Social learning for resolving community conflict over land-use change to plantation forestry

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Southern Cross University

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Social learning for resolving community conflict over land-use change to plantation forestry

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A thesis submitted for a

Doctor of Philosophy in Environmental Science

Southern Cross University
Statement of originality

I certify that the work presented in this thesis is my original work, except where otherwise acknowledged in the text. The material has not been submitted, either in part or whole, for a degree at this or any other University.

I acknowledge and certify that I have read, understood and complied with the University’s rules, requirements, procedures and policy relating to my higher degree research award and to my thesis current at the time of this submission.

Signed: 

Dated: 

Andrea Jane Leys
Supervisor statement

This thesis is the original work of Andrea Jane Leys who I supervised as a PhD candidate through the School of Environmental Science and Management at Southern Cross University, Lismore.

Signed: [Signature]

Dated: 2.8.10

Professor Jerome Vanclay
Abstract

This thesis examines social, economic, political and environmental challenges resulting from the conversion of agricultural land to hardwood forestry plantations for a sub-tropical region of Australia, notably the Upper Clarence catchment in north-eastern NSW. The conversion of agricultural land in the catchment to hardwood forestry plantations was an example of land-use change. This change has implications for natural resource management as a whole, as new operational and management practices impact differently on local ecosystems and communities. One of the aims of this study was to quantify these impacts and examine alternative management scenarios for increasing sustainability outcomes at the landscape and community scale between competing land-users.

A systematic methodology was developed for a social learning process within an adaptive co-management framework for overcoming limitations to previous top-down governance mechanisms for natural resources. Social learning allowed deliberation over objective data and the development of a shared understanding of issues concerning the local community relating to reafforestation. Diagnostic and evaluation frameworks were developed through an action research methodology for mobilising social capital into the social learning process for contributing to adaptive co-management of natural resources. Potential values of the plantation forestry industry were identified by participants to assist in future community development that promote rural industry sustainability and improved economic prospects. The effectiveness of social learning was tested as an innovative participatory learning strategy for collaboratively resolving stakeholder concerns and reducing conflict.

The key findings of the study were (1) stakeholders with diverse experiences and views were able to develop a shared understanding of the socio-ecological and economic system dynamics of plantation forestry through participation in a social learning study; (2) the social learning study generated a change in attitudes in participants towards the plantation forestry
industry for greater support, and empowerment to enter discussions over governance and operational issues; (3) participatory modelling was a useful tool for the research modeller to collate data and generate initial discussions, however its overall effectiveness as a tool was limited due to lack of engagement by participants to learn these modelling techniques; (4) bottom-up community based mechanisms offer promise in sustainable landscape governance of natural resources as opposed to traditional top-down measures from government. This is through using collaborative learning to create change in attitudes and value systems that generate increased social and environmental ethics and an awareness of need for adaptive change; (5) the social learning study offered an effective platform for involving local participants in the development of a set of criteria with facilitating researchers to evaluate the success of the study; and (6) the current federal policy for managed investment scheme (MIS) retail forestry has created market distortions, whereby there is the need to develop new transformative policy measures based on productivity and performance targets, and improved environmental and social outcomes for rural communities.

This thesis presents an innovative model framework in the form of a systematic methodology for social learning to provide guidelines that support the operation of more widespread community-based learning processes. It is based on a critical reflection of this iterative and reflexive participatory case study of the plantation forestry industry, together with findings in literature that assist in conflict resolution over natural resource management issues relating to land-use change. The model framework encompassed the strategic use of social research methodologies to elicit local and expert knowledge at suitable leverage points in the process to add to current debates. It provides useful guidelines for setting up an independent research team by a bridging organisation, in this case a research institution, for facilitating learning process that links science and community for transformational environmental education.
Preface

Commencing a PhD in natural resource management seemed a suitable pathway to follow on from a career of working and teaching within the Australian landscape to achieve sustainable agricultural productivity against the vagaries of variable and unpredictable climatic conditions, soils of low fertility, and constraints of human socio-political systems. This all started with a childhood spent working on my family's property west of Gunnedah in north-west NSW, surrounded by the Pilliga Scrub and Kerringle State Forest. In hindsight it was a very isolated upbringing, however soul building from hard physical work and inspirational in forming a strong sense of place and understanding of the support networks and resilience of the local Goolhi community. From a very young age I helped my mother manage the medium wool merino breeding flock, with mustering on horseback and motorbike, crutching, drenching, lamb marking, drafting and roustaboting at shearing time being routine operations, whilst my father managed the shorthorn beef cattle enterprise and winter cereal crop production.

Forestry was always in the background as I grew up, with ongoing harvesting occurring in neighbouring forests. It became obvious early in my childhood that the large remnant stands of iron bark and yellow gum, purposely left as shade trees on the family farm when cleared by my grandfather were in fact valuable timber. Timber cutters would turn up to try their luck wanting to cut them down! Cypress pines grew like weeds, however provided useful termite resistant timber for various farm structures, and originally used to fit out the family homestead which still stands today. Lightening strikes in the neighbouring Pilliga Scrub often started bushfires, and remain vivid in my memory. My family were in a vulnerable position living near to forests, and had to be vigilant in keeping fire breaks maintained and undertaking fuel reduction burns prior to the scorching summers around the home, sheds and stock yards to provide some sense of safety.
Armidale became my home for four years while completing a Bachelor of Rural Science with Honours at the University of New England, and the place of building some lifelong friendships. A desire to explore the vast country then took me to teach at Glenormiston Agricultural College in the western district of Victoria. A yearning to come back north firstly brought me to Canberra to work as a Research Agronomist with the CSIRO. While undertaking agronomy trials in this position I was introduced to a private farm consultant at Harden-Murrumburrah in the southern slopes and plains of NSW and a job offering that took me there for some subsequent years. I learnt a lot from my farming clients in this southern region of NSW and developed a passion for working within the social dimensions to solve tricky management problems. This work strengthened my appreciation of the importance for local social capital in resolving issues, and later helped in my decision to commence a PhD that combined social science with my rural science interests.

Years prior to commencing this PhD I formalised my teaching qualification with a post-graduate Diploma in Education by distance education, again through the University of New England at Armidale, and spent many years teaching agriculture and science related subjects.

My personal interests led me to a PhD that combined the disciplines of environmental and social sciences in natural resource management, in the discourse fields of sustainable land-use practice, stakeholder participation, pesticide eco-toxicology and political ecology using action research, social-ecological system dynamics, social learning, evaluation and stakeholder analysis. It became apparent when reflecting on research findings in the area of participation in natural resource management that there were gaps in the literature for providing robust and rigorous empirical evaluations, and for community benefits of applying social learning theory in bottom-up adaptive governance of natural resources in Australia. The aim of this PhD was to contribute to these gaps in scientific literature through an interdisciplinary case study of the
plantation forestry industry, which proved a challenging task in an economic climate when several private plantation forestry companies based on managed investment schemes (MIS) collapsed during the 2009 financial crisis.

I dedicate this thesis to the memory of my late parents Anna and Malcolm Leys who encouraged me to create my own opportunities and follow my dreams, and to my immediate family whom I am indebted for their kind and enduring support.
Acknowledgements

I would like to thank Professor Jerry Vanclay for his generous support and guidance in supervision throughout my candidature where he actively encouraged me to engage in critical thinking and creative problem solving. His ability to maintain a calm resolve and sense of humour in the midst of controversy, for which we were both occasionally and unexpectedly placed throughout this research project, was greatly appreciated.

The following academic staff from the School of Environmental Science and Management at Southern Cross University provided an ear at certain pivotal times in my candidature, and for that I would like to thank them; Ross Goldingay, Doland Nichols, Caroline Sullivan and Amanda Reichelt-Brushett. I would like to thank Greg Luker for GIS support, and Dr Alison Specht for post-graduate study support, including the organisation of an advanced methods course in statistics.

The administration team in Environmental Science and Management are to be thanked, particularly Sonia Weiss, Rosi Brown, Shirley Paterson, Paul Kelly, Barbara Harrison, John Arthur, Amanda Simmons, Margy Hare and Delva Smith who quietly made administrative tasks, equipment hire and travel arrangements happen. My gratitude goes to Glenda Scibilia and her school liaison network team in the Library at Southern Cross University for their relentless work behind the scenes in searching for, and providing the large volume of scientific journal papers and books requested throughout my study. I would like to thank Robyn Anderson for providing ongoing support from the Division of Research (DoR) and Brian Hutchinson from Information Technology.

Participants were an integral component of this study and I thank them all for contributing time towards identifying and exploring community issues relating to plantation forestry expansion. They provided sensitive business and personal information which proved
invaluable for accurately investigating natural resource management problems and helping understand the local social and political dynamics.

Gratitude is expressed to Dr Jacki Schirmer, CRC-Forestry Communities 4.3 project leader based at the Fenner School of Environment and Society at The Australian National University, Canberra, and Dr Kathryn Williams from the School of Resource Management and Geography at Melbourne University, as relieving project leader from December 2009, for expert social research methodology advice, peer review of publications and professional opinion. I would also like to thank Frank Vanclay, Communities’ project colleague, previously from the University of Tasmania, now Professor of cultural geography at the University of Groningen, Netherlands, for advice on social surveys. This research was part of the broader CRC-Forestry research Program 4: Trees in the Landscape.

I would like to thank the Co-operative Research Centre for Forestry who funded this research project and provided financial support to complete courses in qualitative data analysis and scientific media training. They also provided funding to attend and present research findings at The International Symposium on Society and Resource Management in Vienna, Austria, in July 2009; The 18th Commonwealth Forestry Conference in Edinburgh, Scotland, in June 2010; and as a visiting researcher to the Macaulay Land Use Research Institute, Aberdeen, Scotland, hosted by the Socio-Economic Research Group in July 2010, all which provided invaluable learning experiences. The CRC Forestry Communities’ research team engendered peer support and fostered critical reflection throughout my candidature for which I am grateful.
The Stringy-bark Tree

There's the whitebox and pine on the ridges afar,
Where the iron-bark, blue-gum, and peppermint are;
There is many another, but dearest to me,
And the king of them all was the stringy-bark tree.

Then of stringy-bark slabs were the walls of the hut,
And from stringy-bark saplings the rafters were cut;
And the roof that long sheltered my brothers and me
Was of broad sheets of bark from the stringy-bark tree.

And when sawn timber homes were built out in the West,
Then for walls and for ceilings its wood was the best;
And for shingles and palings to last while men be,
There was nothing on earth like the stringy-bark tree.

Far up the long gullies the timber-trucks went,
Over tracks that seemed hopeless, by bark hut and tent;
And the gaunt timber finder, who rode at his ease,
Led them on to a gully of stringy-bark trees.

Now still from the ridges, by ways that are dark,
Come the shingles and palings they call stringy-bark;
Though you ride through long gullies a twelve months you’ll see
But the old whitened stumps of the stringy-bark tree.

Written by Henry Lawson (1867-1922)
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Chapter 1: Introduction

1.1 Background to controversy surrounding plantation forestry expansion in Australian rural landscapes

There has been considerable controversy surrounding rapid expansion of the plantation forestry estate within Australian rural landscapes particularly over the previous ten (10) year period which has seen a 284% increase in hardwood plantations from 335,000 hectares reported in 1997-98 to 950,000 hectares in 2007-08 (ABARE 2009). Various controversial views have been reported in response to this land-use change, including impacts on socio-ecological systems within rural communities, particularly the loss of traditional agricultural land for grazing and cropping (Barlow and Cocklin 2003, Schirmer et al. 2008, Williams 2008, Williams et al. 2008).

While research has been conducted to quantify socio-economic impacts in some regions within Australia where plantation hardwood forestry is expanding (Schirmer et al. 2005, Schirmer et al. 2008), gaps remain in our understanding of the broader social impacts this land-use change is having on demographics, local businesses, volunteer organisations, and on individual well being and sense of place in sub-tropical regions of Australia. Further information is lacking on environmental impacts. This study explores some of these gaps in knowledge for a sub-tropical region of north-eastern NSW and adds a further dimension to previous research through exploring mechanisms to address and resolve issues of controversy. A Glossary defining the major scientific terms used in this thesis can be found on page 199.

1.2 Need for new discourse for engaging with plantation forestry communities

Where government policy in the form of fiscal incentives encourages individual industry development and land-use change, other rural industries and broader communities can be
adversely impacted upon. Therefore land-use change policy should be accompanied by effective community engagement that can smooth processes of implementation. Federal taxation legislation that allows full upfront deductions for plantation forestry establishment has been an important driving force behind land-use change to private plantation forestry in Australia, particularly by companies reliant on managed investment schemes (MIS) for investment and capital raising. Taxation legislation for retail forestry supports the Plantations 2020 vision which was a strategic partnership between Commonwealth, State and Territory Governments and the plantation timber growing and processing industry to increase the area under commercial tree crops. This was in response to an increasing demand for domestic and export timber and reduction in supplies from public forests (Plantations 2020 Vision 2006). The original aim was to treble the area under tree crops from an area of approximately 880,000 in 2006-07 (ABARE 2009).

Recent data however has suggested that there has been a 15% reduction in demand for export woodchips and 3% decline for paper and paperboard over the 12 month period between mid 2008 to mid 2009 in a difficult global financial climate. For the same period ABARE (2009) reported an increase of 5% exports in sawn wood and 26% increase in wood-based panelling. This indicates a market trend in the industry towards higher value wood products and less for paper and pulp products.

A CRC Forestry group of social researchers have over the last three years began working at strengthening community engagement strategies with the plantation forestry industry at the operational level in forest management using group forums. Findings from socio-economic research have been used as data for group discussions, though very limited participation from the wider community has been reported (Schirmer 2009 pers. comm., Dare et al. 2010a, 2010b). The methods these researchers have used have been aimed at assisting private plantation forestry companies incorporate operational community engagement into their management in order to
comply with industry certification standards such as under Australian Forestry Standard (Dare et al. 2010a, 2010b). These however have largely ignored marginalised stakeholder groups within the community to address wider issues of controversy between diverse land-users and explore landscape scale solutions.

For effective engagement, individuals and groups holding diverse views need opportunity to interact, exchange views, collaborate and learn for problem solving that can allow adaptive change (Keen et al. 2005, Muro and Jeffrey 2008). In this context, community engagement supports the social constructivist theory of creating shared knowledge and developing a common social reality. This study aims to experiment with participatory approaches for engaging the community and plantation forestry industry to address issues of controversy through developing a shared understanding of the dynamics of local plantation forestry systems and develop a set of adaptive co-management recommendations for improving industry sustainability within the local region. A new collective culture for deliberating over natural resource management is being tested for use by the plantation forestry industry through a process of social learning incorporating participatory modelling.

1.3 Aims

i. Critically evaluate the effectiveness of stakeholder participation in reducing controversy over natural resource management issues relating to rapid plantation forestry expansion in Australian rural landscapes; and

ii. Develop a systematic methodology for implementing social learning processes that can assist in more widespread applications for adaptive co-management of contested landscapes.
1.4 Social learning, adaptive co-management and evaluation in natural resource management

Social learning with cognitive change can provide a basis for developing a common understanding of systems for use in problem solving, reaching agreement and pursuing collective action (Muro and Jeffrey 2008). This can be particularly useful in situations of controversy over natural resource management to promote behavioural and practice change, and resolve conflict. With a fundamental shift in forest management from productivity based towards ecosystem service provision across the globe (Wang 2002, Kusel and Adler 2003) there is an increasing need for participatory process that involve the community and incorporate their values.

Processes in social learning in participatory settings have been reported for helping build local actor and community capacity by Keen et al. (2005), McGurk et al. (2006), and Gaddis et al. (2009), and in achieving broader community outcomes by Mostert et al. (2007) and McDermott and Schreckenberg (2009), including improvements such as biodiversity conservation, amenity values, and improved sense of well being. However limitations to success of participatory processes have been reported due to lack of community representation, unequal power (Ross et al. 2002) and lack of formal mechanisms to reduce these power differentials (Wilmsen et al. 2008, Compton et al. 2009). This thesis explores use of stakeholder analysis techniques for identifying these power differentials and methods for overcoming these limitations.

The movement from top-down government control over natural resource management towards devolved governance at the local and regional level broadens the scope of actors involved, and emphasizes the need for co-operation according to Plummer and Armitage (2007). Adaptive co-management is an emerging area of landscape governance that depends on co-operation between stakeholders and local citizens with diverse views to collaboratively respond
to change (Brunckhorst and Rollings 1999, Olsson et al. 2004, Fabricius et al. 2007, Armitage et al. 2009). Where adaptation is not available through existing institutions and policy, adaptive co-management offers a discourse for the development of innovative and sustainable natural resource management practices that can contribute to social-ecological resilience through social learning and reflexivity (Plummer and Armitage 2007).

Adaptive co-management has been posited for involving transformation of traditional institutional settings through changing attitudes and value systems of stakeholders in research by Cash et al. (2006), Walker et al. (2006) and Steyaert and Jiggins (2007). On the other hand there have been limited reports on effective processes used in developing these adaptive co-management practices. This thesis contributes further to this field of research by developing diagnostic and evaluation frameworks for participatory processes, and includes gauging attitudinal change of stakeholders attributed to involvement in processes of social learning.

1.5 Research questions

The overarching question of this thesis was to ascertain the effectiveness of social learning as a participatory discourse for reducing controversy over land-use change. In the quest to find an answer, this was broken down into several further questions:

i. Can and how does stakeholder participation help reduce community controversy surrounding rapid land-use change in Australia, with plantation forestry as a case industry?

ii. Is social learning effective because it facilitates a shift in stakeholder attitudes?

iii. Does social learning increase the development of a shared understanding of natural resource management problems and collaborative solutions (i.e. adaptive co-management)?
iv. Is participatory modelling an effective tool for use in social learning processes to help resolve landscape natural resource management issues?

1.6 Thesis including scientific publications

The body of this thesis is presented as a series of multiple papers, each one constituting a separate chapter. These have been presented in a logical order based on progress throughout the study and to provide a flow of themes. At times there is some overlap between papers, particularly some repetition in methodology which was unavoidable. The first paper (Chapter 4) reports on the initial stage of the study where interviews were undertaken with key participants to develop insights on community issues over plantation forestry expansion. The second paper (Chapter 5) follows on with the development of an evaluation framework to test participatory modelling in a social learning setting with a Participatory Advisory Committee (PAC), and involved the development of evaluation criteria and guidelines for meetings. The third paper (Chapter 6) describes the initial findings from PAC meetings, in particular a set of guidelines on adaptive landscape management for recommending to the plantation forestry industry to improve sustainability and integration outcomes within the local community. The fourth paper (Chapter 7) includes preliminary findings of the study presented as proceedings of an international conference. The fifth and final paper (Chapter 8) is a synthesis of the methods developed for evaluating a social learning study used to address land-use conflict in the field of natural resource management. It provides a comprehensive table of guidelines in the form of a systematic methodology for social learning together with personal reflections to assist replicate this kind of study. Finally, this paper places social learning processes into the natural resource governance framework.
Chapter 2: Literature review

2.1 Action research

There are numerous challenges facing researchers where an interdisciplinary approach is required to engage participants within a community and work collaboratively to respond with practical outcomes. This study addresses two such challenges, firstly the selection of a research methodology, and then the selection of methodological techniques for data collection and analysis suitable for a case study on social-ecological system dynamics in an Australian plantation forestry community. This thesis explores innovative techniques for mobilising social capital and setting up a supportive learning environment for investigating issues of controversy over plantation forestry for knowledge development and capacity building to assist in problem solving and conflict resolution between diverse rural industries.

The first major challenge was to select a methodology which was flexible enough to incorporate multidisciplinary perspectives, however rigorous enough to enable efficient data collection and analysis, where both qualitative and quantitative data were being pursued. Where community participation was required in critically exploring complex and dynamic issues, which directly relate to the relationships between stakeholders and their social-cultural and bio-physical environments, it is argued that an action research (AR) methodology can suitably address this as opposed to other methodologies commonly used, including participatory rural appraisal (PRA), and critical theory (GT).

