010) the concept of group social learning is central to current debates on tensions between sustainable development, democracy and free market ideology, however requires further attention to theoretical design and facilitation. Diduck (2010) supports this view by suggesting greater focus is needed on theory and practice in non-formal education and the need for place-based empirical studies, proposing that relational spaces enhance adaptive capacity. The effectiveness of these participatory learning processes in natural resource management is not only for fostering attitudinal and behavioural changes, highlighted in findings by Buchy (2004) and Hagmann et al. (2002), but also the need to promote fundamental changes to value orientations within society, a view shared with Inglehart and Welzel (2002) from political cultural studies.

This paper reports on a study to test an innovative social learning approach to adaptive co-management facilitated by a research organisation. While social learning aims to foster knowledge sharing and creation between stakeholders with diverse experiences and views, confounding epistemological distortions can arise; such as through gender and power imbalances (Buchy, 2004) and lack of representation from marginalised groups in society, particularly the indigenous (Hill and Williams, 2009). Guidelines were developed for social learning studies based on lessons learnt on a case study exploring landscape dynamics under land-use change to hardwood eucalyptus plantations from traditional cattle and cropping enterprises in the Upper Clarence catchment of sub-tropical north-eastern NSW, Australia.

The guidelines are presented in the form of a methodological framework to support further social learning studies aimed at conflict resolution and the development of adaptive co-management practices for sustainable natural resource use within the landscape. While the social learning process helped reduce conflict among stakeholders in response to a convergence in views and attitudes, limitations and challenges also emerged. These included issues surrounding future funding for these types of studies, bridging gaps with community (otherwise referred to in literature as scaling-out, Hagmann et al., 2002) and up-scaling into multi-level governance structures, suggested by Marshall and Stafford Smith (2010) to be critical when landscape-scale transformation is required. The paper develops a critique for social learning as an approach to adaptive co-management within the natural resource governance framework through an exploration of literature.

Plantation forestry within cultural landscapes

Across the globe, rural landscapes are increasingly perceived as cultural landscapes with multi-functional identities that encompass historical, environmental and cultural facets (Antrop, 2005; Martineza et al., 2010). Hardwood plantation forestry is one rural industry that has been subject to broad criticism for neither establishing a clear identity nor demonstrating sound economic performance in Australia (Varmola and Carle, 2002; Venn, 2005; O'Toole and Keneley, 2010). The industry has been caught between identities of old growth or natural forests that are valued in society for the provision of social, cultural, ecological and economic services (Garcia-Quijano et al., 2005; Nail, 2008) and those of agriculture, valued for efficient and cost-effective production of food and fibre (Robertson and Swinton, 2005).

Only over the recent two decades has the socially contentious nature of plantations been vigorously publically debated as public activism has increased (Gerrand et al., 2002). Concerns have been voiced over perceived negative social impacts on rural communities and environmental impacts on water quality and flows, pollution from pesticides, and threats from mono-cultures on biodiversity (Schirmer, 2007). Initially government forestry departments established softwoods (mainly introduced *Pinus radiata* and the native *Araucaria cunninghamii*) predominantly for sawlogs on crown land through clearing natural forest, and occurred mainly under the public radar. However, as hardwood plantation development began to rapidly expand in the period between the late 1980's and 2009 mainly for low-value pulpwood through private company investment, these community concerns began to escalate (Gerrand et al., 2002).

This rapid expansion occurred in response to reduced logging access to natural forests, improvements in quality and consistency of wood and pulp products from plantation hardwood timbers (Schirmer, 2007) and provision of fiscal tax measures from the federal government for retail afforestation on agricultural land (Leys and Vanclay, 2010a). Gavran and Parsons (2010) estimated the total national plantation area to have increased by around 51% in the past ten years to a current estate of 2.02 million hectares (approximately half hardwood and half softwood, with an insignificant area of mixed plantings). A recent confounding effect when communities have been given power to influence forestry policy has been reported by Tattersall (2010) through a mechanism referred to as Community Based Auditing. This community engagement mechanism arose in response to ongoing conflict over the management of Tasmania's public natural forests with environmental activists, and the consequence has been a historic move by the Tasmanian timber industry to phase out logging of natural forests altogether.

The collapse of the majority of hardwood plantation forestry companies during the global financial crisis of 2009-10 that were reliant on the Managed Investment Scheme model for ongoing private investment has created serious impacts on the plantation forestry industry (Schirmer, 2010). Business models depended on a steady flow of investor funds for operational management and continued expansion to build their resource base. The innumerable socio-political, economic and ecological challenges have left the industry with a hard road to acceptability in the eyes of the public and disenchanted investors who lost money. Major policy transformations will be required that promote increased self-sufficiency and improved management performance if a sustainable hardwood industry is to be created (Leys and Vanclay, 2010a). With a current account deficit in

Australia of $2.1 billion ($Aus) in timber and timber products (ABARE, 2009), and continued public pressure to lock up further areas of natural forests to logging, there remains considerable opportunity for innovation in this industry.

Mechanisms for sustainable development of landscapes

As governments across the globe recognise the need to involve local actors in sustainable development of these cultural landscapes, there have been challenges to finding effective mechanisms that incorporate community-based approaches for multi-level natural resource governance. The need has been particularly recognised for urgently responding to climate and policy change and impacts from economic globalisation (Olesen and Bindi, 2002; Lemos and Agrawal, 2006; Prager and Freese, 2009).