Action research is an analytical and theory building process based on a group of people going through a series of cycles of knowledge development and reflection to assist in the development of action plans. It is suitable for providing a framework for the necessary development of common epistemological ground among disciplines by selecting a particular
branch of philosophy to demonstrate the field of knowledge being developed. It has further strength through providing a flexible framework that encompasses several methodologies as required for dealing with multidisciplinary studies.

Participatory strategies were required to address social and ecological issues perceived by the community to be resulting from pressures of land-use change from traditional cattle farming to plantation forestry. The disciplines of environmental, rural and social sciences, comign the fields of human ecology and social learning were selected in a flexible framework as the AR process evolved. This study was conducted in collaboration with private industry partners from agriculture and forestry, local government and citizens of the public, for their potentially unique and valuable contribution of social capital to the development of knowledge and ability to initiate action or change. Action science (AS) was a discourse within AR used to refine the methodology using collaborative inquiry for understanding the complex inter-relationships and dynamics for a situation of uniqueness, uncertainty, and instability not lending itself to established theories alone.

A second major challenge faced in this interdisciplinary research was in the selection of methodological techniques for collecting and analysing data. The technique of convergent interviewing (CI) developed by Dick (1990) and used widely in the fields of business and organisation management globally, was deemed appropriate for use in this applied science study where all the knowledge necessary to initiate action was not known or available at the commencement of the study. Convergent interviewing is a technique that involves open ended questioning of participants to allow for hidden or emergent themes, and to ascertain when no new information is forthcoming, indicating the point where the line of enquiry if terminated and no further questioning is undertaken. Further, CI which involves one on one communication fostered trust building and rapport between the researcher and stakeholder, serving as a useful risk
management strategy in this case study where there was considerable angst within the community towards the plantation forestry industry.

The more effective rural communities are at learning, the more likely they will be innovative in taking on or accepting challenges and technologies which create structural change that improve social, economic and environmental outcomes. Further, learning can create an increased awareness of the limits to their innovations and expectations, producing realistic and feasible opportunities. Argyris (1999) argues that research often does not focus on producing actionable knowledge to reduce or lower barriers to learning which can come about from policy, practice or action preventing participants from experiencing and discovering the causes of difficult, embarrassing or psychologically threatening problems. Work by Argyris (1999) and Roberts and Dick (2003) suggests that social science research should focus more on providing liberating and emancipating alternatives that provide participants with competencies to remove those barriers to learning including any self-fuelling, anti-learning or overprotective processes, policies or practices. Only then can learning be facilitated, and communities take on innovation and achieve benefits.

In the current climate where Australian rural communities are undergoing significant land-use changes in response to climate change, post-drought and flood and fire recovery, changing markets and taxation legislation, there is an increased opportunity for research institutions to focus on helping communities produce actionable knowledge. There are numerous methodologies available for cross organisational learning within communities; however for particular situations certain methodologies will be more suitable and effective for developing normative practice within the constraints of their own social-ecological environments.

Studies by Satake et al. (2007) found it crucial that people learnt and remembered past experiences when developing sustainable practices for dynamic social and ecological systems, to prevent over exploitation of natural resources and degradation of social welfare. Kuhn and Park
(2005) suggest this cognitive and social development relates to developing an epistemological understanding through intellectual engagement practice.

AR is one such group of methodological frameworks useful in research studies where change may be required, however where all the knowledge for change does not exist at the start and can only be developed progressively through further research and critical reflection. Initially AR was proposed by the social psychologist Kurt Lewin in the early 1900’s to deal with problematic social situations.

Robert Dick is another researcher who has contributed significantly to the field of AR in Australia. Dick (1999) described action research as a cyclical process necessitating the continuous refinement of methods, data and interpretation in the light of the understanding developed in the earlier cycles, therefore being emergent and iterative in nature. Groups involving those who are affected by decisions and those who carry out decisions work together to decide what actions need to be taken to improve community outcomes.

Like Lewin (1951), Dick (1990, 2002a) believed AR was a very useful methodology for use in science in situations where change may be necessary, however only possible through the development of an improved understanding of the problem. It is qualitative based due to the nature of dialogue exchange and the fact that in social research there isn’t always an accessible metric. However, through the use of convergent interviewing, Dick (1990) claimed rigour could be provided to qualitative studies by helping to identify the informative data.

Convergent interviewing (CI) refers to a dialectic process which looks for emerging patterns of convergence or agreement, and patterns of discrepancy or disagreement, this then providing criteria for deciding whether to analyse particular data further, or discard it. When CI finds disagreements, the researcher then tries to resolve the disagreements by seeking explanations (Lloyd 2005). It is the vigorous pursuit of disconfirmation that provides rigor to the
qualitative research through protecting the researchers and participants from their preconceptions and research bias (Dick 2007b).

2.2 Selecting Action Research discourse: Participatory Action Research and Action Science

A further extension of AR is Participatory Action Research (PAR), explained by Cupain et al. (2003) as a process through which members of an oppressed group or community identify a problem, collect and analyse information, and act upon the problem in order to find solutions and to promote social and political transformation. Cyprian et al. (2003) used PAR with some success in a case study in Cameroon on the central west coast of Africa, to involve the community in the management decisions of the 3000 hectare Ottotomo forest reserve. There was a history of conflict between the poor local community needing to use it to support their livelihoods, and the state forest managers who were trying to conserve it for biodiversity values. Cyprian et al. (2003) recognized that the conservation of natural resources could not take place in isolation from economic development, especially where people depended on it for their livelihood. They identified that collaborative management of forests had clear advantages in their potential to provide benefits to local people in exchange for the costs of conservation.

Recent developments in the field of PAR in the UK have involved “taking an attitude of inquiry” which is an additive to one’s methodology based on reflection as a key quality action research indicator (Marshall and Reason 2007). They suggested that in the development of inquiring practice in action research, more emphasis should be put on framing processes and making them flexible to ensure participation can generate the best quality of knowledge, whilst consideration is given to issues of power, the fact different methods may be required to generate knowledge, and that research is an emergent process. A measure of quality of action research according to Reason (2006) is based on how the researcher goes about making choices and their articulation. It is therefore necessary to monitor the process and assess the level of engagement of
participants, as well as be able to withdraw quality and informative knowledge, and then reflect and use this knowledge.

Some of the challenges participatory action researchers have been faced with include the lack of control over the process and outcomes of the research due to the collaborative nature of the research. It was noted by Baskerville (1999) that when a researcher hopes to follow a defined problem, which can be the case for example for an industry funded project, the theoretical emergence may totally change the direction of the research, and due to the ethical responsibility to follow the study through, it may be in a field where the researcher and funding body are not comfortable. Therefore stakeholder expectations need to be addressed in the project planning stage as a risk management strategy.

AR is emergent and iterative in that a deeper understanding and critical reflection occurs throughout the process to further refine and analyse the situation. Dick (2002b) argues that AR has an advantage here over other methodologies in that when you require a flexible and responsive approach, and where research is data driven, it does not necessitate an extensive pre-study literature review that may end up being irrelevant as the problems become further defined. Alternatively in AR Dick (2002b) recommends planning time should be spent on the methodological and philosophical literature in the early stages of a study for insights into selecting and collecting data.

Visual tools such as maps and images are used to provide a sound sense of location and differential relationships that encourage the group to view issues and opportunities from a spatial perspective, with emphasis on the dimension and scope of these issues. Visual modelling environments such as provided by the software ‘Simile’ can be used as a tool for helping address social-ecological system dynamics through exploring alternative management scenarios of natural resources in a landscape.
Interviews are a common methodology also used in participatory action research (PAR), particularly using an open and informal style that encourages respondents to elaborate on points of interest and relevance. A refined interviewing technique known as convergent interviewing (Dick 1990) is increasingly being used that involves exploring common themes of enquiry. Further, a representative stakeholder team is often engaged to act as a working party. Open meetings are encouraged within communities to invite discussion on issues. The PAR approach aims to remove power barriers by empowering groups that otherwise may not get their issues heard or acted upon. This has particularly been the case for participatory modelling exercises carried out in third world countries, where attempts were made to empower local groups to take responsibility for decision making on natural resources and create more acceptable and sustainable opportunities within their communities. Vanclay et al. (2006) found that through empowering local groups which had been subjugated by more powerful local groups in case communities in India and Africa, people more readily accepted change and standards of living were subsequently improved.

Action science (AS) as defined by Friedman (2006) is used in AR to focus on the production and use of knowledge for promoting learning with and among individuals and systems whose work is characterised by uniqueness, uncertainty and instability. In particular, AS attempts to bridge the gap between social research and social practice. In a case study scenario looking at social issues of attitudes, power and influences towards rural industries, and the ecological systems they affect, including the biophysical factors water, soil and biodiversity, AS would therefore provide a suitable mechanism for promoting learning within the community. A major feature is that participants function together as co-researchers rather than subjects, empowering participants to make decisions and act towards change to improve their situations. The line of inquiry taken in AS is to establish their perceptions of problems, results they wish to achieve, strategies they could use to produce action, and intended outcomes of actions. Dick
(2007b) suggests a further strength of AS is the strong emphasis on challenging defensive behaviour which can undermine relationships and interpersonal understanding.

Friedman (2006) describes the theory of AS for creating communities of enquiry within communities of practice and that under certain situations, specific strategies are used to achieve planned outcomes. For a case study looking to address contentious issues in the community, AS can provide the framework for the development of strategies to improve the sustainable use of natural resources whilst trying to achieve the goal of learning to enhance the community's resilience through adapting or adjusting to changes. External drivers causing change include alterations to government legislation regarding access and use of natural resources, as well as dynamic market forces, particularly as global economic networks expand.

### 2.3 Critical Theory and power relationships

Critical theory is the use of theoretical critique to examine the complex set of mediations which interconnect consciousness and society, culture and economy, state and citizens' according to Kellner (1989) based on knowledge from the social sciences and humanities. It explores relationships within historical contexts for social groups at particular points on time and place and their roles in the economy and political processes. There are two main intellectual traditions associated with critical theory, one being that used in literary studies for hermeneutics, looking at knowledge via interpretation to understand human texts and symbolic expressions; the other being a form of self-reflective knowledge, involving both understanding and theoretical explanation to reduce entrapment in systems of domination or dependence often found within social groups. It is the latter of these interpretations that is used in this study, although explorations are limited in scope within this science thesis.

Habermas (1971) suggests that the use of critical theory in science requires self-reflection to release the subject from dependence on hypostatized [embodied] powers', determined through
ones emancipatory cognitive interest. He argues that objectivism is an illusion in science and can only be eliminated through renouncing what is conceals; that is the connection between knowledge and interest, suggested as the intent for a good and true life. Banerjee (2010) used critical theory to add support to this view that the popular notion of organisational ‘stakeholders’ can be problematic in corporate citizenship, social responsibility and sustainability initiatives through regulating the behaviour of stakeholders to serve narrow business interests. The need for self-reflection is therefore paramount when examining stakeholder groups to remove preconceptions associated with social norms to liberate the individual.

A further implication associated with stakeholder grouping is the notion of political power. Foucault (1994) in cultural studies suggests power goes beyond ‘primary’ relations such as those between institutions, social forms, or behavioural patterns to a system of reflexive or secondary relations that emerge through differences in aptitude, faculties, reactions, and character types whether acquired or innate. These secondary relations help set limits and practice that determine discourse for speaking, naming, analysing and classifying objects.

Rose and Miller (1992) argue that power is an effect of authority in rather than an explanation of success, suggesting ‘a powerful actor, agent or institution is one that, in the particular circumstances obtaining at a given moment, is able to successfully enrol and mobilise persons, procedures and artefacts in the pursuit of its goals. Powers are stabilised in lasting networks only to the extent that the mechanisms of enrolment are materialised in … persistent forms – curricula, …obligations… Power is the outcome of the affiliation of persons, spaces, communications and inscriptions into a durable form.’

Further, Rose and Miller (1992) question true ‘representation’ where power imbalances exist, suggesting that those employed in enquiry to devise techniques to intervene and transform are calculated, and therefore can be considered biased. Developing expertise was recommended as a solution to embody neutrality using private or independent institutions rather than
government authorities, however linking private decisions and public objectives through knowledge. Community-based learning processes offer a mechanism that is independent in design and decision making from higher levels of governance, however offer links for debating public concerns and objectives. Research institutions such as universities can help operationalise these collaborative learning processes and provide valuable access to scientific information that helps develop independent expertise in location as an ally to governments for polity and society.

2.4 Social Learning Theory

Social learning refers to a group process whereby knowledge is shared and created between stakeholders with diverse experiences and views on natural resource management that are embedded into the learning process. Processes aim to strengthen community capacity to collaboratively manage ecosystems sustainably for human well-being (Connick and Innes 2003, Schusler et al. 2003, Pahl-Wostl et al. 2007, Lockwood 2010) based on citizen input, social responsibility and knowledge building (van den Belt 2004, Steyaert and Jiggins 2007, Muro and Jeffrey 2008).

Social learning has been reported in literature to be useful for exploring system dynamics, drawing on cognitive and social psychology to enhance learning and understanding of complex non-linear systems behaviour (Sterman 2002). It can be useful for providing a platform for identifying and overcoming defensive routines and resistance from stakeholders to foster shared learning. Research by Prager and Nagel (2008) found that farmer participation enhanced the quality of agricultural policy decision making, in particular for identifying the most effective tradeoffs and increasing uptake of recommended changes. This local actor participation has similarities with social learning studies where local knowledge is incorporated into the decision making process. Social learning offers a democratic approach to environmental management in response to the limitations of top-down governance in the face of continued declines to
biodiversity and social injustice (Lockwood 2010). Muro and Jeffrey (2008) posit social learning as forming the basis for behavioural change and conflict resolution.

Different levels of learning are often distinguished by the degree of engagement of participants in the cognitive and problem solving process, and are used for understanding the complexity and dynamics of change. Argyris (2002) describes single-loop learning theory as “learning that occurs when errors are corrected without altering the underlying governing values.” This contrasts with double-loop learning based on reflexivity where errors are corrected by changing the governing values and then the actions. Triple-loop learning, otherwise referred to as circular organisation (Romme and van Witteloostuijn 1999) is the most complex learning structure, suggested by Flood and Romm (1996) as the facilitating infrastructure that explores the structural opportunities and key competencies people need to participate in making well-informed choices.” On the other hand, van der Veen (2000) refers to transformative learning as the highest order learning, where individuals develop by reflecting on objective and subjective information to help form perceptions of the world around them. Social learning in this thesis is considered to involve all levels of learning, however mobilised at different stages of the process.

Social learning theory therefore has considerable merit for placement in action research studies that foster communicative strategies and critical reflection for making improved decisions of natural resources within the landscape. Gaps were identified in literature for rigorous evaluation of social learning studies that identify strengths and weaknesses of techniques and tools of social learning that could support more widespread application. There were further gaps for a diagnostic framework for setting up a research team and mobilising stakeholders at strategic points of a case study. This thesis provides evidence to contribute to these gaps in the literature, improving our understanding of the merits and mechanisms to operationalise effective processes of social learning.
 Participatory modelling (PM) is an analytical technique used by researchers endeavouring to improve the triple bottom line of communities (environmental sustainability, social responsibility and financial viability; Hacking and Guthrie 2008) and is more frequently being incorporated into broader processes of social learning (Pahl-Wostl et al. 2007). It uses an environment of free public deliberation where emphasis is placed on reducing power differentials while analysing system dynamics and building consensus over environmental problems (Vanclay 2007, Giupponi et al. 2008, Voinov and Gaddis 2008, Voinov and Bousquet 2010). Stakeholder input is required for dialogue exchange and the opportunity to learn together through a process Walker et al. (2002) refers to as “co-discovery”. PM aims to engage scientists, policy makers, governing authorities and citizens to work with local actor knowledge and experience in the quest to develop a shared understanding of ecosystem dynamics so more effective solutions can be explored and decisions made. In the field of participatory modelling, the development of an enquiring community is commonly referred to as a “Community of Practice” (Wenger 2000).

PM relies on systems thinking to ensure interconnections between social constructs and the environment are not overlooked when carefully considering solutions (Vanclay 2007). According to Allison and Hobbs (2006), enquiry within the social context looking at relationships between humans and their environment in a framework of systems is necessary because it is the ecological systems which provide the means for growth or constraints for the social systems themselves. They refer to this emerging paradigm as “post-normal science”, replacing the reductionist methodology of traditional science.

An evaluation of the social and cultural influences in the case study area is also necessary to set the context for a participatory study. Developing an understanding of the history and people within the community can help develop insights into their goals and aspirations. According to Junker and Buchecker (2004) and Castelletti and Soncini-Sessa (2007) conducting
this background is a high relevance to the success of participatory case studies for gaining trust and legitimising the model in the eyes of the local community, thereby reducing the risk of failure.

Prior to undertaking any formal modelling, participatory modelling requires that community issues are identified through a democratic voting process involving key stakeholders. Outranking methods are commonly used such as ELECTRE III and card sorting (Lahdelma et al. 2000, Laukkanen et al. 2004, 2005, Mendoza and Martins 2006).

PM has been successfully used in environmental planning and policy making in developing countries (Vanclay et al. 2006, Vanclay, 2007) and more recently in developed countries including Europe and America where traditional top-down approaches to deal with conflicting perspectives over natural resource management and land-use change have not been successful (Giupponi et al. 2006, 2008, Voinov and Gaddis 2008, Gaddis et al. 2009). Giupponi et al. (2008) present an integrated methodological approach to participatory modelling for climate change research in Europe where PM is used as a tool in participatory decision analysis, referred to as NetSyMoD (Network Analysis- Creative System Modelling- Decision Support). A major advantage of this integrated approach is that stakeholders can then be engaged in the co-learning process, that according to Voinov and Bousquet (2010) helps clarify and align values among diverse participants. This study takes the latter view by evaluating the effectiveness of participatory modelling as an innovative tool in an operational social learning framework for resolving conflict in a situation of land-use change in Australia.
2.6 Visual modelling environments for simulation

PM requires the use of visual simulation software for collating qualitative and quantitative data and running alternative management scenarios to gauge potential outcomes on system stocks and flows. Giupponi et al. (2008) describe forms of stock as state variables, flows to be energy, matter and information, and connected by causal links otherwise known as feedback loops. Various visual simulation software programs have been used in literature to model system dynamics and explore sustainable options for natural resource allocation and management and their tradeoffs, including Simile (Vanclay 2003), STELLA (Costanza and Voinov 2001, den Exter 2004), DYNAMO and Vensim (Voinov and Bousquet 2010).

Vanclay et al. (2006) describe how Simile was used in developing countries including Zimbabwe, Indonesia and Cameroon to improve sustainable livelihoods around small-scale forestry and agricultural pursuits. In a case study of the village of Batanai in Zimbabwe, Simile was used to map and explore innovative solutions to produce better quality brooms, improve the management of broomgrass communal lands and find new broom markets. The outcomes of study were increased household income and less poverty (Vanclay et al. 2006).

Participatory modelling has been used in climate change research in Europe by Giupponi et al. 2006, 2008) and water quality research in USA by Voinov and Gaddis (2008). Ritzema et al. (2010) used participatory modelling to overcome the problem of data scarcity for the restoration of the Kolleru-Upputeru wetland ecosystem on the east coast of Andhra Pradesh in South India. Researchers here worked closely with stakeholders to improve their understanding of the dynamic wetland systems to build consensus for an integrated action plan that improved ecosystem management.