In Australia, several attempts have been made since the early 1990's for Federal and State or Territory funded initiatives to devolve regulatory power in natural resource governance to rural communities through 'Landcare' (Prager and Nagel, 2008; Lockwood et al*.,* 2008) and regional NRM groups including 'Caring for our Country' (Prager, 2010). Limited success has been reported with these measures due to a lack of willingness by local actors to engage these in community-based programs that have typically involved onerous systems of accountability over funding and implementation (Wallington and Lawrence, 2008; Farrelly, 2009). Prager and Nagel (2008) challenged the effectiveness of these initiatives on the grounds that they have not been able to actively shape government policy. Other limitations to the effectiveness of local and community processes have been reportedly due to poor practitioner skills and lack of capacity of local citizens to participate effectively (Head, 2007; Robins, 2008).

This paper presents arguments on the merits of social learning as a place-based local participatory process to complement other market and hierarchy based governance arrangements (Ison et al., 2007) for helping resolve complex issues in the landscape resulting from land-use change. Strengths include social engagement through emergent trust from local actors, together with learning and negotiation over dynamic ecosystem processes. This method is posited for offering a less adversarial and elitist platform that can otherwise result from traditional hierarchical governance measures (Ross et al., 2002). It can provide an effective problem solving mechanism where traditional market-based measures cannot cope with the cyclical and dynamic nature typical of ecosystems. Since community engagement practice is now embedded in plantation forestry certification schemes such as the Australian Forestry Standard and Forest Stewardship Council (APTI, 2006), this novel study with industry that introduces intellectual engagement[1] through social learning, may have potential for more widespread use in conflict resolution and fostering behavioural change.

Natural resource governance and environmental ethics

Governance provides a structure based on tradition and processes for determining how power and responsibility are exercised. It states who can be involved in decision making (Fabricius et al*.,* 2007) and when social capital is mobilised. This is considered to be dependent on social networks of reciprocity, trust and collective action (Armitage et al*.,* 2009). Saner and Wilson (2003) suggest that 'good' governance involves sound environmental ethics and should satisfy three basic perspectives; ethics of character, duty and utility. In this paper it is argued that processes of social learning can

enhance opportunity for participation and social change across boundaries through mobilising sources of social capital.

Lockie (2003) found flexible frameworks for participatory processes that incorporate fairness and understanding of diverse community attitudes and values, to be inclusive and help empower local actors. This view was thought to offer potential in this study with the plantation forestry industry due to the long history of conflict with environmental and farming groups. Further, by examining the multiple dimensions of value systems that encompass non-material benefits, broader community outcomes are also possible (Mostert et al., 2007). These include improvements to amenity values, water quality, biodiversity conservation and greater ownership over the solutions, together with an improved sense of well-being (McDermott and Schreckenberg, 2009).

Subsidiarity and up-scaling local and community-based processes

Participatory processes have been linked to governance systems where power is devolved from higher levels to local actors by applying the concept of subsidiarity. This is the principal of assigning a particular responsibility to the lowest level of governance with the capacity to discharge it effectively and where recommendations are effectively implemented and sustained (Marshall, 2009; Prager and Freese, 2009). Lockwood (2010) suggests devolution as a practical and moral response to the limitations of existing governance systems in light of continued declines to biodiversity, inattention to social justice and an increasingly informed citizenry as education standards have improved.

However, recent developments in NRM policy analysis by Marshall (2008) and Brondizio et al. (2009) claim usefulness in up-scaling or 'nesting' participatory processes into regional governance systems. This is to take account of the perceived increasing functional interdependencies of ecological and social systems in responding to economic globalisation and global environmental change. Further, the need for mutual obligation in environmentally responsible practice at the federal level has been suggested by Wallington and Lawrence (2008); however balance is required to also maintain socio-economic outcomes from intervention measures. This is particularly relevant as political authority from the federal government appears to be increasing by virtue of maximising opportunities from fiscal dominance to capture the Federal Constitution's allocation of environmental and NRM governance responsibilities to the states and territories (Marshall and Stafford Smith, 2010). This is particularly evident with proposed cutbacks on water allocations to irrigators and communities of the Murray-Darling River Basin under the federal Water Act. Currently there appears to be a lack of consideration given to the water-use efficiencies of individual crops that would be a more robust approach if cutbacks were made to inefficient enterprises. This is rather than the blanket approach proposed for cutting water allocations on average by 27-37% (Kelly, 2010) that will negatively impact on food production and likely create price rises for many staple goods.

Natural resource connectivity and interdependency between vertical levels of governance

The tensions between institutions representing groups competing or co-operating for authority over resources is described by governance scholars as vertical interplay, where resource appropriation by one user reduces availability to others (Brondizio et al., 2009). Adding to this complexity is that ecological systems are non-linear in nature, with processes and structures

interacting inconsistently across scales (Cash et al., 2006; Lemos and Agrawal, 2006; Walker et al., 2006). The implications of this complexity for civil society are that dynamic tensions are being placed on socio-political systems for allocating scare resources across scales and competing rural industries. This pressure will only increase under projected global population growth and as urbanisation continues to expand (Antrop, 2005; Robertson and Swinton, 2005), supporting the academic argument for interconnected multi-level governance.