A major criticism of some participatory modelling efforts in literature has been the lack of power and influence of stakeholders, with Voinov and Bousquet (2010) suggesting "stakeholders have merely been paid lip service and their engagement has consequently been quite nominal' in
many cases. There are gaps in the literature for rigorous evaluation of community-based participatory processes that ensure stakeholders are empowered and their views are reflected (Wilmsen et al. 2008, Compton et al. 2009). Further gaps exist for robust evaluation frameworks that are participant driven and legitimate for democratic processes (McGurk et al. 2006). Vanclay (2007) has suggested that the important outcome of participatory modelling is not the model itself, rather the new insights gained through the process. Mendoza and Martins (2006) claim that more emphasis should be given to the quality of methods to maintain support and close collaboration between stakeholders. This thesis addresses these shortfalls identified in the literature.
Chapter 3: Methodology

3.1 Background on methodology

An action research methodology was selected for an interdisciplinary case study to maximise the input and knowledge from local stakeholders, together with expert knowledge from experienced modellers and scientists to foster processes of self-discovery and collaboration. Strategies used and modified were common to the field of participatory action research (PAR). However an innovative mechanism was tested for community engagement with the plantation hardwood forestry industry involving a process of social learning (SL) to assess the effectiveness of stakeholder participation for addressing and resolving issues of controversy over plantation forestry expansion.

Social learning theory was used for its potential benefits for promoting collaborative problem solving in sustainable ecosystem management at the landscape scale, considered to offer potential merits for the plantation forestry industry. It was implemented as an alternative to operational community engagement that has previously been used by plantation forestry managers and commonly reported as being ineffective by Dare et al. (2008, 2010a, 2010b). However, there may be potential bias in this claim due to it originating from a single author team. A rigorous and critical evaluation conducted by the principal researcher (author) in collaboration with participants, reports on the effectiveness of the strategies used. Social learning in natural resource management has been posited as having potential as a mechanism for linking research institutions to communities through the development of bridging partnerships whereby knowledge is shared and built, and the needs of local community actors can be incorporated. This study tests this hypothesis, contributing further evidence to the field of literature on the facilitation of social learning for conflict management by bridging organisations.
One of the objectives of the social learning study was to develop a set of guidelines on improved management practices for recommendation to the plantation forestry industry. The aim was to develop knowledge and understanding on social and environmental impacts of current practice and where improvements could be made for more sustainable outcomes in the catchment and local community. These guidelines are presented in the thesis as a set of adaptive co-management recommendations (refer to Chapter 6, p98).

Social learning with a Participatory Advisory Committee (PAC) was selected over alternative participatory methods including search conferencing and citizen jury’s. PAC’s have also been referred to in the literature as Public Resource Advisory Groups (Wellstead et al. 2003); however rely on voluntary membership, usually 12-16 people in number, representing a wide variety of different community-based organisations and interests. The primary role of a PAC is to provide advice to particular companies representing an industry, for example forestry, regarding their management planning process. Wellstead et al. (2003) suggest that ‘although these groups do not have final management authority, they do provide input and information that is implemented into forest management activities…. the establishment of a clear mandate, adaptability and flexibility in the process, and working with good information as the criteria for public participation effectiveness.’

Search conferencing as described by Selin et al. (2007) is a deliberative planning technique used in situations of rapid social and economic change that ‘enables a large group to collectively create a plan that its members themselves will implement’, and therefore participants have obligations beyond that of a PAC. Citizen Jury’s on the other hand are commonly used to involve the public in policy making, whereby governments are made responsive to the needs of the society they serve and accountable (Rowe and Frewer 2000).
3.2 Selection of a case study region

To study the effectiveness of social learning incorporating participatory modelling for resolving conflict over land-use change, several criteria were addressed in identifying a suitable case study area:

(i) Firstly, for participatory modelling to be tested it was necessary for conflict to exist within the community over the use and access to natural resources, which generally arises due to the diverse range or goals and perspectives of different land users (Vanclay et al. 2006);

(ii) Secondly, communities with a more traditional agricultural base tend to have more difficulty accepting land-use change due to conservative values and have greater conflict over how resources should be used or shared as compared to communities with a more diverse economic base (Howe et al. 2005); and

(iii) There also needs to be gaps in the knowledge base and understanding on local ecological dynamics for modelling to serve a social learning purpose in natural resource management. This can be qualitatively determined through focus group surveys and interviews with representative stakeholders.

A sub-tropical region undergoing rapid land-use change to plantation forestry was targeted, as previous social research in this field had been limited to temperate regions of Australia (Schirmer 2008a, b, Schirmer et al. 2005, 2008, Williams 2008). The Upper Clarence catchment of north-eastern NSW was chosen as the case region, with Woodenbong identified as the largest town in the catchment (population approx 330, source: ABS 2006) and typical of many rural communities across Australia. The catchment demonstrated an aging rural population historically dependent on agriculture for generating employment and flow on services, for contributing to local volunteer organisations and maintaining a sense of rurality (Barlow and
Cocklin 2003). Beef cattle production, supported by winter and summer cropping enterprises were found to have been the most recent agricultural enterprises on local properties. However due to the relatively cheap land, moderately fertile soils and reliable rainfall (mean annual rainfall approx 1,100 mm/yr) land-use change to plantation forestry was occurring in the region. The Upper Clarence catchment covers an area of 690,500 hectares, and in March 2009, 4.0% of this land area (27,400ha) was under hardwood plantation forest and 0.6% (4,230ha) under softwood plantation (M-C Pelletier, Hurford Hardwoods, pers. comm. 2009), and increasing as fast as private plantation companies could secure the purchase or lease of properties.

A scoping survey was sent out through the local Kyogle Council Newsletter in early 2008 to assist in the selection process. This was aimed at gauging the level of conflict and range of conflicting views held in the community regarding the recent expansion of the hardwood plantation forestry industry whereby a social learning study incorporating participatory modelling could be useful. Perceived impacts on water dynamics and native vegetation were found to be major issues fuelling conflict within the community at this stage, and this was the basis for the selection of a water catchment for a case study as opposed to an alternative geographical or political territory.

The conversion of agricultural land in the catchment to hardwood forestry plantations was an example of land-use change. This change has implications for natural resource management as a whole, as new operational and management practices impact differently on local ecosystems and communities. One of the aims of this study was to quantify these impacts and examine alternative management scenarios for increasing sustainability outcomes at the landscape and community scale.
3.3 Ethics approval

Ethics approval was applied for with the Human Research Ethics Committee (HREC) at Southern Cross University to conduct the research presented in this thesis, and was granted on the 14th November 2007; approval number ECN-07-158 in the name of Andrea Leys as principal investigator and Professor Jerry Vanclay as supervisor and co-investigator. A change of protocol was applied for in order to add the final evaluation surveys used in this study (Appendix 4) and was approved on the 30th October 2009. The HREC considered the research to present low or negligible risk to participants, defined as “the only foreseeable risk to participants is one of discomfort” and at both stages an expedited review process was undertaken.

The approved research was conducted in accordance with the National Statement on Ethical Conduct in Human Research, which necessitated all participants being provided with details of an Ethics Complaint process through the University. No formal complaints were received.

3.4 Semi-structured interviews with key informants

Having established from statistical analysis of the scoping survey using SPSS that there were numerous significant conflicting views within the case study catchment, stakeholders from a variety of community groups were then selected for interviewing. Semi-structured interview questions were initially peer reviewed then pilot-tested to increase robustness of the technique and improve credibility of the research (Appendix 1). Ethics approval was obtained from the Human Research Ethics Committee (HREC) at Southern Cross University to ensure research methods followed the guidelines provided in the National Statement of Ethical Conduct in Human Research, including conducting a risk assessment and providing an information sheet to participants so they had the opportunity to follow up upon the conduct of the research if deemed necessary.
Convergent interviewing (CI) was conducted with key stakeholders on a one to one basis, at times convenient to them in their own homes, taking on average one and half to two hours each (1.5 to 2.0 hrs/interview). Twenty eight (28) key informants were interviewed using the snowballing technique (Aaker and Day 1990), which involved other stakeholders identifying new people to be interviewed, and continued until no new information was being discovered from participants. The interviews were aimed at developing further insights into attitudes and perceptions over plantation forestry expansion as a sound entry point for commencing the second stage of the study which looked to address community concerns (Appendix 1.3: These questions provided a guide only).

Initially interviews were audio-recorded. However due to some participants expressing the view that they were not comfortable, the remainder were not audio recorded, instead only hand scribed answers were taken by the principal research investigator. Semi-structured interviews were flexible and iterative in support of action research theory (Dick 1990, 2002a, 2007b) and helped develop individual rapport with key stakeholders and trust within the community. Interviews were later transcribed, then analysed into key themes and further into major concepts by inductive coding and thematic analysis using the qualitative analysis program NVivo. To make the process more accountable to participants and the community, it was agreed that a feedback report would be written and released publically. The Stage 1 Technical Report is presented in the Appendix 5 of this thesis.

Thematic analysis of interview transcripts was undertaken using quasi-statistics to count the number of times themes were mentioned by participants (Erickson 1992). This was considered useful for prioritising issues of concern within the community for following up with a social learning study. However, this method is considered contentious in the field of social research due to potential bias through variance in interview techniques used in coding, different levels for aggregating themes, influence of media and current events on peoples attitudes at the
time, and personality and differences in expression between participants (K. Prager, pers. comm. 2010). Therefore this technique has limitations that need to be recognised when determining how the findings will be used, otherwise alternative qualitative analysis techniques may be more appropriate including content analysis, document analysis, typology, narrative analysis and discourse analysis which can be explored in Miles and Huberman (1994) and Bryman (2008).

3.5 Stakeholder Analysis: Mapping socio-political and cultural power relationships and influence

Stakeholder Analysis (SA) was a technique used throughout the study to develop understanding of power relations between participants and industry groups, with results reported in Chapter 7 and 8. Observational recordings of stakeholders were made in order to map power relations and social hierarchies that could influence the participatory process and then assist towards implementing power sharing strategies that provided fairness and equal opportunity. Parkins and Sinclair (2009) report on the risk of civic elitism in participatory processes if self-interest groups are allowed to exert their power and influence in decision making. Further, Laverack and Wallerstein (2001), Wilsen et al. (2008) and Compton et al. (2009) report on deficiencies in the literature for mechanisms that empower local actors. Therefore the importance of using an independent facilitator was paramount to this study, as well as the development of learning strategies that provided all stakeholders with equal opportunity to participate in and influence the social learning process.

Varvasovszky and Brugha (2000) used a stakeholder force-field matrix to map power relationships in the field of health policy and planning, providing a useful visual model for predicting and reporting on changes in stakeholder positions regarding impact of policy. As such, this method was further developed in this study for use in natural resource management to illustrate temporal changes in attitudes, and power and influence attributed to an increased understanding of dynamic systems directly resulting from participation in the social learning
study. A control group was also evaluated who did not participate in the social learning study for comparison. The method developed is innovative in the field of natural resource management for resolving conflict over land-use change in Australia.

3.6 Public meetings: Identify and rate issues of controversy in the community

Public meetings were then held in the major plantation ‘hot spots’ of Woodenbong and Bonalbo during March 2009, regions where most of the forestry expansion was occurring. A professional facilitator was employed to ensure there was no bias, to maintain order in meetings, and provide participants with equal opportunity for contributing to dialogue. A card voting system was used to identify the major issues within the community relating to plantation forestry expansion, with weighting applied through order of preferences from individual voters (Figure 3.1). The final results were collated, and then checked by the facilitator, researcher, and participants, and consensus agreed on issues for following up with a Participatory Advisory Committee (PAC). The aim of the PAC was to undertake a social learning study on plantation forestry dynamics within the local landscape and then report findings back to the community.

3.7 Platform for deliberation and collaborative learning: Participatory Advisory Committee (PAC)

A dozen (12) stakeholders representing a diversity of views within the community volunteered to form a PAC through an expression of interest (Appendix 2.1), and remained throughout the entire process. The PAC included both female and male Caucasian respondents of Anglo-Celtic background ranging in age from 31 – 68 years of age. A nominal sitting fee of $50 per person was offered to assist in covering travelling expenses to attend each of the PAC meetings, and was administered via the university finance division on the condition participants completed a “Statement by a supplier” form provided by the Australian taxation office (Appendix 2.2), one per block of three meetings, with payment sent by cheques through the mail.
system. At the initial PAC meeting guidelines for subsequent meetings were decided upon by consensus, as were criteria for evaluating the effectiveness of the social learning study. Eight monthly meetings were held over an eight (8) month period from April 2009 to November 2009 at the Woodenbong golf club.

Figure 3.1 Card voting and ranking system used at public meetings in 2009

3.8 Participatory modelling using the simulation software ‘Simile’

The visual modelling software _Simile_ was initially used as a participatory modelling tool to generate discussion through visually presenting dynamic systems data collected throughout the process and for exploring alternative management and industry development scenarios (Vanclay _et al._ 2006). The major sources of data used for the study were scientific papers and reports, and farm and forestry management data provided by participants and expert opinion. Data was only sourced in response to requests by participants and consensus among the group for deliberation and reflection. The use of visual simulation software was to enhance the
development of a common understanding on issues concerning the community over the rapid expansion of plantation forestry in the case study region. Further, the study aimed to develop a set of adaptive co-management practices between diverse and competing stakeholders for improving sustainability of the plantation forestry industry within the landscape.

3.9 Invitation of expert opinion to PAC

Throughout the study, several expert speakers were invited to address the PAC in order to fill gaps where information was considered by participants to be lacking. Participants helped collect data they felt was relevant to the study, including data from other land-uses deemed useful for comparison, particularly in comparative impact analysis. The PAC needed further information on impacts of plantations on local businesses so one of the participants was assisted in developing a survey which was distributed to all shopfront businesses in Woodenbong, the largest village in the catchment. The same PAC member further collected the surveys (Appendix 3) and returned them to the principal investigator for analysis using SPSS (Statistical Package for the Social Sciences).

3.10 Findings of PAC: Technical report for community feedback

A final PAC meeting was held in November 2009 to go through a summary of findings and recommendations in order to reach agreement for a report to be published as feedback to the wider community. At open meetings held in March 2009 it was requested and agreed that a formal technical report on the findings from this stage of the study would be made publicly available. To ensure accountability, a draft report was therefore provided to all PAC participants for review and comment so any necessary amendments could be made prior to publishing. The technical report for Stage 2 of this study is presented in Appendix 6 of this thesis.
3.11 Participant and researcher evaluation of case study

Final evaluation surveys (Appendix 4) were conducted for two different levels of participation to determine whether the social learning study had influenced attitudes among people with diverse views towards the plantation forestry sector, and further establish its effectiveness as an overall process for more widespread use in communities for alleviating community concerns over land-use change. The two levels of participation used in the final evaluation for statistical analysis using SPSS, including cross factor analysis, were full-participants, being those on the PAC (Appendix 4.2), and non-participants who were concerned citizens and interested in the study, however did not participate on the PAC and were therefore used as a control group (Appendix 4.3).

Evaluation techniques were adapted from research by Connick and Innes (2003), Conley and Moote (2003) and Chess and Purcell (1999). Conley and Moote (2003) recommended the incorporation of non-participants into the evaluation process to overcome shortfalls in literature, an area which was addressed in this thesis to contribute to the literature. Connick and Innes (2003) reported on the value of evaluation for recording changes to attitudes and behaviour in collaborative water policy making in the USA. In response, the evaluation techniques developed in this case study of the plantation forestry industry, incorporated participant and researcher evaluations to gauge temporal changes in attitudes to contribute further to the field of evaluation in natural resource management.

3.12 Governance over research

The research presented in this thesis was governed under a unique structure imposed after the commencement of the study by the Cooperative Research Centre (CRC) for Forestry, being the funding and contractual body. This governance structure according to the CRC for Forestry was aimed at minimising potential risk of harm to researchers, industry partners, Universities,
study participants and community citizens through quality control of output from this project due to the controversial nature of some of the research, and included rigorous peer review of methodology and publications. The CRC Forestry approval process followed the order of:-

i. Principal supervisor - Professor Jerry Vanclay;

ii. CRC for Forestry Project 4.3 - Communities Project Leader - Dr Jacki Schirmer or Dr Kathryn Williams;

iii. Communities Project Steering Committee (PSC) - Included nominated representatives of industry partner organisations and staff researchers working on CRC Forestry Communities sub-projects from Melbourne University, Australian National University, Southern Cross University and University of Tasmania;

iv. CRC for Forestry Program 4 - Trees in the Landscape program leader - Professor Brad Potts; then

v. CRC for Forestry - CEO - Professor Gordon Duff (only for CRC for Forestry Technical Report 201 in Appendix 6); and

vi. Communities Project Steering Committee (PSC) – Private plantation forestry company representatives from Gunns Limited and Forest Enterprises Australia (again only for Technical Report 201).

vii. CRC for Forestry Communities Project Leader – Dr Kathryn Williams (again only for Technical Report 201 for final sign-off).

This governance structure resulted in significant delays in data collection and publication of journal articles and most particularly in the release of the second technical report. However the process encouraged critical reflection and developed a cooperative team work ethic and a greater understanding of constraints to private industry funded scientific research.
Chapter 4: Land-use change conflict arising from plantation forestry expansion: Views across Australian fence-lines

**Journal:** *International Forestry Review*

**Status of publication:** Submitted 8 December 2009; published September 2010, volume 12(3), 256-269 (please refer to Appendix 7.1)

**Declaration by candidate**
I declare the nature and extent of my contribution to this chapter of work to be:

<table>
<thead>
<tr>
<th>Nature of contribution</th>
<th>Extent of contribution (%)</th>
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<tbody>
<tr>
<td>Title, key ideas and questions, literature review, framing, writing</td>
<td>95</td>
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<tr>
<td>Data analysis</td>
<td>100</td>
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<tr>
<td>Presentation and journal scoping</td>
<td>95</td>
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The following co-author contributed to the publication

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<th>Name</th>
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<tr>
<td>Jerome Vanclay</td>
<td>Editing, journal styling, and some literature recommendations</td>
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**Declaration by co-author**
The undersigned hereby certify that:

- The above declaration correctly reflects the nature and extent of the candidate’s contribution to this work, and the nature of the contribution of the co-author;
- The co-author meets the criteria for authorship in having participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
- The co-author takes public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication; &
- There are no other authors of the publication according to these criteria; potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit.
Land-use change conflict arising from plantation forestry expansion: Views across Australian fence-lines

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Summary

An annual trade deficit in Australia for forest products of approximately $2 billion (Aus$), predominantly in paper, pulp products and sawn timber, makes sound argument for continued support of plantation forestry expansion. Existing government policy promoting afforestation through fiscal tax-based incentives for Managed Investment Scheme (MIS) retail forestry however, has raised many questions regarding the need for performance targets and accountability criteria in response to the collapse of several private plantation companies during the global financial crisis of 2009 and 2010 that had been responsible for managing a large sector of the national estate. This paper reports on the first stage of a social research case study for a sub-tropical rural community in north-eastern NSW, Australia that had been undergoing rapid land use-change to plantation forestry prior to the global financial crisis. Socio-political, economic and environmental concerns of stakeholders are identified through social research methods to provide insights for a follow-up study using participatory modelling. Community concerns raised also help inform debate on the need to reform existing federal retail forestry policy to improve triple-bottom line sustainability1.

Keywords: Interviews ∙ stakeholder analysis ∙ narrative ∙ policy reform ∙ afforestation

1 Triple bottom line sustainability refers to environmental sustainability, social responsibility and financial viability, used as criteria when judging the overall performance of a company or business entity (Hacking and Guthrie 2008, Vanclay 2006).
Introduction

Growth of the Australian plantation forestry estate

Plantation forestry has expanded rapidly over the previous decade in Australia from an area estimated at 1.3 million hectares in 1998 to 2.0 million hectares in 2009, mainly to hardwood eucalypts (ABARE 2009, APIU 2009). The major driving force behind this expansion has been an increasing domestic and export demand for sawlogs, paper and paperboard products, and woodchips, which has not been able to be met by a declining public forest supply. Currently Australia has a $2.1 billion annual trade deficit in forest products, including $450 million in sawnwood and wood based panelling, $1.9 billion in paper and $245 million in pulp (ABARE 2009), thereby providing rationale for continued government support of further afforestation in rural landscapes.