Bridging organisations to facilitate social learning

Recently the concept of bridging organisations has emerged for providing a facilitation and mediation role to connect local and regional collaboratives into the multi-level natural resource governance structure (Hahn et al., 2006; Prager, 2010; Berkes, 2009). The benefits have been reported to be the creation of synergies for implementing change and ensuring values from local level knowledge and initiatives are not lost. Bridging organisations act as an intermediary for communication to support networking and cooperation and can take on organisational responsibilities to provide relief for local participants who are generally time restrained. However, information on skills required by bridging organisations to facilitate social learning processes has been very limited to date. This study aims to address the gap in literature by taking a novel approach through having a University research institution facilitate the role of a bridging organisation.

Adaptive co-management to overcome deficiencies in traditional governance systems

There has been a global trend in natural resource management to move from top-down national and territory government control to more inclusive participatory multi-level and cross-scale governance in response to ineffectiveness of traditional measures (Lemos and Agrawal, 2006; Wallington and Lawrence, 2008; Lockwood, 2010). However, Marshall (2008) and Marshall and Stafford Smith (2010) argue that while governments have stated support of these aspirations to shift towards participatory multi-level governance, in practice they have sought to maintain or extend their control through innovative government-community partnerships that are actually purchaser-provider arrangements tightly controlled from the top-down.

Adaptive co-management is an emerging discourse that provides flexibility for collaboratively examining complex socio-ecological systems and facilitates effective governance without regulation from existing institutions and policy (Armitage et al., 2009; Lockwood, 2010). Vision and leadership are applied by groups of stakeholders to collaboratively respond to change, with co-operation and partnering required between diverse stakeholders (Pahl-Wostl et al., 2007). Innovative and sustainable natural resource management practices are developed with locally based enabling policies and resources that are often re-allocated based on the formation of new or re-organised existing knowledge networks (Olsson et al., 2004b; Fabricius et al., 2007; Plummer and Armitage, 2007). The term ‘management’ is differentiated from ‘governance’ in the literature by suggesting that management is the operation of processes under the rules of governance (Hahn et al., 2006) whether they be formal or flexible. Adaptive co-management offers flexibility in that local actors contribute to rules of membership and negotiation as opposed to prescriptive measures enforced by formal institutions (Connick and Innes, 2003; Olsson et al., 2004a; Hahn et al., 2006; Pahl-Wostl et al., 2007).

Adaptive co-management requires a systematic and iterative approach for improving resource practices through learning from past management experiences (experiential learning, Bormann et al., 2007) and exploring new alternatives (experimental learning). This has been considered useful in situations of change and uncertainty (Pahl-Wostl et al., 2007) such as forestry that typically have long term production cycles (Larsen and Nielsen, 2007). It has been suggested that processes of social learning in problematic natural resource settings need to move beyond relationship and knowledge building towards adaptive coordination that fosters concerted action (Bormann et al., 2007; Steyaert and Jiggins, 2007). As such adaptive co-management can assist in the development of localised context specific diagnostic frameworks that challenge legitimacy, power relationships and identities within communities (Gaddis et al*.,* 2009). These challenges open opportunity for transformation in institutional settings through the promotion of change to human behaviour and value systems (Cash et al*.,* 2006; Steyaert and Jiggins, 2007).

Methodology

The purpose of this study was to implement a social learning study in a case region where hardwood plantation forestry was rapidly expanding and where conflict over land-use change impacts were being reported. The Upper Clarence catchment of sub-tropical north-eastern NSW, Australia (longitude 29^0) was selected as the case area. The aim was to see if conflict could be reduced through collaborative efforts to develop improved management practice between diverse rural industries. This was based on criteria rated as important in early open meetings with the local community; being improved biodiversity and conservation outcomes, productivity improvements and socio-economic benefits to the local community (detailed in Leys and Vanclay, 2010b). This paper reports on the final stages of the study to present a synthesis of interdisciplinary methodologies that worked, as well as report on limitations and challenges that presented through both researcher and participant observation and evaluation techniques.

Participatory Action Research

Participatory action research methodology was initially used to gain insights on community attitudes and perceptions towards hardwood eucalypt plantation forestry expansion. Techniques involved social surveys, semi-structured interviews with key informants and public meetings (Leys and Vanclay, 2010a). Public meetings provided opportunity for the community to raise issues of concern and vote on the ones they thought crucial for following up with a social learning study.

The experimental social learning study was undertaken with 12 community volunteers who represented a diversity of views towards plantation forestry, and included representatives from the private and public forestry industry, cattle and mixed farming, environmental, urban and tourism interests, governing authorities and a scientific and education group (further details in Leys and Vanclay, 2010a). Three research scientists facilitated the social learning exercise that held complementary multi-disciplinary skills in the areas of forest growth modelling, agricultural and forestry education and extension, social research and wood science. The facilitator was the principal researcher (lead author - Leys) already immersed in the study and having built community trust when conducting surveys and interviews; also impartial towards plantation forestry, having neither affiliations to the forestry industry prior to the study, nor any community activist groups with particular policy positions on plantation forestry.

Participatory Advisory Committee (PAC) and social learning strategies

The social learning group was established in the form of a Participatory Advisory Committee (PAC) that could report findings back to the community and broader plantation forestry industry to place social pressure for change towards more sustainable forest management practice, although there was no formal responsibility for industry to act (Leys and Vanclay, 2010b). Recommendations in the form of peer reviewed technical reports were also fed to representatives of local, state and federal governments in an effort to improve their understanding of impacts of the MIS retail forestry policy on rural communities that had been legislated under Australian taxation law. Further, to increase government awareness on reforms that could allow the plantation forestry industry to move forward towards more socio-economic and environmentally sound development.

A variety of strategies were implemented by the PAC that included brainstorming in groups, cognitive mapping[2], data tabulation and simulation modelling to explore issues raised by the local community at earlier public meetings. Data was provided by local participants, invited expert speakers, scientists, with further empirical data collected through investigation between meetings using surveys and scientific literature to fill information gaps. The PAC developed a set of adaptive co-management recommendations for operational and practice changes by the plantation hardwood industry in the catchment, together with a set of future development options that would minimise negative social impacts and maximise socio-economic benefits to the local community if further expansion were to occur.

Regular evening meetings were held on a monthly basis throughout 2009. This helped overcome a threat reported by Mostert et al. (2007) where participants can lose interest and drop out if meetings are held irregularly. Experiential learning was used where concrete experiences led to reflection, in turn leading to abstract conceptualisations of new ideas, supporting research by Giupponi et al. (2006) and Muro and Jeffrey (2008). A detailed account of the adaptive co-management practices recommended by the PAC can be found in Leys and Vanclay (2010b).

Monitoring and evaluation of social learning study

Participants were actively involved in monitoring and evaluation processes to address a shortfall reported in the literature. Research has suggested that participants should be more actively involved in the development of evaluation criteria and analysis process (McGurk et al., 2006; Laurian and Shaw, 2009). A lot of the literature reporting on participatory studies natural resource management has been limited to processes developed by the researchers alone, including work by Mostert et al. (2007) and Gaddis et al. (2009). This can be considered not truly reflective or robust.

Participants were self-classified into stakeholder groups based on their major interest or business identity for the purposes of stakeholder analyses. Some stakeholder groups were combined earlier in the study due to findings on similar views and values from qualitative thematic analysis of semi-structured interviews (Leys and Vanclay, 2010a). Stakeholder analysis techniques were adapted and further developed from research by Varvasovszky and Brugha (2000), Chevalier (2001) and Lockie (2003) to gauge and map differences in attitudes between individuals and stakeholder groups towards the plantation forestry industry both prior to and after the social learning study. Power

differentials between participants and stakeholder groups were also evaluated for change based on assessment of sense of power to contribute to and influence decision making within the social learning exercise. There was the premise that community empowerment to influence and transform social and political issues come only through the ability to organise and mobilise individuals in groups (Laverack and Wallerstein, 2001).

Stakeholder analysis measurements involved a mixture of self-assessment by participants in the social learning study using evaluation surveys and participant observation by researchers. To be able to evaluate attitudinal changes in response to the social learning study, comparisons were needed to a control group who had not been involved in this stage of the study. A sample control group was formed from all respondents to a mail survey that was sent to people who had attended initial public meetings and did not follow through to volunteer as members on the PAC. The control group represented diverse stakeholder groups which would allow cross analysis with full participants to see if there was any change in attitudes towards plantation forestry due to factors other than involvement in the social learning study. Longitudinal techniques were used to reduce error and add rigor by conducting evaluation surveys with the same people in 2009, and again 12 months later in 2010 from both treatment and control groups.

Questions in the evaluation surveys related to the effectiveness of the social learning study for addressing the main community issues of fire management, socio-economic benefits to the community and impacts of pesticides. It also covered questions on usefulness of learning techniques such as modelling, incorporation of local and expert knowledge and fairness to contribute, as well as levels of empowerment, time efficiency and usefulness of findings to the community as criteria. Furthermore, questions were asked in regards to attitudes and future opportunities for the plantation industry (the survey forms available in Leys, 2011). The final evaluation surveys were conducted after the largest plantation forestry company operating in the catchment (Forest Enterprises Australia) was suspended from trading on the Australian Stock Exchange (3 March 2010), however prior to voluntary administration (14 April 2010) and appointment of receivers (15 April 2010). The other major plantation company Great Southern Plantations Ltd had already gone into receivership during 2009, however had not yet been taken over by Gunns Plantations Ltd.

Results

Evaluation by participants on the PAC

Participants on the PAC claimed the most effective strategies for creating new knowledge and a shared understanding of plantation forestry dynamics were; brainstorming ideas in groups, visual modelling of dynamic systems using the simulation software 'Simile' (Muetzelfeldt and Massheder, 2003; www.simulistics.com), tabulation of data using spreadsheets and open group discussions to explore knowledge from various sources. These sources included local experience, invited expert opinion and scientific research with a detailed figure of results available in Leys and Vanclay (2010b). The identification and exploration of value-adding processing for plantation timber waste was highly regarded by participants. The reason for this was that if silvicultural thinning of plantations was undertaken, there would be a large volume of waste timber that could be potentially used for local renewable bio-diesel production and help generate regional employment opportunities.

Even though a shared understanding was reached on most issues, a few participants still felt plantations had a negative visual appeal in the catchment, and that as the industry expanded further, negative impacts on water flow regimes were likely. The continued loss of farming country used to produce beef cattle and the summer crops soybean and maize continued to be of concern particularly to farming stakeholders.

Change in attitudes towards plantation forestry due to participation in social learning study

Involvement in the social learning process had a positive influence on participant attitudes towards the plantation forestry industry. Participants had been asked in the evaluation survey's to select the option that best described their attitude towards the plantation forestry industry both prior and post study on a scale of 1-5. This scale represented (1) strongly opposing, (2) opposing, (3) neutral, (4) supporting, (5) strongly supporting, with qualitative reasoning also asked for. A mean increase was found from opposition to neutral (overall mean before study = 2.45, mean post-study = 3.55) as illustrated in Figure 1. This figure further highlights a variance in attitudinal change between stakeholder groups. The Education and Scientific, Urban and Tourism, and Farming stakeholder groups came to the study either strongly opposing or opposing the industry. After the social learning exercise there was evidence of an increased level of support from these groups. Several participants suggested this was due to their increased understanding of the plantation forestry industry achieved through the collaborative exploration of community concerns (Leys and Vanclay, 2010b).