The Government Plantations 2020 Vision (MCFFA 1997) envisaged a strategic partnership between the Commonwealth, State and Territory Governments and the timber growing and processing industry, aimed at enhancing regional wealth creation and international competitiveness through a sustainable increase in Australia’s plantation resource. It was initially based on a target of trebling the area of commercial tree crops by 2020 to three (3) million hectares. Further, fiscal incentives in national taxation legislation under Division 394 of the Income Tax Assessment Act 1997, that has allowed full upfront deductions to investors in companies for Managed Investment Schemes (MIS) retail forestry (PJCCFS: Parliamentary Joint Committee 2009) has been the major driving force (Dargusch 2008).

Community reaction to rapid plantation forestry expansion

While Australia has established sound markets for plantation forestry products, with increasing importance being given for production in the sub-tropics and tropical regions
(Varmola and Carle 2002), the expansion of the industry has been met with considerable controversy at the local community level. Williams et al. (2003, 2008), Schirmer et al. (2008), Barlow and Cocklin (2003), Tonts et al. (2001) and Tonts and Black (2003) report on the socially contentious nature of changing land-use in temperate regions from traditional agricultural enterprises including dairying, sheep and cattle production, with conflicting perceptions on social, environmental and economic impacts on rural communities and landscapes. A socio-economic impact study by Williams et al. (2008) of the Victorian and South Australia plantation region found negative attitudes towards blue gum \((Eucalyptus globulus)\) plantations for perceived damage to road infrastructure, loss of business and social involvement in small rural communities, loss of native vegetation, and increased water use and risk of wildfires.

In the state of Victoria alone, 19,000 hectares of plantations were reported to have been lost or severely damaged in the 2009 bushfires (Stewart 2009), considered to be the most devastating bushfires in Australian history for the catastrophic loss of life, and public and private infrastructure (VBRC 2009). Further, Schirmer (2009) reports on major losses to rural populations and a decrease in infrastructure through removal of farm fences, sheds and storage infrastructure under land-use change to plantation forestry from agricultural pursuits. Concerns also emerged from underlying challenges that plantation forestry presents to the rural identity (Barlow and Cocklin 2003, Lockie 2003).

**Questions over effectiveness of past policy reform in Australia**

Major intergovernmental policy reform was implemented through the introduction of Regional Forest Agreements (RFA) between the years of 1995 and 2000 in Australia in an attempt to help overcome community conflict; however Brown (2002) highlights the lack of success due to insufficient engagement with local stakeholders. Interestingly, Nawir and Santoso (2005) and Niemela et al. (2005) report on research from other countries where a lack of
effective mechanisms to resolve social conflicts and ineffective governance have also been major constraints to successful plantation forestry development.

Plantation forestry is a long term land-use enterprise with production cycles ranging from 13 to 30 years in Australia. In communities where the plantation estate is in the early to middle stages of the production cycle, anticipated benefits were found to not always be readily assessable or visible, particularly where no harvesting had commenced. Although forestry industry surveys conducted by Schirmer et al. (2005) and Schirmer (2008a, b) reported significant increases in the number of people employed in the plantation forestry sector over the previous decade and a greater number of regional based businesses becoming increasingly reliant on customers from the plantation industry, these increases have been reversed by the collapse of major plantation forestry companies during the global financial crisis of 2009-10 (Stewart 2009). To add ‘salt to the wound’, many of the failed plantation forestry companies have been publically accused of over-inflating timber yield predictions to investors well before their collapse (Lawrence 2008, PJCCFS: Parliamentary Joint Committee on Corporations and Financial Services 2009). This prompts a major rethink of policy alternatives for afforestation in Australia.

**Policy reform that promotes triple bottom-line sustainability**

This paper argues that an improved understanding of the diversity of views held within communities can provide insights for the development of sustainable policy for improving triple-bottom line outcomes, including benefits to regional communities in Australia. Low et al. (2010) present alternative afforestation policy arrangements used in other countries, including tax-based levy systems for forest users in Indonesia and Norway that provide capital to generate further investment in plantations. They also discuss support for setting up regional forestry cooperatives in Canada through government grants known as the Cooperative Development Initiative (CDI) and a legal stabilisation mechanism through the Canada Cooperatives Act 1999. Benefits from
the CDI scheme are achieved through pooling resources and funds from small grower investors that enhance purchasing and marketing power, provide independence for rural communities and promote sustainable forest production and usage.

A change to the fiscal environment for afforestation schemes in Great Britain in the late 1980’s led to plantation forestry becoming more socially acceptable (Nail 2008). This was firstly a result of the creation of Woodland Grant Schemes (WGS) for farmers that incorporated investment targets with public benefits requiring access, conservation, and protection of biodiversity. Since 2007, the Woodland Grant Scheme was replaced in Scotland by an alternative land management support scheme to simplify grant delivery and access, and promote further forestation based on improved performance and competitiveness while continuing to target social and environmental improvements (DFGS 2006).

England has similarly evolved forestry grant schemes that promote plantation development on agricultural land based on meeting regional targets and sustainability criteria such as further improving public access, biodiversity and heritage conservation, protecting water and soil, and enhancing the landscape for living and working while producing high quality timber (EWGS 2009). Eligible farmers are paid to take agricultural land out of production to establish plantations, and are then paid an annual incentive for maintenance according to performance criteria. This raises the issue of the need for the Australian plantation forestry industry to demonstrate both good performance and form improved alliances in community-based environmental management, posited as powerful ways to turn opposition into support by Marshall (2008) and Lockwood (2010).

Further, it is argued that by developing insights into the diversity of stakeholder views, rural communities in Australia could be engaged into collaborative processes that explore contentious problems for which there may be unclear knowledge at the outset, however through the development of shared understanding, develop capacity to challenge existing policy and
support necessary industry transformation. This democratic discourse is commonly referred to as devolution in forest policy, and is not new on the international scene (Bryden and Geisler 2007, Sikor and Thanh 2007); however is an innovative consideration on the Australian forest policy scene for providing more than ‘lip service’ to multiple stakeholders. Sikor and Thanh (2007) refer to forestry devolution as policy that aims to include a more diverse set of actors in forest management through the recognition of local customary knowledge and where applicable, land rights by governments. Devolution aims to empower marginalised groups, and improve community livelihoods and conservation of natural resources.

**Use of social research to inform debate on need for transformative forestry policy**

This paper reports on findings from the first stage of a case study using social research methodology to identify community concerns relating to plantation forestry expansion. This stage was aimed at developing insights on issues of controversy over natural resource management that could then be explored through an innovative experiment with social learning, incorporating participatory modelling as a tool. The study supports the view of Steyaert and Jiggins (2007) that through the use of social learning, alternative management plans can be explored to assist in the transformation of industries for achieving improved social, environmental and economic outcomes to communities. Further, it is viewed that landscape scale adaptation is necessary for promoting resilient rural communities, referred to by Adger *et al.* 2005 as communities that use their capacity to engage social capital and work with new economic resources to develop employment opportunities. It is not the purpose of this paper to explore the second stage of the case study which develops an evaluation framework for mobilising local stakeholders into a social learning process through fostering relationship and capacity building for collaborative problem solving (Muro and Jeffrey 2008), since findings and recommendations can be found at Leys and Vanclay (2010b).
In summary, a case study of the sub-tropical Upper Clarence catchment in north-eastern NSW, adds to the literature for increasing understanding on the diversity of perceptions held towards the plantation forestry in Australian rural communities, with comparisons made to previous research findings from temperate zones in Australia. This study adds further insights into issues of controversy to challenge existing policy and inform debate for transformation in Australian afforestation policy. Transformative sustainability refers to a recent global paradigm change towards implementing fundamental changes to social conditions that have led to the immense environmental challenges of climate change and global warming (Rathzel and Uzzell 2009). Recommendations are made for policy mechanisms that could promote transformation to a sustainable plantation forestry industry in Australia.

Methods

Scoping for a case study region

A sub-tropical region was investigated to add to findings in literature on social research in rural communities undergoing land-use change to plantation forestry, which in Australia had been limited to temperate zones (Schirmer 2007, Schirmer et al. 2008 a,b, Williams et al. 2003, 2008, Williams 2008). The Upper Clarence catchment of northern NSW covers an area of approximately 690,500 hectares in eastern Australia (Figure 4.1). It was selected for a case study after an initial scoping survey (Figure 4.2) sent through a local government newsletter to all householders, which returned a 10% response rate, identified a diversity of views towards plantation forestry for which a more in-depth social research study would be suitable.

As of 2009, 31,650 hectares were under plantation forestry (4.6% of the land area) with 87% of this comprised of hardwood eucalypts. In the early 1990's the only plantation forestry in the catchment were state owned softwood radiata pines. Rapid expansion has occurred mainly since the early to mid 2000's by private plantation companies. They have used tax-based
incentives for up-front deductions on plantation establishment costs through managed investment scheme (MIS) retail forestry policy as their main vehicle for expansion (M-C Pelletier, Hurford Hardwoods, and Rod Stanford and Mike O’Shea, Forest Enterprises Australia, 2009, pers. comm.).

Figure 4.1 Location map of the sub-tropical Upper Clarence catchment in north-eastern NSW, Australia (Map produced by Greg Luker, GIS Lab SCU, 1/12/2009)

Action research as a reflexive and iterative methodology

Action research (AR) was used for offering a reflective and emergent methodology to achieve an improved understanding on community issues of controversy (Dick 1990). Semi-structured interviews were conducted with key informants to collect qualitative data using the snowballing technique. This involved participants identifying themselves and others for interviewing based on perceptions of being well informed and leaders in the community (Chevalier 2001, Varvasovszky and Brugha 2000). A process of convergent interviewing was undertaken where the interviewing process was continued until no new information was forthcoming (Dick 1990). A total of 28 one-on-one interviews with key informants were completed, taking on average 1 ½ to 2 hours each. These interviews involved questions to elicit
information under social, ecological and economic themes to encompass a multi-disciplinary and holistic research approach (Table 4.1), and were explored in-depth to allow for hidden or emerging concerns.

![Image](image.jpg)

**Stage 1:** Developing insights into community controversies

- Document analysis
- Scoping survey
- Semi-structured interviews with key informants
- Stakeholder analysis

**Stage 2:** Mobilising stakeholders into a social learning process to address and resolve issues of controversy

- Public meetings
- Social learning study with volunteer stakeholders
- Participant evaluation

**Figure 4.2** Research methodologies used to explore the social dimensions of plantation forestry expansion in a case study of the Upper Clarence catchment

**Table 4.1** Major themes and areas of questioning explored in semi-structured interviews with key-informants from the Upper Clarence catchment

<table>
<thead>
<tr>
<th>Theme</th>
<th>Areas of questioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social</td>
<td>Demographical changes&lt;br&gt;Sense of place in community&lt;br&gt;Change in support networks&lt;br&gt;Power to contribute to decision making&lt;br&gt;Health and well-being&lt;br&gt;Professional networks; quality and access</td>
</tr>
<tr>
<td>Ecological</td>
<td>Changes in water quality, soil stability, biodiversity&lt;br&gt;Weed incidence and control measures&lt;br&gt;Policy effectiveness in conservation</td>
</tr>
<tr>
<td>Economic</td>
<td>Business and employment opportunities&lt;br&gt;Enterprise financial viability&lt;br&gt;Land values&lt;br&gt;Technology use and access in business</td>
</tr>
</tbody>
</table>
Stakeholder analysis based on thematic coding of interview transcripts

Through the use of the qualitative analysis software NVivo (QSR International) to code interview data into themes, five major stakeholder groups were identified that typically represented consistent views. The five groups selected were from various industry and interest groups and continued to be used throughout the study for further stakeholder analysis (Table 4.2).

Table 4.2 Stakeholder groups used in Upper Clarence case study

<table>
<thead>
<tr>
<th>Stakeholder group</th>
<th>Representatives from the following industry and interest groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cattle and mixed farming</td>
<td>Graziers, crop and dairy farmers</td>
</tr>
<tr>
<td>2. Forestry</td>
<td>Private plantation companies, state forestry and private native forestry sectors</td>
</tr>
<tr>
<td>3. Environmental, urban, recreation and tourism</td>
<td>Environmental lobby groups, local town citizens, business identities, and eco-tourism ventures</td>
</tr>
<tr>
<td>4. Governing authority</td>
<td>Legislating and compliance bodies from state and local government</td>
</tr>
<tr>
<td>5. Science and education</td>
<td>Research scientists and teachers</td>
</tr>
</tbody>
</table>

Thematic coding initially involved separating all references (narrative quotes) relating to a singular view-point from individual participants. The most important issue for each theme was identified by having the most references to it from the 28 key stakeholders. This analysis was conducted to improve understanding of the diversity of views held in the community and to gauge the level of conflict over land-use change. Further, it assisted in rating the relative importance of issues for planning the second stage of the study that involved the implementation of a social learning study with a volunteer participatory advisory committee. Some comparisons were made to other case study regions in Australia to gain a national scale picture of impacts from plantation forestry expansion; while some interpretation on issues was deemed necessary due to the different methods used in these studies, as data was obtained through mixed qualitative and quantitative means including community and industry surveys and focus groups. It is important to note that the interviews were conducted in 2008 and findings from comparative
studies were all conducted prior to the global financial crisis and collapse of major plantation companies in Australia.

**Results**

**NRM issues for the sub-tropical Upper Clarence catchment**

The major natural resource management issues for each stakeholder grouping used in the case study of the Upper Clarence catchment are summarised in Figure 4.3. These were the issues repeatedly raised by stakeholders as issues of concern in direct response to plantation forestry expansion and used to follow-up in deliberations over perceived effectiveness of existing forestry policy in Australia in relation to triple bottom-line deliverables. Narrative from key-informant interviews is provided to help develop further insights into local perspectives, and is presented under ecological and socio-economic themes, taking into account the inter-connectedness of social and economic issues.

**Ecological issues explored**

The Upper Clarence catchment case study presented controversy surrounding invasive weed problems in plantations. Several participants claimed that the introduced weed *Sporobolus fertilis* (giant Parramatta grass) was well adapted to the region and spreading rapidly. It was suggested by many participants that herbicide control was expensive and application time consuming, and the weed had no grazing value due its sharp hard leaves. *Ligustrum lucidum* (broad-leaved privet), *Macfadyena unguis-cati* (cat’s claw creeper), *Lantana camara* (lantana) and *Cinnamomum camphora* (camphor laurel) were other problematic weeds mentioned as prolific around creeks and gullies on plantation forestry properties in this sub-tropical region. The issue of invasive weeds was found to be unique to higher rainfall zones, as it was found eucalypt
plantations in temperate regions develop closed canopies that largely limit potential for invasive weed problems.

The woody weed Lantana was claimed to provide habitat for the *Manorina melanophrys* (bell miner) which contributed to dieback disease in Eucalypt plantations (Wardell-Johnson *et al.* 2007). The Environmental Urban Tourism and Recreation stakeholder group felt strongly about the lack of maintenance of retained vegetation within plantations in relation to biodiversity conservation (Figure 4.2). They also felt there was a lack of legislation in NSW governing this area and insufficient information on management, an issue not reported from other regions of Australia. A quote from an Environmental stakeholder follows.

_Riparian zones that are left alone in plantations for what is considered natural regeneration are degrading in that they are becoming choked by weeds. These are key areas for biodiversity preservation and therefore need active management._

The lack of species diversity in plantations was reported by most stakeholder groups, who suggested plantation companies should look towards planting mixed species including ones that had higher potential timber values than the most prominent species *Eucalyptus dunnii* (Dunn’s white gum). Other plantation regions in Australia are dominated by *E. saligna* (Sydney blue gum). This view was supported by Law and Chidel (2006), who found that monoculture plantings reduced the diversity of animal species when compared to mixed species remnant vegetation.

Several participants viewed the removal of old remnant trees from land being prepared for plantation establishment as a lack of recognition by plantation companies for local ecological values. One participant reported competition between *Ninox novaeseelandiae* (boobook owls), *Platycercus eximius* (eastern rosellas), *Pseudocheirus peregrinus* (ringtail possums), *Corvus coronoides* (ravens), *Cacatua roseicapilla* (galahs) and *Ptitoris paradiseus* (paradise rifle birds).
for nesting sites in one hollow habitat tree in front of his homestead and neighbouring a plantation forest, a view supported by research (Goldingay and Stevens 2009). Quotes from stakeholders follow.

—IPlantation monoculture provides no replacement for habitats. Animals like sugar gliders need lots of mixed timber corridors… The black cockatoo, which is protected under the Native Vegetation Act, use the forest black oak as a habitat tree and banksia’s. Why plantation companies can cut these down and farmers can't doesn't make sense. Unfair legislation! Farmers would be prosecuted.

—IThe Plantations and Reafforestation Act that is under review is too liberal compared to the Native Vegetation Act. You can clear steep areas and lots of timber including old growth cattle camps left for shelter on grazing properties including many old iron barks and red mahogany trees. They burn the timber rather than sell it locally to farmers for firewood and fencing materials. There should be protocol for salvaging this old growth timber or change legislation to prevent clearing it at all, due to its high conservation and biodiversity values.

One of the plantation forestry participants expressed a conflicting view:

—IThe Plantations and Reafforestation Act is too restrictive in what recumbent trees are retained as potential nesting trees for use as hollows. Often the NSW Industry and Investment plantation assessment officers request that poor quality angophoras are kept because at a static point in time they have hollows and look like they will provide habitats. However experience has shown that these decompose very quickly and are not sound habitat tress to be kept in plantations. Better quality eucalypt trees which have better long term qualities should be kept. Greater flexibility is needed within the Code which allows for dynamic assessment of trees.
Figure 4.3 Major issues found for each stakeholder grouping directly relating to plantation forestry in the Upper Clarence catchment

**Group A: Issues common to all stakeholder groups**
- Invasive weed problem
- Biodiversity threats
- Lack of local processing plant
- Insufficient local employment and training opportunities
- Importance of retaining sense of place and local support networks
- Demographical move towards retirees and unemployed

**Group B: Environmental, Urban, Tourism and Recreation group**
- Feral animal numbers increasing
- Reducing number of rare and endangered species
- Removal of remnant habitat trees
- Numbers of school children declining
- Contamination from aerial applied pesticides

**Group C: Scientific and Education**
- Feral animal threat to native wildlife
- Biodiversity undervalued in region
- Removal of habitat trees and stock camps on grazing properties
- Lack of thinning and pruning silviculture in plantations limiting timber quality and productivity

**Group D: Governing Authorities**
- Inadequate weed control and fuel hazard reduction
- Lack of infrastructure investment
- Pesticide spray drift around waterways and homes
- Lack of jurisdiction over land use planning within NSW Local government for preserving visual and landscape amenities

**Group E: Cattle and Mixed Farming**
- Clearing regrowth forest for low value *Eucalyptus dunnii* that is highly susceptible to psyllid attack
- Tree health and species selection
- Loss of valuable food producing land
- Managed investment schemes creating market distortions
- Land prices pushed too high
- Farming families displaced
- Rural service industries struggling to remain viable
- Fuel buildup a fire hazard

**Group F: Forestry industry**
- Seedling quality and tree health
- Fire hazards from neighbouring pasture land
- Land becoming too expensive
- Lack of skilled labour for contracting jobs
- Under-funded and under-managed National Parks and State forests
- Government barriers to development of processing facilities
- Dealing with negative sentiment in local farming community and media
The issue of loss of habitat trees had been reported in other plantation regions of Australia and reflected diversity in understanding within the community regarding legislation on the State and Territory Codes of Practice such as the NSW Plantations and Reafforestation Act and Code of Practice. Several participants representing views for the plantation forestry industry claimed all their operations were strictly regulated and followed allowable guidelines regulated in by the State of NSW. These conflicting views suggest that there are shortfalls in policy that could be improved through increased stakeholder input into devolved afforestation policy that could improve local ecological outcomes. A participant from the Recreation and Tourism group suggested:

_There is misinformation around the community about plantation forestry. Also lack of communication._

A different view was presented by a Forestry participant:

_Open communication from our company is available. Problem is, not everyone accesses this._

The sub-tropical region presented unique findings on tree health and timber quality, even from the forestry stakeholder group. The psyllid insect *Creiis lituratus* was reported to be prevalent across the catchment, with plantations of *E. dunnii* particularly susceptible to damage from this phloem feeding insect. Further, various chrysomelid beetle species including *Chrysophtharta* sp., *Paropsisterna* sp. and *Paropsis* sp. also presented challenges, with plantations needing to be aerially sprayed with insecticides such as dimethoate, which many participants viewed as a highly toxic organophosphate chemical.