Interestingly, attitudes between stakeholder groups became more aligned as a result of the study. These findings supported research by Connick and Innes (2003) and Pahl-Wostl et al. (2007) where social learning led to attitudinal change within individuals in social environments through interaction and deliberation, illustrated by a convergence in views among groups. Lockwood (2010) suggests that environmental ethics are improving as a result of more people understanding how land-use practice can influence the well being of ecosystems. However, it could be argued that people's ethics remain constant, though they behave differently because better information allows them to correct misperceptions.

Evaluation of the social learning study further highlighted empowerment among participants to influence decision making over plantation forestry issues during PAC meetings.

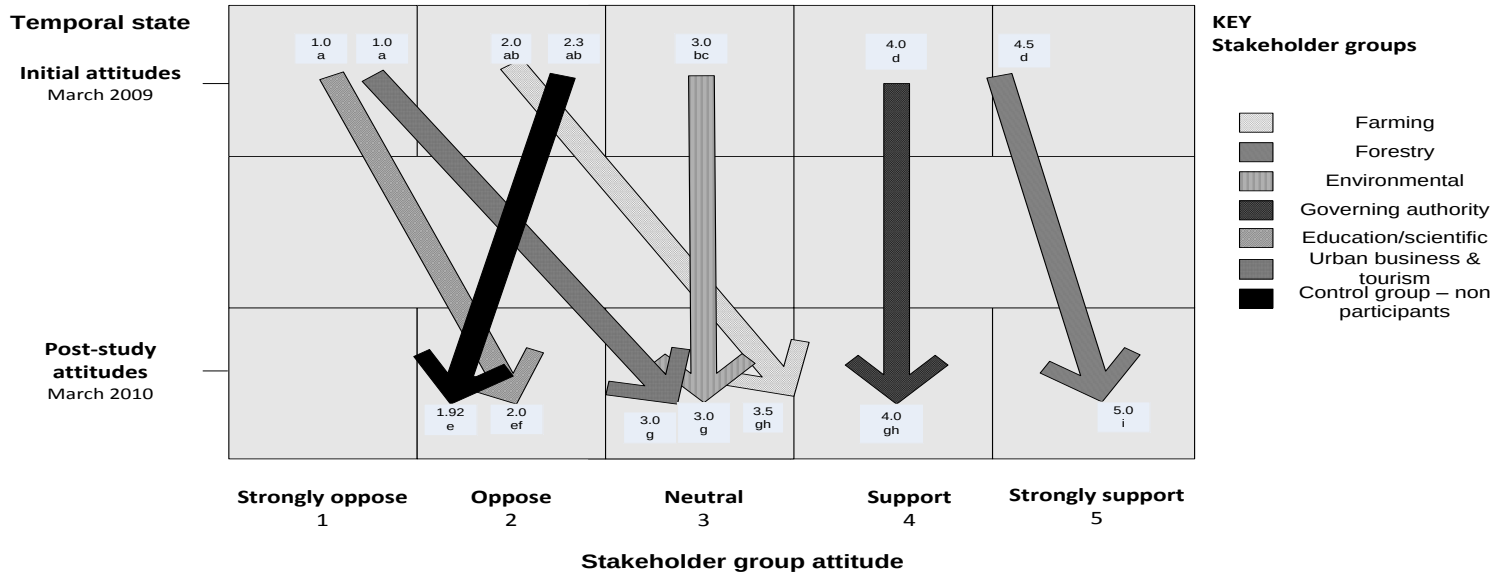
Ninety one percent of participants felt they were able to influence the process either moderately or highly, compared to 9% reporting low influence. Participant's rated effective facilitation highly for allowing fair contribution to dialogue and problem solving.

Comparing attitudes with the wider community

There was an overall decline in support for the plantation forestry industry for the range of local citizens surveyed (control group) who did not participate in the social learning study (Figure 1). While the return rate for surveys was low (25%; 12 returned out of 48 sent) and therefore representativeness of the stakeholder groups could be legitimately questioned, the trends in attitudes nevertheless captured a growing dissent within the community. The financial collapse of the two major local private plantation companies during the study period was mentioned by the majority of control respondents as the main reason for their decrease in support.

Other reasons given for a decline in support included local contractors out of work with unsustainable debts after purchasing machinery to provide services to the now debt-ridden industry; unfavorable media reports and personal observations from local residents of poor plantation practice; 'Aboriginal economy' suffering through loss of habitat for native food species; lack of communication and accountability from the plantation forestry industry; poor industry planning and merit processes; perceived misleading MIS retail forestry product disclosure statements for investors; negative flow on effects from displaced beef and cropping farmers; and negative impacts of monoculture plantations on biodiversity. It was interesting that 75% of the control group sample claimed they would support future mixed species afforestation for biodiversity conservation and sawn timber product, believing it could create improved economic and environmental benefits. Currently most of the plantation estate was being grown for pulp (R. Stanford, PAC member, 2010). Fifty percent of the control group suggested they would support plantation by-products that included waste from silvicultural thinning and processing for use as biomass in renewable energy production. In contrast, one forestry participant was concerned about the lack of ongoing financial support of the plantation forestry industry from banks.

A comparison of findings from evaluation surveys of the treatment and control groups suggested that the social learning exercise had a positive influence on participant attitudes towards the plantation forestry industry. Participants in the social learning study had an overall increase in their level of support over the 12 month study period, while the control group demonstrated an overall decline in support (Figure 1). These findings offer promise for social learning as an effective mechanism for changing perceptions based on improved knowledge and understanding, while empowering diverse stakeholders to contribute to decision making over natural resource management. The techniques implemented are now explored in greater depth.



Notes:

N=23 Comprising treatment group of 11 participants (Participatory Advisory Committee) and control group of 12 participants (non-participants in social learning study);

a-d one-way ANOVA F = 7.291, P = 0.024; significant difference in attitudes between stakeholder groups in April 2009 prior to social learning study. Values and arrows represent means for each stakeholder group represented, except for control group where total mean is used as there was a non-significant difference between stakeholder groups both prior to study (F = 0.72, P = 0.632) and after study period (F = 0.465, P = 0.791);

e-i one-way ANOVA F = 7.727, P = 0.012; significant difference in attitudes between stakeholder groups in April 2010 after social learning study, and between treatment (mean = 3.55) and control group (mean 1.92) one way ANOVA F = 13.523, P = 0.001, P<0.01; and

a-i two-way repeated measures ANOVA; F = 22.168, P<0.001 (Huynh-Feldt); significant interaction in attitudes over time with participants in social learning study (mean = 2.45 April 2009 to mean = 3.55 April 2010) and those of the control group (mean = 2.33 April 2009 to mean = 1.92 April 2010).

Figure 1 *Change in stakeholder group attitudes towards the hardwood plantation forestry industry in the Upper Clarence catchment, NSW, Australia, attributed to participation in the social learning study. (Developed by A. Leys from methods adapted from Varvasovsky and Brugha, 2000)*

Guidelines on systematic methodologies for implementing a social learning study

It was necessary for the facilitating scientific research team to be trained educators or experienced facilitators to provide the skills to implement the social learning study. This was consistent with findings in literature where facilitator skills were found to highly influence the ability to retain the interest of participants and provide equal opportunity for participants to contribute to discussion. This was in addition to holding specific roles that collectively encouraged a supportive and non-threatening learning environment (Richardson and Anderson, 1995; Vennix, 1999; Cash et al*.,* 2006; Muro and Jeffrey, 2008).

The social learning process required an understanding of diverse learning strategies and the ability to identify the different learning needs of participants. This was to help reduce power differentials between stakeholder groups and individuals, consistent with views of Larsen and Neilsen (2007), while avoiding potential for bias or manipulation of agendas due to self-interest, claimed to pose risks to participatory processes in research by Head (2007) and Lockwood (2010).

In summary, it is recommended that prior to commencing a social learning study that a team of three to four experienced scientists, also trained as educators or experienced facilitators is formed with pre-determined individual research roles (refer to Table 1). This is aimed at maximising efficiencies in resource application, expertise, and time and work-load fairness. One researcher is recommended per four to six participants so each researcher can assist during group work. Groups should be formed with no more than six people, with the total number of participants for a study ideally between 12 and 24. These guidelines are slightly smaller than those recommended in research by van Den Belt (2004) as experience suggests opportunities are maximised for all participants within these limits.

Various strategies were mobilised at different points in the study to ensure participants remained interested and effectively engaged in the process of social learning. Researcher observation in early meetings identified extroverted personality types who tried to dominate group discussions from quieter introverted types. Introverted personality types were best engaged through brainstorming in groups and open forum discussions, where time for turn taking and recording view points was provided (Leys and Vanclay, 2010b). The process was iterative to allow the research team time to revise and deepen the analysis as new data was obtained, a view supported by Varvasovsky and Brugha (2000).

Of the three researchers in this study, one had the combined role of facilitator and recorder/ evaluator (lead author- Leys). Another had a combined role of gatekeeper and modeller. The third was less involved, coming into the study after it had commenced, observing and assisting during group work and open discussions. The role of the gatekeeper was as an interceptor in discussions to prevent extrovert personality types taking over conversation. Further roles included encouraging individuals with diverse views to work in groups and share experiences to consider opposing view points, as well as helping structure and facilitate activities to maximise the quality of teamwork (Vanclay et al*.,* 2006; Table 1). The gatekeeper also assisted in liaison between facilitator and participants to help maintain motivation and momentum (Richardson and Anderson, 1995). The role of the modeller was one of technical model construction using a flip chart and computer simulation (Vanclay, 2003).

The facilitator's role was to initiate discussion among group members, explore expectations and provide variety in group learning strategies. The role of recorder/ evaluator was also that of the principal research scientist (lead author, Table 1) already immersed in the study full time and with a prior understanding of participant's goals and aspirations. This involved observing and recording changes in attitudes, knowledge development, and assisting the PAC identify gaps in information that required further investigation. Further roles included meeting organisation such as venue hiring, catering, and collaboration with participants to set meeting times and agendas.