_Plantation companies could be more sustainable if they planted trees in strips with natives that provide habitat for natural enemies of pests including psyllids, and habitats for wildlife_
and flora preservation. For example 100m strips. This preventative approach to protecting biodiversity would be much more acceptable in the community.

_There are health issues for the community from aerial spraying pesticides. Some people … have been sick. Many residents have noticed smell drifting over town when plantations have been sprayed near the town boundary. Also contamination of waterways and creeks. This is pollution._

_Contamination of the town drinking water source has occurred … through aerial spraying dimethoate in nearby plantations._

_Chemicals contaminate my honey and kill my bees. I relied on organic honey for my income. I can't anymore. Spraying occurs in the next door plantation without notifying me._

Another participant provided an opposing view on the source of the chemical smell:

_The smell over town was from 2,4-D ground spraying for weeds in grazing paddocks. I should know as I was contracted to do it!_

To help minimise future problems with tree health, it was recommended by some forestry representatives and local farmers that other endemic species such as _E. pilularis_ (blackbutt) and _Corymbia maculata_ (spotted gum), together with others suggested in following quotes, offered potential for more widespread use in plantations due to their better insect resistance and wood qualities compared to _E. dunnii_. Limitations to further species selection however, were reported by plantation forestry stakeholders, whereby they guaranteed returns to investors in MIS schemes ranging from 13 to 15 years from planting. This provides further qualitative evidence of the need for policy reform as current mechanisms are promoting
planting of the fastest growing species rather than species with the best timber qualities suited to the region.

‗I would like to see more mixed species plantings in the catchment to include endemic species such as spotted gum, iron bark and tallowwood.‘

‗Gympie messmate (E. cloeziana) offers potential as a plantation species as I have seen good growth … and it is endemic to the area.‘

‗E. dunnii has some superior properties to other species including better frost tolerance and rapid growth. That is why we have used it so extensively.‘

Another feature of the case study reported by the Scientific and Education stakeholder group was the lack of thinning and pruning operations in plantations that could potentially maximise future saw log quality and increase the value of the timber resource in the catchment. A couple of the reasons given for the lack of silvicultural operations in plantations was that there were no local or regional processing facilities for small-diameter plantation timber, and the nearest export facility for woodchips was approximately 200 km’s away, found to be unprofitable due to the high cost of transport. A private farmer and forester provided the following suggestions.

‗There is an urgent need for thinning plantations to ensure the future quality of sawlogs and viability of the industry. Thin when stand is dense, tall, and straight, and growth is slowing down in response to competition for space, light and nutrients…Thinning operations would help create local employment opportunities, and help keep a local mill going.‘

‗As plantation forests close up there is not much ground cover left for grazing. Forests should be thinned to allow grazing to continue. This multiple land-use option would be much more socially acceptable.‘
There was considerable concern among participants in the Upper Clarence catchment regarding potential fire threat of plantation forests to local communities due to fuel build-up on forest floors in close proximity to towns and villages. Forest estates other than plantations were also considered to pose potential bushfire risks to communities, and it was recommended that plantation companies should work collaboratively with all other forest tenures to establish sound fire management and response plans.

‘Plantations mainly use stock grazing for weed management. Where they are not grazed or grazed effectively along fire breaks and gullies, weeds and timber regrowth are potential fire hazards.’

‘Not enough collective action is being taken between the plantation industry, state forests and national parks for fire hazard reduction, putting communities at risk of potential bushfires in dry seasons.’

‘Should be controlled low intensity burns of all local forests to mimic mother-nature from naturally occurring fires started from lightening strikes and aboriginal land-use practices.’

A long time resident in the catchment and worker in the timber milling industry commented:

‘Fire hazard reduction measures were used in the past where forests were pre-burnt prior to logging. This worked well in reducing fuel and litter build up….The hardwood eucalypts are very hardy and would respond to low intensity burns with regrowth soon afterwards. Now fuel and litter loads are high and potentially dangerous to surrounding communities. The potential high intensity fires under these circumstances are too hot and kill wildlife… With this change there will be big fires every 15 to 20 years, which could be devastating.’

Another forester suggested:
State forests used to be grazed to help keep the forest floor clean. Now many forests have been converted to national parks, most in the mid 1990’s, and they are undergoing successional ecological change to more rainforest species, and thicker tangled wilderness stands. This succession is not natural, having been induced by man due to change in land management practices whereby the use of fire has largely been eliminated and invasive weeds have got beyond control.’

**Socio-economic issues explored**

Representatives from the Cattle and Mixed farming stakeholder group reported concerns relating to the loss of prime agricultural land to tree crops, shown in Figure 4.4. This issue was commonly reported from other regions of Australia by Schirmer et al. (2008) and Williams et al. (2003, 2008) and Williams (2008), as were perceptions of a rapidly expanding plantation forestry industry artificially inflating rural land prices. It was further suggested that a major implication of higher land prices would be an increase in the cost of food in Australia, providing further evidence to closely examine the social and market distortions of current afforestation policy.

‘Plantation forestry in the region has been the greatest single land-use change since white settlement…Squatters once had large holdings … From the early 1900’s there was a wave of subdivision into grazing and dairying. Dairies were around 400 acres in size… Dairying was then put under pressure from deregulation. Now you need 5,000 acres for cattle grazing to be viable, or a little smaller if you have some cropping. Grazing is now put under pressure from forestry expansion, whereby it is being phased out rapidly. It has been estimated to date 25,000 to 30,000 breeder cattle have been displaced to tree plantations.’

‘Locking up potential food producing land in trees will come at a cost to the consumer. They will end up paying a lot more for food in the next 5 years. Impact appears not so obvious to political leaders to date.’
Land prices were reported to have doubled over the previous five year period for the Upper Clarence catchment to $7,000/hectare (Rod Stanford, Forest Enterprises Australia, 2009, pers. comm.). One Mixed Farmer participant suggested that based on current market prices for cattle that land prices over $4,900 /ha were unviable for cattle industry expansion based on a carrying capacity of 1.2 breeder units per hectare (equivalent to 1 breeder / 3 acres). This same participant suggested that plantation timber crops should not be put into the higher rainfall zones that were suitable for reliable food growing, suggesting they should only be grown on poorer soils in the lower rainfall zones of Australia.

"Aging farmers in the region can’t afford generational succession and retire as well. The average age of Australian farmers is 59 years. Young farmers can’t afford to buy land in the catchment as it is now too dear and not viable for a return on capital at current prices … Where are the next generation of farmers going to come from as they can’t even afford to pay interest on loans to purchase properties?"
An alternative view was provided by a plantation representative of the Forestry stakeholder group:

‗Land prices are very high as a result of real estate values going up Australia wide. This is a problem for us when needing to raise capital to purchase more land. Our company have set a range of prices they will pay, and will negotiate with landholders. The high land prices are an issue in the community.‘

A farmer held a view not consistent with most other farmers interviewed:

‗The timber industry is helping create a financially viable community. Unless farming becomes more viable in the future, plantations will keep expanding.‘

There was a lack of overall support for forestry Managed Investment Scheme (MIS) taxation legislation among most stakeholder groups, consistent with findings from Dargusch (2008) where questions were raised regarding environmental and social outcomes. Quotes from representatives for the Cattle and Mixed Farming stakeholder group illustrate the lack of support for the MIS legislation in Australia:

‗I don’t support the MIS plantations scheme …. The whole structure is inequitable, creating a superior land-use all to support the governments 2020 Vision to increase land planted to timber. I would like to see rights under the Plantations and Reafforestation Act brought closer to the Native Vegetation Act to put all land users on a more even par.‘

‗The MIS plantation companies are large corporations and are not community based. Profits go outside the region to investors.‘

Whilst all stakeholder groups in the Upper Clarence case study suggested an urgent need for a processing plant in the region to help create employment opportunities and address
the high unemployment rate, a representative from a local plantation forestry company claimed plans for a local processing plant within the next three years, however delayed a year due to the global financial crisis. A skill shortage in the region was identified as an issue for the forestry industry. Findings by Schirmer et al. (2005, 2008a, b) and Schirmer (2008a, b) from other plantation regions in Australia showed once harvesting commenced that employment opportunities increased significantly, as did local business trade, however before the global financial crisis started in 2009 and incomparable with the Upper Clarence case where there were currently no processing or value-adding facilities for plantation timber, a view shared in research by Tonts et al. (2001). Some diverse views from participants from the Upper Clarence:

_‘I question the economic benefit of the plantation forestry industry to the local community. There is currently no processing in the region. We need a local mill that can process small diameter timber and value adding manufacturing to be of any benefit to the community.’_

_‘There are few permanent employment opportunities in plantations. Most are in casual or temporary labour, and then on unemployment benefits.’_

_‘Why are there no mills to process plantation timber? 90% of trees planted are for pulp and we have no pulp mill, and it is uneconomical to take to the port of Brisbane. It is only the tax advantage these companies are interested in!’_

_‘There are potentially 350 to 400 jobs from processing plantation timber from our company alone. We have a five to six year plan. We will need harvesting and transport contractors that can be put on five year contracts. We currently employ 157 people, although some are based outside the catchment at larger regional centres, and have already spent $13.5 million on capital. We are aiming to get locals for employment, as they need to be close to the resource to keep costs down. Our company plan is to produce 100,000 tonnes of timber’_
per year initially, and then up to 1 million tonnes per year by 2014 which we believe is a sustainable figure. We would also like to develop other value-adding processing including bio-fuel production using residues and waste trees. Our business is vertically integrated and we use the MIS as a vehicle to build the process.

Declining business viability was reported as a social issue affecting local communities in several regions across Australia. In the sub-tropical Upper Clarence the Farming group were particularly concerned about rural service businesses losing trade as plantation forests expanded. These views were confirmed for only some types of businesses through a local survey, and are reported in Leys and Vanclay (2010b).

_Trees are displacing local families off farms.... Large property ... has been bought by a plantation company ...1,600 of the 2,600 acres under trees.... Was improved pasture country carrying 600 beef breeders.... No longer repairs to machinery, no school children, no labour for stock and fencing, no local shopping, no electricity, lost two homes, and two full time jobs, lost livestock carrier work, and lost rural supplies.... Has huge social cost through diminishing work and produce to and from the property._

Loss of farming families from the district is having a social impact on local schools and services such as the mechanic and local grocer._

Plantation forestry expansion has had a detrimental flow on effect for the cattle industry. Carrying capacities of cattle have been drastically reduced. Local meatworks have had to source cattle from a wider collection area increasing costs for transport... Profits are reduced making the industry more difficult to operate in, and creating long term business uncertainty._

An alternative view was provided by a Forestry stakeholder:
Plantation buy outs can result in farmers being displaced without immediate employment. There is a window with a phase of discomfort where impacts seem great. However experience has shown that these displaced famers tend to get employment back in the farming industry. This is one of the dynamics of the timber industry.

A key concern has been that processing and value-adding facilities are often located in larger regional centres in plantation areas across Australia. Preliminary findings from Tonts et al. (2001) presented a hypothesis that socio-economic benefits through the generation of local employment were only possible when processing facilities were located within local communities. Further, Kelly and Lymon (2003) reported community concerns over timber companies employing contractors from outside plantation communities for ground preparation, planting and harvesting. However Tonts et al. (2001) suggested that although timber processing facilities were highly mechanised, and local employment would only be for low skill and low paid positions, wider flow benefits were likely due to the need for additional infrastructure and services that would complement a processing facility including electricity, water, waste management, housing for employees, and essential services of health and education. The following quotes were provided by participants from the Governing Authority stakeholder group:

_‘There is an urgent need for developing other processing and value-adding manufacturing for residues and waste trees such as bio-fuel production.’_

_‘Woodenbong (largest town in catchment with population around 330) has an electricity shortage. A co-generation plant set up by local plantation companies would be a viable value-adding industry to use wastes and thinnings, and would be carbon neutral. They could sell the extra electricity back to the state government into the electricity grid.’_
Evidence from quantitative studies by Schirmer (2008a, 2008b, 2009) and Schirmer et al. (2005) did report a decline in local business trade in goods and services for many small rural towns and villages in temperate regions of Australia, however an increase in larger regional centres, although this was prior to the global financial crisis.

Several participants raised the issue of a lack of planning authority and legislative control by NSW local government for protecting local towns, villages and entrances to tourist amenities including national parks. The loss of visual amenity due to physical barriers from tree plantations was considered a social problem, as many participants felt plantation trees were consuming local landscapes leading to a decline in the visual appeal of the Upper Clarence catchment. Governing Authorities again blamed this on the lack of power in local government over plantation authorisation and land-use planning, a situation unique to NSW. Participants in interviews were provided with a variety of landscape photographs and asked to comment:

_‘Grazing land looks more productive than timber stands. Food can be produced off it to support the population.’_

_‘Monoculture plantations are visually unappealing. Mixed landscapes demonstrate useful amenities and are more visually appealing for the variation.’_

Williams (2008) reported similar findings from Western Australia and Tasmania, in that many people perceived the change of land-use from agriculture to plantation tree cropping as a loss of visual amenity. Further, Tonts et al. (2001) and Kelly and Lymon (2003) reported the loss of visual amenity of agricultural landscapes as reducing the attractiveness to new residents into these communities for lifestyle change and hobby farming. Noise pollution from heavy forestry machinery, chipping mills, and passing trucks were perceived to threaten the
quiet country lifestyle for some local residents and the developing tourist industry in Western
Australian plantation communities (Kelly and Lymon 2003).

‗Monoculture used in plantation forestry is unappealing to people coming to the region. It
may end up limiting tourism prospects for the region.‘

All except the Forestry Industry stakeholder group provided views on the importance
of retaining social support networks and a strong sense of place within the local community
for contributing to their feelings of self worth and happiness.

‗I love living in the community as it is very active in community work, friendly and polite.
Very supportive of each other, and each has their own identity. Some of the local groups
include Lions, Landcare, Hall committee, Show Society, and Volunteer Rural Fire Service.
People are moving into town as housing is affordable, particularly for pensioners, and
those with disabilities. We have an adult disability centre that also runs a nursery and care
centre which employs a few people. We want to retain this lifestyle.‘

Plantations were found to be more socially acceptable in the Upper Clarence when
grown on country leased by plantation companies from local farming families as opposed to
outright property purchase. Several Farming participants suggested this helped retain farming
families within communities who supported local social networks, in particular volunteer
organisations. This has implications for policy reform towards incentives for farm forestry as
opposed to tax-based incentives for large companies.

‗I support mixed farming with forestry joint venture leasing arrangements, as they can
provide long term investment returns which can be very useful when a lot of farmers never
had superannuation.‘
I have a joint forestry venture with the Tokyo Electricity Power Company as a carbon offset plantation. I couldn't be happier with the lease annuities to support my farming enterprise.‘

A shift in the type of occupancy for dwellings on properties bought by plantation companies from owner occupied to renters was perceived to be having detrimental impacts on local communities. Further changes to the local demographics were reported:

‘Often the homes rented out go to unemployed who contribute nothing back to the community. Dope growers who add to the drug culture. They provide no social capital or prosperity, job creation or wealth to the community.’

‘There has been an increase in itinerant workers in the area. This is changing the social makeup of the local community.’

‘There is a threat in losing community to the aged and under privileged that don’t or can’t contribute back to the community. It is also difficult for the community to provide for them due to lack of resources and services.’

Plantations were also perceived to be having a negative impact by some participants on the local indigenous population, not mentioned in other plantation communities:

‘There is a negative impact on local Aborigines: Their landscape has been changed, trees have been planted too close to cultural sites, and water flow in local waterways has slowed down.’

‘Assessments done by the NSW Industry and Investment for authorising plantations to comply don’t consult adequately with local cultural groups in regards to planning considerations to cultural heritage. They only use their database for listings of cultural sites, however many of which are not listed as they [the Aboriginal community] don’t want
the public to know about it. This needs to be addressed at the local level in the future with tribal Elders in the community.‘

Contrary to this view, a quote is provided from a representative for one of the several plantation forestry companies operating within the catchment:

‗Our business has chosen voluntary standards as part of our business plan including the Environmental Management System (EMS) which is third party audited. Also the Australian Forestry Management Standard (AFMS 478) which covers community engagement, indigenous rights, and regionalisation initiatives.‘

At the time of interviews, all participants anticipated the continued expansion of plantation forestry within the Upper Clarence catchment, with the main reasons suggested to be due to the poor outlook for the beef cattle industry, making selling properties or leasing partial properties to plantation companies a viable alternative. This situation however halted with the subsequent collapse of the MIS plantation timber industry in Australia.

**Discussion and conclusions**

Narratives from a case study of the sub-tropical Upper Clarence catchment in eastern Australia have provided valuable insights to further understand perceived impacts of plantation forestry expansion on communities and regional landscapes in Australia. These insights were gained through semi-structured interviews with key stakeholders that explored emerging areas of concern relating to social, ecological, economic and political themes. A major concern was the unsustainable expansion of the hardwood *Eucalyptus dunnii* being planted in the catchment to suit short-rotation investment cycles for contractual arrangements for MIS company prospectus. This concern was founded on perceptions of the high susceptibility this species has to insect attack and relatively poor wood quality compared to
other endemic species that could be planted. The implications are the increased fire risk defoliated plantations pose to communities, a view substantiated in research by Fleming et al. (2002), and the limited potential for financial returns to investors.

The perceived change in the demographical composition of communities towards an ageing and unemployed population was a major concern to all stakeholder groups, particularly in regards to social implications for providing and funding additional essential services, loss of volunteers to support local organisations and threat to the sense of rurality and place in community. Overall the lack of investment in any regional infrastructure for processing and value-adding manufacturing of plantation timber was found to be the major socio-economic impediment to local employment prospects and the financial viability of the industry.

These findings, together with comparisons to other case regions from temperate zones, contribute important dialogue to help inform debate of the need for policy reform that supports triple bottom-line sustainability to overcome shortfalls in existing Managed Investment Scheme (MIS) retail forestry policy in Australia. Transformative sustainability has been referred to in this study as policy that supports fundamental changes to the social conditions that have led to current environmental challenges of climate change and global warming (Rathzel and Uzzell 2009), and deemed necessary for consideration by Australian policy makers to respond out of a moral and social responsibility to the environment and future generations.

Through an exploration of literature, there are various policy mechanisms used in other countries for supporting afforestation that target performance and productivity criteria, while maximising social and environmental outcomes to regional communities. A couple of mechanisms identified for their potential use in Australia, include firstly an incentive-based scheme for farmers where they are paid to take agricultural land out of production to grow plantations on their properties, complemented by further annuities for maintaining them...
according to performance criteria. This includes achieving performance tiers in biodiversity, soils, water, and landscape protection while maximising timber productivity through active management. These schemes have been successfully implemented in Great Britain (EWGS 2009, DFGS 2006, Nail 2008), and are likely to be supported in Australia as they keep farmers on properties and in rural communities, a view supported in research by Schirmer (2007).

Secondly, government assistance for regional forestry cooperatives is further recommended to support a farmer afforestation scheme that could maximise regional economies of scales through collective action of small producers. Low et al. (2010) suggest legal support can further assist in the formation of regional cooperatives through legislated ‘cooperative acts’, such as the case in Canada for the support of the Cooperative Development Initiative (CDI). Regional forestry cooperatives are likely to be attractive in Australian rural communities for developing greater self-reliance and empowering local stakeholders in decision-making, particularly towards market prices as farmers have notoriously been price-takers, a view shared by Botterill (2006).