All the research team helped model instructions for group work by becoming members of a group and role-playing the desired behaviour, consistent with recommendations in Vanclay et al. (2006) and Leys and Vanclay (2010b). A set of guidelines for systematic methodologies for implementing a social learning study are presented in Table 1. This framework is provided so similar procedures can be replicated. This mechanism could be used more widely for institutionalising social learning into the adaptive governance model for natural resource management, although the need for additional longer-term monitoring and evaluation, together with funding concerns were recognised. The systematic methodology supports dynamic systems learning through empirical investigation. Some positive aspects of the participatory study reported by participants on the PAC included:

> *Everyone had the chance to put forward their own points of view, ask questions and poke holes in other people's points of view.*
>
> *The participatory process let all participants have an equal voice in discussions, all ideas were accepted with dignity, participants enjoyed the discussions, and guest speakers were very informative.*
>
> *There was opportunity for interested people to access factual information.*

The total direct cost of implementing this study by the research institution was approximately $100,000, which included researcher time, travel and meeting expenses. This figure also included nominal incentive payments for participants to attend meetings at $50 per person per meeting for the nine meetings held throughout 2009.

Table 1 *Guidelines to systematic methodology for implementing a social learning study*

	Entry point	Process	Strategies	Facilitator/s	Outcome/s
1)	Pre-study scoping	Identify case study territory	(i) *Literature review* (ii) *Media analysis* (iii) *Discussion with Local Government Councillors* (iv) *Research ethics application* (v) *Finance agreement* (vi) *Budget proposal*	Principal Research Scientist with multi-disciplinary skills in social research and science field/s	Ascertain suitability of case study region Ethics approval Funding and budget approval
2)	Setting the scene: Socio-political assessment	Trust building with local actors	(i) *Semi-structured interviews with key informants; convergent interviewing using snowballing technique*[1] (ii) *Stakeholder analysis* (iii) *GIS mapping of study area* (iv) *Preliminary community feedback report* (v) *Risk analysis*[2]	Initially a team of two researchers	Establish understanding of power relations within stakeholder groups Insight on problematic NRM issues within community; differences in views, values and levels of controversy Identify and manage risks
3)	Community engagement	Identify problematic issues within community	(i) Open meetings (ii) Advertising & media (iii) Venue hire & catering (iv) Expressions of interest for follow up study (v) Further stakeholder analysis to ensure diversity of views represented	Team of three to four research scientists/ educators with predetermined organisational roles[3,4]: a) Independent facilitator b) Gatekeeper c) Recorder/ Evaluator (Principal researcher) d) Modeller	Gauging relative importance of community issues for follow up study

4)	Exploring problematic NRM issues	Collaborative social learning process	(i) (ii) (iii) (iv)	Social learning process with Participatory Advisory Committee (PAC) paid a nominal sitting fee Develop participatory criteria and indicators of success[5] Participatory modelling[3,6] if technical expertise and/or interest of participants Invited experts to add creditable scientific and empirical knowledge[6]	Team of researchers with individual roles as for open meetings[3,4]	Community visioning through setting goals and establishing expectations Developing shared knowledge on dynamics of problematic issues Determining most sustainable management scenarios or solutions by consensus or agreement
5)	Evaluation of study	Monitoring strengths and weaknesses of participatory process	(i) (ii)	Evaluation survey of participants and non-participants Community feedback; final Technical Report	Principal Research Scientist immersed in the study	Gauge change in attitudes attributable to involvement in social learning study through a combination of participant and researcher evaluations[7]
6)	Governance monitoring	Mechanisms for implementing recommendations	(i) (ii)	NRM Policy analysis Recommendations to governing authorities	Team of researchers & Participatory Advisory Committee (PAC)	Monitor outcomes of study and socio-economic and environmental impacts of implementing recommended changes to practice

Note: Developed by A. Leys and includes adaptations from sources; - 1. Leys and Vanclay (2010a) 2. Noller and Venkatesh (2007) 3. Vanclay et al. (2006) 4. Richardson and Anderson (1995) 5. Leys and Vanclay (2010b) 6. Giupponi et al. (2006) 7. Conley and Moote (2003)

Discussion

An experimental social learning study addressed community issues of conflict over plantation hardwood forestry expansion in the sub-tropical Upper Clarence catchment of north-eastern NSW Australia. A range of attitudes and values were discovered from a diverse range of participants, together with collaborative knowledge development on landscape system dynamics. A change towards more positive social and environmental attitudes were observed and gauged through empirical evaluation surveys. These were in response to an increased understanding of regional benefits for more ecologically sound land-use planning and practice aimed at conserving biodiversity and physical landscape values. These included the need for less environmental pollution through the use of softer pesticides[3] by all land managers, and maintenance of the visual landscape amenity through improved weed control, silvicultural practice and plantation placement by the forestry industry.

An overall positive shift in participant attitudes towards the plantation forestry industry was established. This suggests that the mobilisation of social capital[4] across rural industries can impact favourably on attitudes of participants through effective dialogue exchange and setting the scene for shared action, a view shared by Connick and Innes (2003). The overall change towards more negative attitudes in non-participants (control group) provided further evidence of the effectiveness of social learning for influencing perceptions, a significant finding in relation to conflict management in the field of natural resource management.

The social learning study helped overcome previous barriers to communities for collaboration with the forestry industry. Wang (2002) suggests this has been problematic in forestry due to fragmentation caused by diverse stakeholder views. Limitations to the time frame in this study proved a challenge and prevented long-term monitoring of the uptake and impacts from implementing recommended practice changes. This has been suggested as important for providing robust evaluations of participatory processes by Bormann et al. (2007).

Plummer and Armitage (2007) provide a useful evaluation framework for adaptive co-management based on three main components operating at different spatial and temporal scales: ecological, economics for sustainable livelihoods, and institutional and power processes. In this study recommendations were made for the improvement in management of riparian and remnant vegetation within plantations, however this would take several years to adequately assess changes to populations of endangered wildlife species. Innovative methods for measuring these changes have been reported in Martinez et al. (2010). Similarly there are significant barriers to measurements on populations of non-target organisms, such as human health impacts from improvements in pesticide practice in response to the use of softer alternatives. Further research is required for estimating non-tangible benefits from these kinds of studies.

This paper illustrated how effective community engagement was achieved through facilitation by a bridging research institution. Partnerships were formed between diverse rural industries including plantation forestry and agriculture with community, environmental groups and governing authorities. Social capital was mobilised using various social research methods listed in Table 1. A Participatory Advisory Committee (PAC) was formed to develop adaptive co-management recommendations for sustainable land-use practice by the plantation industry aimed at improving economic viability, environmental sustainability and social benefits. Adaptive co-management builds

on the more traditional approach of adaptive management that is described by Berkes (2009) as 'learning-by-doing' and less collaborative and flexible in nature. Flexibility was found to be important throughout the implementation process, particularly for managing risk. This allowed time for researchers to reflect and change strategy to help manage uncertainties associated with different participant personalities (group dynamics). This has been reported to enhance self-organisation of social-ecological systems and help build community resilience by Olsson et al. (2004a) and Hahn et al. (2006), although highly dependant on local leadership qualities.

The involvement of participants in the development of criteria for monitoring and evaluation of the study offered a robust and non-onerous system (reported in Leys and Vanclay, 2010b). This helped target participant goals, ensured effective use of time (Conley and Moote, 2003) and provided a democratic and legitimate framework for exploring issues of controversy (Laurian and Shaw, 2009). It is important to note that one of the roles of the facilitator was to encourage shared leadership rather than directive leadership, a commonality found in research by Head (2007) and Bormann et al. (2007). Guidelines were presented as a set of systematic methodologies (Table 1) to allow replication of this type of study in communities experiencing conflict over natural resource allocation and management where collaborative learning and problem solving could be beneficial. The social learning model proposed offers capacity building opportunities for local actors to develop increased knowledge and understanding of sustainable land-use practice through the sharing of local experiences and expert opinion with empirical scientific evidence. The model offers a mechanism for alleviating conflict between stakeholders.

A shortfall identified in this study was not being able to engage some marginalised groups onto the PAC including the Aboriginal community that meant their views were not voiced nor addressed. It is therefore recommended that additional resources are required for engaging representatives from these groups in future applications. Issues regarding how these types of studies should be financed in the future were also raised. It is recommended that funding should be provided by the industry undertaking land-use development that has been driven by policy change or innovation. The costs to developing industries for getting assistance from a bridging organisation are likely to be a lot less than the alternative costs if the community are off-side. Bridging organisations can help develop networks and provide objective data for effective community engagement and sustainable management of natural resources.

Conclusions

Governance of natural resources has often proved problematic for traditional top-down regulatory levels of government. In response, research institutions including universities offer potential as bridging organisations to help facilitate effective community engagement and develop networks for adaptive co-management within landscapes. Social learning offers a complementary process to existing governance mechanisms through empowering local participants to contribute to the development of innovative management practices. They can help develop context specific solutions that improve socio-economic and environmental outcomes for their own communities. These participatory processes are based on providing a supportive and reflexive learning environmental to develop knowledge about the dynamics and interconnections of landscape scale social and ecological systems. They are also aimed at improving local actor and collective community capacity to make informed decisions.

The social learning model presented in this paper is posited as a tool in community engagement that promotes self-organisation through the integration of robust science with local knowledge for adaptation and change. It provides a mechanism to form cross-scale and multi-level linkages to other industries and interest groups with various levels of governance for influence in policy development and change. Guidelines to systematic methodologies will allow replication of these types of studies; while responsibilities for funding should come from developing industries. The need for longer term monitoring and evaluation of practice changes resulting from social learning studies is also an issue and dependant on longer term funding arrangements. Nevertheless, wider applications are recommended for offering a complementary socially responsible mechanism within the already established tiers of natural resource governance. In a global socio-political environment characterised by increasing competition over limited natural resources, together with pressure on industries from environmental activism, the involvement of a broad range of local actors in natural resource governance is considered paramount.

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Notes

1. Intellectual engagement is the preference of an individual to actively participate in cognitively demanding activities, including reading, problem solving, abstract thinking and curiosity. It is based on the exploration for epistemological understanding of knowledge, while gaining a sense of reward through enjoyment or intrinsic motivation commonly associated with group cultural values (Kuhn and Park, 2005).
2. Cognitive mapping is a term describing the external representation of mental models created in the mind, built from past experiences and used to interpret new events. Cognitive maps represent a framework of interrelated concepts based on the ability of the human brain to associate and link ideas, important in complex decision making (Giupponi et al., 2006).
3. Softer pesticides refer to pesticides with lower potential toxicity in ecosystems (Getz and Warner, 2006).
4. Social capital refers to social networks of reciprocity, cohesion, bridging, hierarchies and power differentials. It is based on trust, civic densities, bureaucratic division, personal wealth, identity and well being that enable participants to act together effectively to pursue shared objectives. These include economic growth, political efficacy, environmental conservation, community vitality and knowledge transfer, however risks loss of efficacy if not periodically renewed or reconfirmed (Adapted from Armitage et al., 2009; and Brondizio et al., 2009).

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