There is further potential for cooperatives to develop a carbon offset trading market based on institutional benefits and synergies by combining forestry with agricultural sinks. ANGA (2009) reported Australian national greenhouse gas emission’s at an estimated 541 million tonnes CO$_2$ per annum in 2007, however when adjusted for land-use change and forestry activities, increased to 597 million tonnes. While this increase was claimed by Lewis and Gomer (2008) to be due mainly to the continuation of land clearing, this is a situation that could be avoided through policy amendments for CO$_2$ sequestration in managed native forests, plantations and perennial pastures.

In conclusion, a current $2.1 billion (Aus$) annual trade deficit in Australia for forestry products, together with declining access to native forests, provides evidence that plantation forestry is a significant industry to the nations economy. The failure of supporting regional
forestry agreements in the 1990’s to address community concerns, and subsequent market failure of the MIS retail forestry scheme (ABC 2010), suggests reform is urgently required to existing afforestation policy that incorporates stringent performance and accountability criteria. Further, there is a need to explore alternative community-based afforestation policy that could assist in the development of a sustainable plantation forestry industry in Australia.

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Chapter 5: Evaluation framework for participatory modelling in Australian plantation forestry communities

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Declaration by candidate
I declare the nature and extent of my contribution to this chapter of work to be:

<table>
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<th>Nature of contribution</th>
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<tr>
<td>Title, key ideas and questions, literature review, framing and development</td>
<td>95</td>
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<td>Presentation and journal scoping</td>
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The following co-authors contributed to the publication:

<table>
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<th>Name</th>
<th>Nature of contribution</th>
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<tbody>
<tr>
<td>Jerome Vanclay</td>
<td>Principal supervisory role of editing and suitability of journal</td>
</tr>
<tr>
<td>Jacki Schirmer</td>
<td>Project leader guidance on evaluating participatory processes, additional literature for review, suggestions on data presentation</td>
</tr>
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Declaration by co-authors
The undersigned hereby certify that:

- The above declaration correctly reflects the nature and extent of the candidate’s contribution to this work, and the nature of the contribution of each of the co-authors;
- They meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
- They take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication; and
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Summary

This paper presents an evaluation framework for testing the effectiveness of participatory modelling techniques for resolving conflict over land-use change from traditional agricultural enterprises to hardwood plantation forestry in a case study of the Upper Clarence rural community of sub-tropical north-eastern NSW. The evaluation framework makes use of multiple processes and outcome-based criteria developed from input by participants to address natural resource management concerns within their community, and were monitored through the use of surveys and researcher observation.

Controversy in the local community over rapid expansion of the plantation forestry estate was initially identified through a scoping survey sent in the mail to householders. Further insights were gained through interviews with key informants in the community, followed by public meetings. The most important issues were rated as the need for improved fire management planning and practice and socio-economic benefits to the local community.

Participatory modelling has been proposed as an innovative tool for community engagement to improve working alliances and collaborative capacity between diverse groups impacted differently by land-use change. It can provide a non-threatening platform to
stimulate discussion and collaborative learning, as well as the opportunity to develop recommendations for changes that provide an acceptable balance among multiple and contrasting actors in an endeavour to improve social and environmental outcomes.

A critical evaluation of a participatory modelling process identified what strategies worked, and included stakeholder analysis, facilitation of power sharing, and co-learning strategies with simulation modelling for instilling a shared understanding of the dynamics of local socio-ecological systems. Evaluation criteria found to be important to participants were the use of expert opinion for providing creditable scientific knowledge, in combination with knowledge from local actors and experts in the field for producing cost-effective, ecologically and socially acceptable models for the broader community. This paper reflects on the challenges emerging at the study design stage for building an evaluation framework.

**Keywords**

Evaluation criteria · participation · co-learning · socio-ecological system dynamics · stakeholder analysis · land-use change conflict

**Introduction**

**Participatory modelling for improving community outcomes**

Participatory modelling has been used successfully in developing countries to encourage and shape deliberation in communities where limited natural resources have seriously constrained the welfare and livelihoods of people and where conflict has existed over resource allocation and management (Vanclay et al. 2006). Further, Ritzema et al. (2010) report on participatory modelling to overcome problems with data scarcity for environmental planning through simulation modelling that incorporates local actor knowledge in India. Australian rural
communities have a history of pressures and challenges to remain viable social and economic entities under land-use change, driven largely by market volatility, government legislation, climatic vagaries, and more recently climate change, creating increasing pressure for the uptake of ecologically sustainable practices. However, the use of participatory modelling as a tool for informing discussion and creating change has not previously been tested nor evaluated with rigour for use in Australian rural communities.

Participatory modelling uses a participatory action research (PAR) methodology which according to Cyprian et al. (2003) is a process in which members of community groups identify a problem, collect and analyse information, and act upon the problem in order to find solutions and promote a transformation of the social, environmental or political context. PAR is an extension of action research which pursues action in the form of change while developing an improved understanding of issues (Dick 1999). Therefore participatory modelling provides an alternative to top-down management procedures traditionally used by government agencies for examining complex interdisciplinary natural resource management issues, often referred to in scientific literature as ‘positivist science’.

**Exploring socio-ecological systems dynamics for developing shared understanding**

This traditional scientific paradigm of ‘positivist science’ which uses reductionist methodology has had limited success in dealing with the diverse perspectives and values within communities and the complexity and uncertainty of future systems behaviour according to Allison and Hobbs (2006). Alternatively, enquiry into relationships between humans and their environment using socio-ecological system dynamics, the underlying theory used in participatory modelling, can help frame systems constraints and explore options for growth. It incorporates the idea of self-organisation of socio-ecological systems by the use of co-learning
between community actors; where socio-ecological systems refer to inter-dependant relationships between human and environmental systems (Young et al. 2006).

The aim of participatory modelling is to develop a shared understanding of issues creating perturbations or controversy over natural resources management, while enhancing community resilience and capacity to make improved decisions (Vanclay 2003). As the production period of the hardwood timber plantations established in the study region and in many other regions of Australia generally varies from 14 to 25 years, systems dynamics provides an ideal way to examine the mobilisation of resources, including labour, capital, transport, machinery, processing, and timber products. While it is not the purpose of this paper to explore the theory of socio-ecological systems, readers are directed to the work of Adger et al. (2005), Folke et al. (2002, 2005), Lebel et al. (2006) and Walker et al. (2002).

The approach advocated in this paper has been demonstrated in research conducted by Voinov and Gaddis (2008) in the area of watershed modelling through engaging and collaborating with stakeholders, decision makers and scientists. They found the effect of combining grass-roots efforts with academic research that incorporated system’s theory with economic and social concerns of the community improved policy making and planning processes. Giupponi et al. (2006, 2008) report on the strengths and limitations of participatory modelling in climate change research, particularly in the use of the operational model NetSyMoD (Network Analysis – Creative System Modelling – Decision Support) that integrates simulation modelling, public participation and decision analysis for use in developing adaptation policy. Further, van den Belt (2004) presents a type of participatory modelling referred to as mediated modelling for analysing systems dynamics and consensus building over environmental problems as a way of improving public information and participation, and a more just way for making sustainable environmental decisions.
Scientists sympathetic to systems dynamics are continually being challenged with the need to develop new theories and strategies that are more inclusive of those having stakes in policy and decision making. Post-normal science has emerged as a democratic paradigm for dealing with the increasingly complex social and ecological systems responsible for the management of our natural resources (Funtowicz and Ravetz 1993). It is proving a particularly useful pathway for engaging policy makers and land-users to debate the serious environmental issues of climate change and environmental degradation, believed by many scientists to be threatening the future of humanity.

The field of post-normal science is typified by a democratic discourse process that relies on establishing an environment of free public deliberation where power is shared equally between those governed by the decisions (Marshall 2008). It is aimed at developing community capacity for making effective decisions through increased citizen input, social responsibility and co-learning. This leads to a definition for participatory modelling by Voinov and Gaddis (2008) commonly accepted in literature:

“Participatory modelling is the process of incorporating stakeholders, often including the public, and decision makers into an otherwise purely analytic modelling process to support decisions involving complex natural resources questions.”

This paper reports on initial outcomes of a study in which stock and flow dynamic modelling is used to represent the complex inter-related social, economic and ecological systems related to plantation forestry in the study area, together with stakeholder analysis, collaborative inquiry and formative assessments. A critique evaluating the participatory modelling process is developed to inform the plantation forestry industry and research organisations about the merits of such a process and how it could be used more widely in other communities experiencing controversy over natural resource management. Evaluation techniques are developed further in response to the demand for more robust information from
planning authorities and researchers (Voinov and Bousquet 2010) for determining what strategies are most effective.

**Evaluation of participatory studies in natural resource management**

Research into evaluation of participatory processes in natural resource management to date by Chess and Purcell (1999), Petts (2000), Conley and Moote (2003) and Laurian and Shaw (2009) use process and outcome-based criteria, or a methodological pluralism that combines both to maximise the merits of the two theoretical perspectives. Process-based criteria relate to characteristics of the approaches used in public participation to make decisions, and include fairness and competence, and information exchange as opposed to outcome-based criteria that relates to the end results or decisions reached from the process.

Chase *et al.* (2004) found significant design implications where participants were allowed to contribute to evaluation criteria and ranking in the development of performance based indicators. They found the most important process-based criteria to be ‘using the best available scientific information, having a genuine influence on decisions, promoting communication and learning, and treating all citizens equally.’ In contrast, cost-effectiveness was a low ranked criterion. It was suggested that quality participatory processes were more important than limitations posed by financial constraints. This type of process evaluation can be monitored using formative assessments, and used in this study together with an outcomes-based assessment in an attempt to overcome limitations from a single approach; this involved use of surveys, semi-structured interviews, open meetings, participatory modelling and investigations with a volunteer participatory advisory committee.

Petts (2000) evaluated community advisory committee’s (CAC’s) and citizen juries in waste management strategic planning in the United Kingdom that met over a period of nine to ten months to provide views and recommendations to county councils. The following
evaluation criteria were developed and believed to combine the principles of publicity and accountability with those of fairness and competence: Participants represent a full range of views; they are allowed an equal opportunity to contribute to the agenda; there are procedures and rules for deliberation; a mutual understanding of values and concerns is promoted over a sufficient time period; successful engagement and shared understanding on issues of conflict; provide information for participants to critically challenge expert knowledge; reduce misunderstanding through knowledge sharing; introduce change that is for the better of all participants; allows recommendations for change; outcomes are for public benefit and transparent to all those who are affected. Petts (2000) also tested novel approaches to evaluating the participatory process, in this case targeting personal values for participants in the form of building self-esteem, learning, social conflict, friendships and entertainment. Assessment was through mixed methods using multi-criteria analysis and site-ranking techniques, interactive, and conducted by an independent researcher not directly involved in the modelling process, a strategy used in this study.

**Engaging stakeholders and confounding effects**

In developing robust evaluation strategies with a community group, Conley and Moote (2003) suggested the need for a broad representation of actors to take account of different perspectives. However this ideal group composition can be difficult to achieve as participants often don’t stay engaged with the study till completion and others may not see benefits from being involved at all. Lowery *et al.* (2004) suggested this is a constraint regularly faced in the formation of participatory advisory committees due to variation in the collective action and mobilisation of groups with varying interests, and claimed bias was a likely implication.

This was further supported by findings of Parkins and Sinclair (2009) that refer to this bias as ‘civil elitism’, typified by the mobilised groups having pre-defined interests in the
outcomes of the processes involved in collaborative resource management. Their analysis of a large number of community action groups in Canada was heavily skewed towards the highly educated middle-class representing the political interests of their stakeholder group, while views of ordinary citizens were under represented. They argued that there was a need for capacity building in rural communities that encourages environmental citizenship to broaden outcomes of such processes, and are explored in this study particularly to address inclusiveness till completion.

**Interception for collaborative learning and development of shared understanding**

Whilst some system theorists suggest the need for interception and paradigm shifts that search for optimal solutions and adaptation to a changing world (Allison and Hobbs 2006; Meadows 1999), others aim towards social or co-learning, including Petts (2000), d’Aquino et al. (2002), Standa-Gunda et al. (2003) and Pahl-Wostl and Hare (2004). The latter in particular focus on the need for ongoing learning and negotiation to enhance communication, sharing perspectives and the development of adaptive group strategies to extend consultation and problem solving.

This participatory modelling study supports the latter view, proposing that complex natural resource systems are in constant flux, and systems analyses using participatory processes are more important for promoting an understanding of the dynamics of socio-economic systems under land-use change rather than intercepting to create further disturbance. Participatory modelling in this study aims to change the culture of communities to enable controversy to be addressed through a rigorous and accountable process of power-sharing, information and technology transfer.
Power-sharing in participatory environmental research

Laurian and Shaw (2009) identified unequal power-sharing as one of the reasons for past failure of participatory processes, together with distortions in communication, differences in knowledge base and in perceptions towards planning bodies. While Marshall (2008) argues that achieving power sharing may be an overly idealistic goal when some groups naturally have more power over others. Such as the case where government agencies are involved, having de facto economic powers that derive from central governments with legislative control over resources and cognitive hegemony (dominance) from the power and ability to make decisions over others, believing their way is right. Alternatively, Chevalier (2001) suggested some participatory studies that encourage involvement from conflicting stakeholder groups may be seen as an exercise in tactical optimism instigated by big business to build public confidence in the legitimacy of its operations and business conduct for maintaining their licence to operate.

Petts (2000) also supports the view that decision makers can be guilty of crafting agendas. This study aims to challenge these views, in that the use of innovative participatory modelling strategies can create an environment of equal power in deliberations and co-learning. Leys and Vanclay (2010a,b) report on initial findings from this study based on semi-structured interviews and public meetings that identified perceived power differentials between groups through stakeholder analysis techniques. The plantation forestry industry was perceived by many participants to have greater powers through legislative advantage from federal taxation laws for Managed Investment Scheme (MIS) retail forestry that allow upfront deductions for full costs of plantation establishment.

This power differential was compounded by the perception that there was greater support for the plantation forestry industry compared to broad-acre agriculture from the NSW Department of Industry and Investment who have an explicit goal to support government
legislation; in particular promoting the expansion of plantation forestry under the ‘Plantations for Australia 2020 vision’. This remains a strategic partnership between the Commonwealth, State and Territory Governments and the plantation timber growing and processing industry, aimed at enhancing regional wealth creation and international competitiveness through a sustainable increase in Australia’s plantation resources, originally based on a notional target of trebling the area of commercial tree crops by year 2020 (Source: www.plantations2020.com.au).

To add a further dimension to this debate, intrinsic power differentials can be based on perceptions that are influenced by lack of knowledge, experiences and conflicting values (Schirmer et al. 2008). This strengthens the argument in this study for the use of co-learning strategies using evidence based data for developing an improved understanding of the issues creating conflict.

D’Aquino et al. (2002) tested innovative methods to remove unequal powers and support a participatory modelling exercise aimed at decentralising land-use management policy in the Senegal River Valley in Mauritania, Africa. They found that a software-based modelling platform was much more flexible, useful and less cumbersome than role-playing games using GIS mapping. Satake et al. (2007) found that learning and remembering past experiences were crucial in determining utility values of natural resources, in particular to prevent over-exploitation of natural resources and degradation of social welfare. These findings provide further support for the argument posited in this paper for the use of an initial stakeholder analysis (Chevalier 2001) to map power relationships and conflicting interests as a strategic entry point to the modelling process.
Use of visual simulation software for exploring shared community visions

Vanclay et al. (2006) used shared visioning as a major tool for power-sharing in planning community futures, supported by the computer software package _Simile_ (Vanclay 2003; [www.simulistics.com](http://www.simulistics.com)). This allowed system influences and relationships to be mapped and quantified in a way that was transparent and accessible to observers not involved in the programming. A case study conducted in Zimbabwe led to improved productivity and a fairer use of communal resources that empowered community members to earn more money and improve their livelihoods, with findings documented at Prabhu et al. (2003). The strength of research by Vanclay et al. (2006) has been the use of participatory modelling to build shared confidence and knowledge in participants for exploring innovative solutions to their natural resource problems who would not have had the capacity to do otherwise. Further, fostering group ownership over the model building was found to improve success. However limited self-evaluations of these studies highlighted the need for further developments in evaluation techniques that were more inclusive of participants or conducted by an independent researcher to make the research more robust and rigorous, and idea shared with Petts (2000) and addressed in this study.

Participatory modelling using software has been found to have limitations, as it is not always simple or easily accessible to all participants. In case studies conducted in communities in the USA-Canadian border region aimed at identifying improved and cost-effective watershed management solutions, Voinov and Gaddis (2008) found while it was necessary to have the support of complex computer models for the process to be scientifically robust, a proportion of participants found the models too complex and not _user-friendly_. They were nevertheless able to retain full participation until the end of the process, with participants finding value from increased collaboration and awareness of alternative solutions not previously considered.
The usefulness of models in natural resource management for predicting scenarios has been constrained by the lack of operational models specific to local conditions according to Gould (2003) and Lindsay (2003). Participatory modelling offers an alternative way to incorporate local knowledge into operational models, for example the development of predictive fire management tools that can help anticipate how fires will behave based on localised information at the landscape scale on land-use and fuel loads, weather and topography. This strategy has the opportunity to improve understanding of regional management alternatives, including prescribed burning and grazing management, and the allocation of fire fighting resources and response chains to best suppress wildfire and protect communities from bushfires, a proven risk to Australian forested communities.

This case study aimed to highlight the importance of developing an increased understanding of the dynamic systems involved with plantation forestry through an innovative socio-ecological approach to participatory modelling. It relied on participants defining issues, directing and contributing to research, and developing and implementing action plans that addressed natural resource management issues of controversy in the Upper Clarence catchment of north-eastern NSW. This paper concentrates on the crucial developmental stage of the study, in particular how the evaluation framework was established to support more widespread use as a tool of community engagement over complex natural resource problems. It contributes the second paper in a series of four that documents the complete participatory modelling/ social learning case study and lessons learnt (Leys and Vanclay 2010a,b,c).

**Developing and implementing the participatory modelling process**

**Selection of a case study area**

An initial scoping survey was conducted in the sub-tropical Upper Clarence catchment of north-eastern NSW Australia to gauge the diversity of views and level of conflict over
plantation forestry expansion in response to media reports generated by the local community expressing concerns. It was designed to elicit perceptions on socio-economic and environmental impacts of plantation forestry and determine whether these issues would be suitable for addressing through a participatory modelling case study. It also helped identify key stakeholders in the community to interview for developing further insights into issues of conflict. This initial survey was distributed via a council newsletter to 700 households in areas experiencing plantation expansion within the study community, and resulted in a 10% return rate.

While the survey response was limited, an analysis of the results indicated a significant difference in perceptions between the various interest groups towards impacts of plantations on water yields, fire threat, native vegetation and fauna, invasive weed prevalence, roads and bridges, farm employment, social cohesion and service provision, and demographic makeup. These diverse views supported the case for a participatory modelling study (Leys and Vanclay 2010b) and helped identify stakeholder groups for use in analysis throughout the study. Participants were specifically asked in the survey to identify with one main industry or interest group that they were most closely aligned to from a list including cattle and mixed farming, private and state forestry, environmental lobby, urban citizens, governing authorities, and the scientific and education sector.

**Public meetings**

Public meetings were held in the villages of Bonalbo and Woodenbong to initiate the participatory modelling process; those being the villages central to most of the plantation activity at the time and where the majority of the survey respondents originated. Public meetings were chosen as an appropriate method to maximise transparency and accountability for engaging the community through promoting fairness in equal opportunity to participate
and express views, and contribute to consensus on issues of concern for following up in subsequent meetings with a participatory advisory committee.

With the public meetings came several risks for the various stakeholder groups due to the open nature of the meetings. The first challenge was to achieve a commitment from local plantation companies to attend the meetings. They were concerned the meetings could result in negative media attention or exacerbate adversarial positions held by other stakeholder groups in the community. There was also the challenge to get other diverse groups interested, many of whom had significant levels of mistrust towards the local plantation companies. Considerable time was therefore spent prior to the meetings discussing the need for representation with members of the community to encourage participation.

To minimise risks to the plantation industry of inaccurate information being reported to the wider community, a media ban was placed on the meetings, meeting agendas were set collaboratively to reduce the potential for discomfort in meetings, and a professional independent facilitator was employed to maximise opportunities for various parties to contribute fairly to dialogue. Once these risks were addressed, the plantation companies were willing to participate, while also recognising the need for effective community engagement if they were to continue expanding and developing their industry within the community.

It was important to set participant expectations at initial public meetings. After identifying the major issues concerning participants, consensus was reached on which of these issues were within the power and influence of stakeholders to explore and implement change. Policy at the federal and state government was recognised as being beyond the scope of local stakeholders to have any significant influence upon in this study, however considered not beyond the scope of participatory modelling in other situations where policy was the focus. This limitation helped frame the study.
Participatory modelling techniques

Initial meetings were open to the public, and involved introducing the study and brainstorming for issues and voting in groups of six people. Issues were recorded onto coloured cards for further sorting and voting (Vanclay et al. 2006; Ploughman 2009). This strategy was used to select key issues and identify priority areas for the community to explore further with a participatory modelling exercise. A final voting weight was determined for each issue by giving every participant two votes, whereby their first preference received a voting weight of two and their second preference one vote. Votes were then added to get a final weighting to determine their relative importance where the issue with the highest score was considered the most urgent to address.

Participants were then given the opportunity to express their interest in collaborating on a Participatory Advisory Committee (PAC), together with the option of being paid a nominal sitting fee of $50 per session ($Aus) for evening meetings. These were planned to occur once a month over an eight month period from early March till the end of October 2009. A group of 12 stakeholders volunteered to be on the PAC that were representative of the diverse range of views towards plantation forestry expansion identified through the earlier survey and interviews with key informants. This group included forestry representatives, cattle and crop farmers, environmentalists, urban residents, educationalists, governing authority representatives and scientists. At the first group meeting an agenda was provided by the research investigators for consideration by participants and then adjusted through participant input. Objectives for the study were devised, as were a list of behavioural guidelines for the meetings and evaluation criteria based initially on theory and lessons learnt from previously documented studies in the literature.

The aim of setting behavioural guidelines was to ensure participants understood it was to be a collaborative working group rather than an adversarial space. Criteria for evaluation
were developed with the aim of producing meaningful and robust results. At subsequent meetings of the PAC, flipcharts, PowerPoint presentations and computer demonstrations with the visual modelling software _Simile_ were used to demonstrate concepts of modelling based on systems dynamics.

**Findings of evaluation**

**Results from open meetings**

A skilfully facilitated agenda kept order in the meetings with none of the heated confrontations that the plantation forestry industry representatives had originally feared. The employment of an independent professional facilitator who had no association to the process provided public accountability through fairness and impartiality. During the supper breaks several parties that had not previously communicated due to conflicting views spoke together, acknowledging their differences, while agreeing to move forward together on issues. Further, representatives of plantation companies acknowledged they were pleased with the outcomes of the meetings (Mike O‘Shea, Forest Enterprises Australia, pers. comm. 2009) due to improved communication and understanding of community concerns.

The 70 attendees at the Woodenbong public meeting and 23 at Bonalbo identified and ranked the first five issues regarding plantation forestry in the same order of importance, with fire planning and management voted as the most crucial issues to explore through subsequent participatory modelling (Table 5.1). The main difference between the two meetings was that the Woodenbong community rated the need for infrastructure development (particularly in roads and bridges) and development of valued-added timber products to be of greater importance than the Bonalbo community who gave a higher rating to concerns over environmental impacts of plantations, including the spread of invasive weeds and reduced water yields.
Table 5.1 Relative importance of community issues relating to plantation forestry expansion

<table>
<thead>
<tr>
<th>Issue</th>
<th>Voting weight (%) at each meeting venue</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Woodenbong</td>
</tr>
<tr>
<td>Fire planning and management</td>
<td>25</td>
</tr>
<tr>
<td>Socio-economic benefits for local communities</td>
<td>24</td>
</tr>
<tr>
<td>Community consultation and information sharing</td>
<td>18</td>
</tr>
<tr>
<td>Collaboration between agricultural producers and plantation industry</td>
<td>11</td>
</tr>
<tr>
<td>for improved property planning</td>
<td></td>
</tr>
<tr>
<td>Health impacts from aerial sprayed chemicals</td>
<td>11</td>
</tr>
<tr>
<td>Infrastructure development; roads and bridges</td>
<td>7</td>
</tr>
<tr>
<td>Development of value-added timber products</td>
<td>3</td>
</tr>
<tr>
<td>Environmental impacts; spread of invasive weeds, reduced water yields</td>
<td>1</td>
</tr>
<tr>
<td>and effects on biodiversity</td>
<td></td>
</tr>
</tbody>
</table>

Stakeholder analysis; community engagement and power relations

There was a significant difference in attendance at the two public meetings held, with 70 people attending Woodenbong and only 23 present at Bonalbo. This indicated a difference in community engagement with our study, particularly as both villages had populations of around 330 people (Source: ABS 2006 census). Several factors are believed to have contributed to this difference. Firstly, a stronger sense of community in Woodenbong was gauged previously in semi-structured interviews, ascertained by participants expressing strong ties to the community and active participation in local social and voluntary groups (Leys and Vanclay 2010a). Further, Woodenbong and district were found to have a strong Progress Association and were very interested in being involved with the study as they saw it as an opportunity to collaborate with the plantation industry in an attempt to improve community outcomes.
In contrast the Bonalbo community was found to have numerous opposing interest
groups, less cohesion and less interest in talking with the plantation industry when they were
invited to attend public meetings. A high proportion of local community media articles and
phone and mail correspondence with the plantation industry had originated from the Bonalbo
area regarding concerns on impacts of plantation operations according to local forestry
representatives. When one Bonalbo participant who had participated in interviews in the first
stage of the study was invited to attend one of the open meetings he responded that he would
not be coming because he doubted the honesty of local plantation industry representatives and
felt that;

“It wouldn’t matter what issues you raised you wouldn’t get an honest answer. And not
only that, the local community don't have the capacity to make informed decisions or even
know what the real issues are surrounding plantations‘.

This response highlighted the difficulty in developing trust between the various interest
groups, and getting community members engaged in science to collaboratively deliberate
conflicting issues.

Socio-economic differences between the two communities were also thought to
contribute to the lower attendance at Bonalbo, which had a very low average per-capita
income estimated at $290/ week compared to the Woodenbong district of $380/ week (Source:
Ms Suzie Coulston, Kyogle Council, Industry Development Officer, pers. comm. 2009).
Further, Bonalbo farms were found to be much smaller on average, have less productive soils,
and a higher indigenous, elderly and unemployed population that may not see benefits from
engaging in the process, nor have a similar sense of place (Cheng et al. 2003). Some
responsibility could also be attributed to the sampling methods used as there was limited
contact with the Bonalbo community other than with the survey respondents and limited media
to promote meetings. The under-representation of these marginal groups was of concern and identified as an area requiring further research.

**Natural resource issues to explore**

A group of 12 stakeholders from the surrounding community volunteered to form a Participatory Advisory Committee (PAC) that held regular meetings at Woodenbong. The aim for establishing this committee was to work through issues and report findings back to the local community. Fire management, socio-economic benefits to local communities, and impacts of aerially sprayed pesticides were the three major issues voted as important to the community in public meetings for exploring through a modelling exercise. The first two of these were addressed using the simulation modelling package _Simile_. Impacts of aerially sprayed chemical pesticides in plantations were investigated using data provided by participants, expert opinion and further scientific investigation, and collated using spreadsheets.

It should be noted that prior to the devastating Victorian bushfires of February 2009 that accounted for around 200 human deaths, massive stock and wildlife losses, destruction of homes, grazing lands, forests, infrastructure and entire communities (VBRC: Victorian Bushfires Royal Commission 2009), fire management was not the most important issue initially raised by the community. Rather it was further down the list and originally raised as a social issue in interviews through the need for more widespread and regular fuel reduction burning for the protection of human life and property. Once these bushfires occurred, fire management became an issue of higher priority for members of the PAC. This suggests that people are heavily influenced by current affairs and media reports, and that the importance of issues can shift quite rapidly in response to these types of critical events. This highlighted the need for iteration and reflection in the participatory modelling process to allow change in
direction when requested by participants, however raises the question of how much current affairs and media should be allowed to change research priorities.

**Participatory modelling behavioural guidelines**

The guidelines agreed upon by participants for behaviour during meetings are listed in Table 5.2 and illustrate the desire for the meetings to retain a friendly working environment and commitment to keep participating until completion of the study.

**Table 5.2 Behavioural guidelines for participatory advisory committee (PAC) meetings**

- Provide each participant with the opportunity to express their view;
- Be friendly, courteous and helpful to all participants;
- Be consistent in attending the scheduled meetings;
- Complete the assigned follow up activities prior to the next scheduled meeting to the best of your ability;
- If there is a problem, discuss it with the facilitation team as early as possible in an attempt to rectify the situation;
- Avoid media contact during the modelling process to prevent inaccurate reporting until study is completed; and
- Complete monitoring and assessment tasks throughout the process.

**Criteria decided upon by participants for evaluating the process**

The criteria participants decided upon for evaluating the effectiveness of the participatory modelling study are given in Table 5.3. There was initial division upon the criterion ‘competence of the panel to work towards agreed outcomes’, with three on the panel believing their experiences were not a measure of competence, rather that they had different life experiences and therefore complementary knowledge to contribute to the process. For this reason it was removed from the list. One committee member was unsure whether ‘improved collaboration and trust between diverse stakeholder groups with conflicting views’ would suggest success of the modelling process.
Finally, one panel member felt there should have been representatives from other forest industry groups and forest management agencies on the panel including Forests NSW (the State forest management agency) and the NSW National Parks and Wildlife Service. As a consequence, representatives were personally invited as guest speakers at subsequent meetings. This was deemed particularly important as each forestry group had individual fire management policies in place and their input was considered highly relevant to participants and how the model would develop.

**Table 5.3** *List of criteria for evaluating the participatory modelling process*

- Fairness through equal opportunity to express individual views, contribute to meeting agendas and rules of behaviour, monitoring process and outcomes of study;
- Cost-effective scenarios explored;
- Ecologically sustainable scenarios explored;
- Building community capacity through developing group working skills and encouraging socially responsible solutions (i.e. robust solutions);
- Develop a shared understanding of land-use systems over time through sharing local and expert knowledge (i.e. credible scientific knowledge);
- Remain engaged in the study till completion (i.e. not too difficult, interesting);
- Time efficient process;
- Improved collaboration and trust between diverse stakeholder groups;
- Feedback to public useful (i.e. socially legitimate strategies);
- Reduced land-use conflict; and
- Developed new culture for deliberating over natural resource issues.

**Participant model development**

**Fire management**

An initial model for fire management was developed using group brainstorming to generate ideas of systems components and causal loop diagrams, then formalised into a model
incorporating quantitative stock and flow data. There was an initial difference of opinion between committee members on the scale at which the model should focus, finally going with the farmer's choice of modelling on a per hectare basis, overriding the plantation forestry representative's view of wanting individual trees modelled. It was agreed by consensus that this would be an easier way to collect data as most land-use enterprises were reported on a per hectare basis.

The fire management issue began to lose momentum as meetings progressed and floods were prevalent in the region. The issue was also determined to be very complex, and due to time limitations at meetings no longer as important to participants as developing a socio-economic model that could see monetary benefits to the community. The order of priority for exploring issues therefore changed.

**Impacts of aerially sprayed pesticides on human health**

Early discussions on pesticides at group meetings were constrained as several of the committee members relied on pesticides in their day to day farming and forestry operations and were nervous investigating the issue. This created a challenge for the committee on how to proceed, given there were also a couple of environmentalists that felt strongly against pesticide use. Eventually a group consensus was reached for participants to bring along detailed data on their own individual pesticide programs that could be modelled for the various land use enterprises to compare with plantation forestry. As the meetings progressed participants became much more comfortable in discussing and learning about pesticides. The PAC requested the principal researcher check pesticide programs with local NSW Industry and Investment agronomists, and collect further scientific data and expert opinion to gain a greater understanding of potential environmental and health impacts from the various classes of chemicals.
Data on chemicals used, application rates and frequencies were used to develop a pesticide footprint model that illustrated average chemical loads by active ingredient for all the major land-use enterprises, including detailed management data provided by plantation forestry companies. Expert opinion was sought on pesticide eco-toxicology load limits of certain chemicals that could be applied by chemical users for assessing potential pollution risks to local water bodies (Kookana et al. 2005). The group developed a stronger appreciation of the importance for using best practices in pesticide application to minimise risks to the environment, chemical users and neighbours.

**Socio-economic benefits to the local community**

In developing a socio-economic model, participants decided to explore the benefits for locating a plantation timber processing mill at different sites within the region. Whilst it was acknowledged early on that a mill would be unlikely at Woodenbong itself as it was not on a rail line, it was feasible and likely that a mill would be located in the region within the next few years at one of the larger town centres of Casino or Grafton. It was decided to model biophysical parameters including climatic and soil data, productivity data on different local land-use enterprises, value-adding opportunities including bio-fuel production and reconstituted board, transport and infrastructure needs, labour needs and spending within the community to determine the comparative viability of the plantation forestry industry to other land-uses using ‘Simile‘ software.

Participants collected productivity and economic data from their enterprises between meetings to add to the model. As meetings progressed over the months, several of the participants felt comfortable enough with the research investigators to provide further personal details on a one-to-one basis during supper breaks that were relevant to the study, however not brought up in the brainstorming group sessions. This information indicated an increasing
awareness that the plantation forestry industry was not the cause of agricultural decline, rather 
agricultural terms of trade and profit margins had been gradually declining over a long period 
of time. Notable quotes from two local middle-aged farmers on the committee regarding 
changes in employment and family farming over the years of agricultural decline follow:

‗ My husband and I have four properties around Woodenbong. Once they used to support 
seven families. Now only my husband and I work on them, and I also have to go out and 
teach to supplement our income. We still have difficulty making ends meet‘.

‗I would have liked my son to come back and work on the farm permanently. Things are 
tight though. The prices we now get for cattle have not kept up with the costs of production 
and the trouble is his friends have all moved away to go to university except maybe one, 
and are earning $80,000 to $90,000 a year just out in nine to five jobs. Farm workers are 
lucky to get paid around $30,000 a year and are expected to work long hours and most 
days. My son can see the long term prospect on the farm was not good and is looking 
elsewhere for a job, and you can‘t blame him. That is why my wife and I are thinking of 
selling or leasing part of our farm out to the plantations‘.

During the process of meetings these issues were raised and discussed by the 
committee. It was agreed that the farming industry was unable to pay higher salaries to attract 
young workers back into the community due to declining profit margins. This raised a further 
question as to the open trade policy and lack of market protection for Australian farmers.

The speed at which certain issues were discussed and others dismissed provided 
evidence to the plantation industry that rather than being guarded on contentious issues in the 
community, open and frank discussion between stakeholders alleviated or resolved concerns 
and fears rather quickly.
Challenges and lessons learnt from the participatory modelling process

Ecological complexity of issues and what is important?

While exploring the issue of fire management the committee realised the extreme complexity of the factors such as weather, soil, topographic and vegetation variance with fire and grazing history, and how these contributed to fuel loads and fire threats to the local community. To manage this complexity, a simple model using ‘Simile‘ was initially designed and detail progressively added as information was shared.

Participant inclusiveness

Most participatory groups are characterised by different personality types that contribute to discussion in various ways. As anticipated, participants with extrovert personalities tried to dominate discussions, and therefore it was necessary for the research facilitator to intervene to provide opportunity for others to speak and also prompt the introverts with questions. Brainstorming in groups, where each participant was given a turn to put ideas onto paper, was an effective strategy used at meetings for eliciting information from the introverts. Group work was always followed by whole committee discussion and collation of ideas to advance the models.

Implications to modelling process from different participant skill levels

There was a degree of variance in background education levels and computer skills among committee members. This did not prove to be a problem in that everyone was provided with equal opportunity to contribute at their own level, while advancing individual knowledge and skills through the co-learning process. However, most participants did not want to learn how to use the ‘Simile‘ program itself, rather they chose to build a general understanding of the
model concepts and simulations as data was entered by the modelling researcher from a laptop projected on a screen at the front of the meeting room.

**Perceived threats to industry from open communication**

During the process of the study, some representatives from plantation forestry companies expressed concerns that the study might generate unfavourable media and inflate community concerns, potentially impacting adversely upon their businesses. Attempts were made to address these concerns by asking participants to avoid media comment until findings had been tested and agreed by all participants. Further, the study was conducted in an independent and objective manner to eliminate bias towards any particular industry, and this position was explained to plantation forestry companies. The principal researcher had no past or current affiliations with the plantation forestry industry, and social research methods using evidence based science, local knowledge and expert opinion helped keep an objective focus. Considerable contact was made to reassure industry that the committee had agreed to a non-adversarial stance, advancing on from previous land-use conflicts through addressing issues in a positive and collaborative manner with the community.

While concerted efforts were made to minimise any discomforts to the plantation industry, there continued to be a lack of understanding of the participatory modelling process by some plantation company representatives located outside the region. Fundamental to participatory modelling theory is the open discussion on community issues creating conflict. In this case, the representatives feared discussion on some of the topics, in particular community concerns relating to the controversial topics of Managed Investment Scheme (MIS) taxation legislation and impacts of pesticides use on communities. This was found to stem from strong beliefs and fears held by some within the plantation sector about how their industry is perceived and concern about the potential consequences of using an open knowledge
development process at local level. In attempt to avoid a situation of civic elitism and prevent bias in the process (Parkins and Sinclair 2009), these issues continued to be investigated in a transparent and accountable manner with the PAC.

Critical insight was gained from this study into the characteristics of stakeholder groups for use of participatory modelling in developed countries in that it challenged traditional mindsets for planning and engagement with people working in natural resource management. The process was found to transcend the boundaries of how dialogue was exchanged between actors in corporate businesses, research and community. It highlighted resistance to open engagement by a small sector of the plantation forestry industry, as several attempts throughout the study were made to influence the process. The successes described to date provide evidence that the process has been beneficial to the plantation industry and wider community, and therefore the fears expressed by some of the plantation industry about engaging in this open dialogue process were able to be successfully managed.

An important lesson for future participatory modelling studies was the need to address stakeholder fears and expectations early in participatory processes to help participants understand these exercises are a genuine effort to develop shared knowledge and assist diverse stakeholders to move forward in a productive and timely manner. It is important to engage with stakeholders who feel they are being unfairly criticised to encourage their participation, as this can overcome their fear of participation and enable them to hear and respond to concerns raised by other stakeholders in the safe communication space provided by the participatory modelling process. It is anticipated that the merits from evaluating this process will aid future understanding. As a consequence, further studies in preliminary evaluation of actor willingness and power differentials through the further development of stakeholder analysis techniques are recommended. Readers are directed to work by Varvasovszky and Brugha (2000) and Chevalier (2001) on stakeholder analysis.
Additional community benefits from the participatory modelling process

Early successes attributed to the participatory modelling study included supporting the plantation forestry industry to foster improved community relationships. Community members reported that local private plantation forestry companies had provided financial assistance to their rural fire services to purchase fire fighting equipment and sponsored local shows and community events in response to feedback in public meetings.

A joint Timber Council has also been formed between local council, the plantation forestry industry, local business and NSW Industry and Investment to work together on regional planning in response to findings made public from initial semi-structured interviews. Additionally a regional consultative group formed between several representatives from forestry and local governing bodies for developing a set of regulations for managing areas of retained vegetation within plantations, addressing the perceived shortfall in legislation. This includes areas of native forest and buffer zones which participants believed there were not adequate guidelines under existing regulatory mechanisms, being the NSW Plantations and Reafforestation Act and associated Code of Practice. Under direction of the NSW Department of Industry and Investment at Wollongbar a collaborative committee has addressed this concern by producing a set of working recommendations under ‘Best management practices for retained areas in forestry plantations‘ (Baker et al. 2009). Some good neighbour agreements have been initiated, although not legislated in NSW, pertaining to shared cattle rights (agistment: Figure 5.1).

The participatory modelling meetings therefore provided communication spaces that enabled some concerns and fears to be rapidly and effectively alleviated, a view shared in group model building research Rouwette et al. (2002). Preliminary feedback from PAC members and phone calls to researchers from within the community have provided evidence
that information gathered and learnt at the group meetings was being disseminated informally through the community by the participants to interested stakeholders and citizens.

![Multi-functional plantation with cattle grazing in sub-tropical NE-NSW](image)

**Figure 5.1** *Multi-functional plantation with cattle grazing in sub-tropical NE-NSW*

**Conclusions**

The development of a participatory modelling framework in a rural community with conflict over land-use change from cattle grazing to plantation forestry proved a successful positive and innovative tool for community engagement compared to alternative traditional top-down methods for deliberating over community-based natural resource management issues. A broad range of participants were engaged and helped direct the process from the early stages of determining issues for further investigation, developing guidelines and criteria for evaluation, through to providing and gathering data to help build models. This was found to increase the confidence of participants to enter collaborative discussions and help build community capacity due to a sense of ownership over the process and improvement in their knowledge and understanding of complex issues.
Group learning strategies in PAC meetings encouraged power sharing and collaborative problem solving. The use of spreadsheets and causal loop diagrams of social-ecological system components to explore dynamics and future management scenarios were also effective techniques. Preliminary conclusions suggest the use of the visual modelling software ‘Simile’ may be limited to use by the expert modeller as participants in this study did not want to learn how to use the program themselves. A need was also identified to broaden initial stakeholder analyses beyond the local community being studied to encompass external stakeholder groups that may be at risk in the process or need to be involved in the study. This could be achieved through extending the mapping process that identifies power differentials, relationships and political interests of all potentially affected parties.

Early conclusions from evaluation at this midpoint of the study suggest setting up a Participatory Advisory Committee is a very effective mechanism for deliberating over community concerns relating to plantation forestry and for generating feedback information to local residents and stakeholders. The use of open meetings to identify and rate the importance of issues shown in Table 5.1 made the process transparent and relevant to the community. The behavioural guidelines developed for PAC meetings reported in Table 5.2 proved helpful for maintaining a friendly and supportive learning environment for all participants. Regular monitoring of PAC meetings highlighted the importance to participants of specific evaluation criterion (Table 5.3); particularly the development of a shared understanding of land-use systems over time through sharing local and creditable scientific knowledge, fairness through equal opportunity to contribute to the study, and exploring socio-economic and ecologically sustainable solutions.
Acknowledgements

We thank the CRC Forestry based in Hobart, Tasmania for funding this research project under the Communities Project 4.3.4- Participatory modelling. Sincere thanks are extended to Ken MacLeod for professionally facilitating public meetings, and to all participants in the study. We would like to thank the anonymous referees who provided valuable feedback that contributed to this manuscript.
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Declaration by candidate
I declare the nature and extent of my contribution to this chapter of work to be:

<table>
<thead>
<tr>
<th>Nature of contribution</th>
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<tr>
<td>Title, key ideas and questions, literature review, framing, writing</td>
<td>95</td>
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<td>Data analysis</td>
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The following co-author contributed to the publication:

<table>
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<th>Name</th>
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<td>Jerome Vanclay</td>
<td>Principal supervisory role of editing and data presentation. Journal recommendation</td>
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Candidate's signature [Signature] Date 2.8.10

Declaration by co-author
The undersigned hereby certify that:

- The above declaration correctly reflects the nature and extent of the candidate’s contribution to this work, and the nature of the contribution of the co-author;
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Stakeholder engagement in social learning to resolve controversies over land-use change to plantation forestry

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Abstract

Rapid land-use change arising from incentives for afforestation has created tensions in rural communities previously dominated by agricultural enterprises. This paper reports on an innovative experiment with social learning that incorporated participatory modelling to resolve community concerns in a case study of plantation forestry in the Upper Clarence catchment of north-eastern NSW Australia. The development of a diagnostic framework helped identify socioeconomic and environmental issues within the community for investigation by a self-selected participatory advisory committee (PAC) representing a diversity of views. Implementation of a social learning exercise offered empathetic and intellectual engagement among PAC members that maintained interest, built confidence, and improved problem-solving capacity while fostering group ownership over decision making. A shared understanding of dynamic landscape problems helped empower participants to collaboratively develop solutions for improved management and operational practices, and cooperate to explore further options for plantation industry development under existing policy guidelines which are presented in this paper. As a result of frank discussions between diverse stakeholders in a mutually respectful learning environment that combined local, scientific and expert knowledge, concerns dissipated and participants developed a more favourable view of plantation forestry activity.
Keywords

Evaluation • participatory modelling • diagnostic framework • adaptive co-management • socio-ecological system dynamics • pesticide eco-toxicology

Introduction

Significant tracts of Australian landscape have undergone rapid land-use change to plantation hardwood forests previously dominated by agricultural livestock and crop production activities (Schirmer et al. 2005, William et al. 2008). Social studies have highlighted a diversity of views within rural communities towards the expanding plantation forestry industry, where controversies over socioeconomic and environmental impacts have been documented by Leys (2008), Lockie (2003) and Williams (2008), though difficult to resolve using traditional top down measures. Brown (2002) highlighted the inherent problems of one the major intergovernmental policy reforms in Australia through Regional Forest Agreements (RFA) implemented between the years 1995 and 2000 to help overcome community controversies, largely failing due to insufficient engagement with local stakeholders. Research from other developing and developed countries has also shown that the lack of effective mechanisms to resolve social conflicts and ineffective governance have been major constraints to successful plantation forestry development (Nawir and Santoso 2005, Niemela et al. 2005).

In natural resource management, stakeholders are social actors or institutions that have a significant interest in a given set of natural resources, acting at various spatial scales (e.g. local, national, international, private or public), that can affect or be effected by interventions or operational decisions. This paper critiques the role of stakeholder participation for addressing issues of controversy over plantation forestry with a case community through an innovative bottom-up approach to community engagement that involved the application of social learning theory to investigate and help resolve issues causing conflict. Social learning is
defined in this study as a group process whereby knowledge is shared and created between stakeholders with diverse experiences and views on natural resource management that are embedded into the learning process, aimed at strengthening the communities capacity to collaboratively manage ecosystems sustainably for human well-being. Social learning can therefore assist in governance of natural resources, a construct shared in research by Connick and Innes (2003), Pahl-Wostl et al. (2007) and Schusler et al. (2003) based on collaborative management and partnership arrangements (Lockwood 2010).

Various tools have been reported in literature for use in social learning processes, and in this study participatory modelling based on system dynamics was evaluated by participants for its effectiveness in exploring issues of controversy over plantation forestry and developing shared understanding. According to Sterman (2000), system dynamics is an interdisciplinary method drawing on cognitive and social psychology to enhance learning and understanding of the behaviour of complex non-linear systems, in particular identifying and helping overcome defensive routines and resistance thought to have merit for use in this study with the plantation forestry industry. Participatory modelling on the other hand refers to an analytical model building process using simulation software to incorporate participant knowledge and initiate collective problem solving (Gaddis et al. 2009, Standa-Gunda et al. 2003), useful for collating systems data and running alternative management scenarios. Participatory modelling was used in this study based on findings in literature that simulation can assist in cognitive mapping (referred to as representations of mental models by Giupponi et al. 2006) and improve a group’s information-processing capacity (Rouwette et al. 2002, Vennix 1999).

The importance in developing a diagnostic framework to operationalise social learning in natural resource management is an emerging discourse to add research rigour to such processes (Gaddis et al. 2009, Leys et al. 2010, Lockwood 2010, Lopez-Ridaura et al. 2002, Steyaert and Jiggins 2007), inclusive of trust building early in the process (Armitage et al.
2009, Hahn et al. 2006, Voinov and Gaddis 2008) and participant evaluation (Chess and Purcell 1999, Conley and Moote 2003, McGurk et al. 2006). The purpose of this paper is to provide evidence for the usefulness of social learning in resolving landscape problems through the development, operation, and evaluation of a diagnostic framework by a participatory advisory committee (PAC) investigating sustainable plantation forestry development. Firstly, the reader is provided with a background to plantation forestry expansion in Australia to develop an understanding of underlying causes for community controversy, followed by a discussion on the theoretical concepts that were operationalised in the case study to help resolve issues of concern supported by findings from social learning investigations.

**Policy scene for afforestation in Australia**

The Australian plantation timber industry had been expanding on average 80,000 hectares per year up until the global financial crisis in 2009 (APTI 2006) driven by Australian government policy to support major expansion in the timber resource by 2020 (MCFFA 1997). Fiscal incentives in support of this policy have been provided through national taxation legislation under Division 394 of the Income Tax Assessment Act 1997 for Managed Investment Scheme (MIS) retail forestry projects (PJCCFS 2009). This incentive was intended to address a gradual decline in public and industrial plantation investment and native forest timber supplies as domestic and export demand for sustainably grown wood and paper products increased (Plantations for Australia 2008).

MIS encompasses a variety of structures based on collective investment in a common enterprise, and forestry MIS refers to plantation forestry projects which may be ready to harvest in 8 to 25 years (PJCCFS: Parliamentary Joint Committee on Corporations and Financial Services 2009). Under current taxation rulings, investors are entitled to full year-of-expenditure business deductions and a 12-month pre-payment rule dependent on a minimum of 70% direct forestry expenditure in planting, tending and harvesting the trees, transport to
mill, and annual costs of the land over the life of the project (Cummine 2008). However, it excludes costs such as management fees, administration and marketing the scheme (PJCCFS: Parliamentary Joint Committee on Corporations and Financial Services 2009).

An inquiry of MIS schemes in Australia in late 2009 by the Parliamentary Joint Committee on Corporations and Financial Services (PJCCFS 2009) recognised that while there was vigorous debate over whether the continued expansion of Australia’s plantation output by 2020 had a sound economic basis, they recommended that an inherent current disincentive to invest in forestry warranted the retention of existing legislative arrangements. The committee noted that the failures of two of Australia’s largest companies based on MIS retail forestry (Timbercorp and Great Southern Limited) in 2009 should focus future investor’s attention on MIS profitability and as such negate the worst effects of what they describe as indiscriminate capital investment.

Dargusch (2008) reported on perceptions of corporate governance by senior managers for firms operating with forestry MIS in eastern Australia, where MIS structures accounted for approximately 34% of total plantations in Australia (PJCCFS: Parliamentary Joint Committee on Corporations and Financial Services 2009). While Dargusch’s research methodology was limited to interviewing only nine male managers from three firms, it did capture an increasing awareness by senior managers that sustainable corporate governance of forestry MIS relied not only on business profitability, however also on positive environmental and social outcomes. This included through improved operational organisation that encompassed conservation and eco-efficient behaviour, and support for people.

All Australian states and territories have codes of practice to regulate plantation forestry compliance, with approximately 63% of plantations certified under the Australian Forestry Standard (AFS) and Forest Stewardship Council (FSC) (Plantations for Australia 2008, CPQCPP 2009). Certification aims at ensuring best practice in forestry, regional
planning, land-use and sustainable natural resource management under national Department of Agriculture, Fisheries and Forestry governance (DAFF; APTI 2006) and assists plantation companies use MIS as a vehicle for resource expansion (Mike O’Shea, Forest Enterprises Australia 2008, pers. comm.). This policy structure has provided incentives for plantation expansion that have not been welcomed by most other competing land users, creating situations of conflict and animosity in communities, particularly regarding perceptions of negative environmental and socioeconomic impacts (Leys 2008, Schirmer et al. 2005, Schirmer 2008a, b, Williams 2008, Williams et al. 2003, 2008). Billen et al. (2009) suggests external drivers such as expanding international markets were forcing rural communities to evolve as evidenced by changing rural land bases.

**Need for improved community engagement by the plantation forestry industry**

The release of a progress report on the Plantations for Australia 2020 vision in 2008 highlighted a broader lack of engagement between commercial forestry companies and communities for addressing environmental and socioeconomic issues (Plantations 2020 vision review 2008). To date, community engagement in Australia has been restricted to the operational level by forest managers, however with limited success reported due to a lack of trust and transparency within communities towards private plantation companies and limited capacity within the industry (Dare et al. 2010a, b).

This paper supports the need for new policy discourse, arguing that community engagement should involve a process of social learning to share knowledge and collaboratively explore for new knowledge, skills and behaviours that can help communities adapt and adjust to change. Rolfe (2006) distinguishes adaptation as a function of recovery factors to bounce back from crisis situations or change, as opposed to adjustment which involves the influence of protective factors to maintain functioning. Research by Keen et al. (2005), Mostert et al. (2007), Muro and Jeffrey (2008) and Steyaert and Jiggins (2007)
provided evidence for processes of social learning in natural resource management that co-created new knowledge and a shared understanding of complex and uncertain problems, leading to better social outcomes than otherwise possible.

**Social learning as a bottom-up approach to community engagement**

Social learning has been reported to play a positive role in the transformation of value systems to help communities adapt to external triggers such as policy and climate change (Satake *et al.* 2007, Steyaert and Jiggins 2007, Walker *et al.* 2006). A major challenge is to build skills to facilitate social learning situated at the landscape scale that incorporates local actor knowledge, understanding and experience with scientific knowledge that can allow systems to self-organise (Folke *et al.* 2005). Social learning has been posited as an emerging field for positively altering people's perceptions of ecosystems to change behavioural practice (Lockwood 2010, Walker *et al.* 2006).

Social interactions are dynamic (Steyaert and Jiggins 2007), and social learning processes can stimulate a growing awareness of the need for concerted action over the complex problems (Frost *et al.* 2006). This study introduced new concepts in social learning, focusing on intellectual and empathetic engagement of stakeholders in order to maintain interest, build capacity and incorporate existing and new knowledge to enable improved landscape governance. Intellectual engagement refers to the preference of an individual to participate in cognitively demanding activities such as reading, problem solving and abstract thinking (Dellenbach and Zimprich 2008) alternatively referred to as mental modelling (Giupponi *et al.* 2006). While empathetic engagement refers to the transfer of affect through knowing and feeling another person's emotions or cognitive thoughts, and responding compassionately (Gruen 2009).

There have been limited reports on strengths and weaknesses of social learning processes for achieving robust understanding that could support wider applications (McGurk
et al. 2006). McGurk et al. (2006) reported on weaknesses limiting success of social learning activities in forest management that included lack of accountability, deficient coordination, ambiguous decision-making processes, and inadequate opportunities for Aboriginal involvement, poor attendance, and lack of broader community involvement. Strengths reported were information sharing and improved communication, relationship building, influence of operational and site-specific decisions, and conflict management. Participatory processes were found to reduce historical conflict between actors, providing a neutral atmosphere for discussions over water pollution issues in the USA which had previously been divisive (Gaddis et al. 2009). This paper contributes to the literature through reporting on strengths and weaknesses of social learning on plantation forestry dynamics through a participant-based evaluation.

**Participatory modelling as a tool in social learning**

Participatory modelling (PM) has been posited as a collective of innovative tools that incorporates local stakeholders, the public and decision makers into an analytical modelling process to support decisions involving complex natural resource management problems (Giupponi et al. 2006, 2008, Voinov and Gaddis 2008) and in this study is embedded into the social learning process (Pahl-Wostl et al. 2007). It uses an action research methodology (Dick 1990) to allow iterative and reflexive responses when exploring innovative solutions for dynamic socio-ecological problems (Prabhu et al. 2003, Vanclay et al. 2006). The level of intervention however, is uncertain and dynamic according to Steyaert and Jiggins (2007), being dependent on understanding local contexts of changing values and stakes interacting with local history and culture, therefore requiring methodological flexibility while maintaining rigour.

Some of the risk can be managed through the development of context-specific diagnostic frameworks (DF) to help tailor the learning process to local community needs.
(Gaddis et al. 2009, Steyaert and Jiggins 2007). There have been few applications of PM processes reported in literature, and there remains a need for more robust evaluations to understand the merits of such processes. Visual simulation software programs that have been applied to support decision making in PM include Simile (Vanclay et al. 2006) and mDSS (Giupponi et al. 2006) to record systems and causal linkages (feedback loops) and data input on stock and flows to run alternative management scenarios. Significant research contributions in this growing field are reported by d’Aquino and Le Page (2002), Prabhu et al. (2003), Standa-Gunda et al. (2003), Giupponi et al. (2006, 2008), Vanclay et al. (2006), Voinov and Gaddis (2008) and Gaddis et al. (2009). This paper contributes further to the literature through an evaluation of the effectiveness of PM situated in a broader process of social learning.

**Methodology**

**The diagnostic framework**

The diagnostic framework developed incorporated both qualitative and quantitative social research methods (Figure 6.1) to investigate plantation forestry dynamics in a case study of the Upper Clarence catchment of north-eastern NSW, Australia. It highlights the steps involved in the scoping of a case study region, and engaging and mobilising stakeholders into the social learning process.
Figure 6.1 Diagnostic framework used to implement social learning study of plantation forestry

Plantation forestry estate in the Upper Clarence catchment

The Upper Clarence catchment covers 690,500 hectares (Figure 6.2), and has a sub-tropical climate and annual average rainfall of 1,100 mm/year. In March 2009, 4.0% of this land area (27,400ha) was under hardwood plantation forest and 0.6% (4,230ha) under softwood...
planted (M-C Pelletier, Hurford Hardwoods, pers. comm. 2009). The softwood plantation estate was 100% public State Forest NSW tenure, compared to the hardwood plantation estate with majority ownership and operation by private investment companies. These private investment companies were either wholly or partially dependent on MIS retail forestry investments for generating capital (R. Stanford, Forest Enterprises Australia, pers. comm. 2009).

Figure 6.2 Location map of the sub-tropical Upper Clarence catchment in north-eastern NSW, Australia (Map produced by Greg Luker, GIS Lab SCU, 1/12/2009)

Gauging importance of landscape scale plantation forestry controversies

Public meetings were held in the case study region to identify issues of controversy within the community over expansion of the plantation hardwood industry and gauge the relative importance of issues using a democratic voting card system for follow-up with an
experimental social learning study. An independent professional facilitator was employed to convene and mediate these public meetings to eliminate potential for bias and ensure there was equal opportunity for all participants to express their views. The major issues identified were the need for socio-economic benefits to local communities, community consultation and information sharing, improved collaboration between agricultural producers and the plantation industry to allow better property planning, better fire management planning and health impacts from aerially sprayed pesticides (Further information on the process can be found at Leys and Vanclay 2010).

During the public meetings, an expression of interest was made to form a participatory advisory committee (PAC). Twelve (12) people volunteered and represented a wide range of views in the community towards plantation forestry. They agreed to meet once a month on average, a process which continued for a period of 8 months during 2009. PAC members worked collaboratively to determine which issues were best addressed through a participatory modelling exercise and in which order. Fire management was addressed first, with participants contributing data and helping collect further data. Expert speakers were invited to fill knowledge gaps on fire planning; however, floods during the study period (media release: ABC 2009) reversed the order of preference for modelling. Pesticide issues were then explored and followed by socioeconomic impacts, with the results from the social learning exercise and the shared knowledge that was developed presented within this paper. Changes in attitudes and power and influence were monitored throughout the study using observational documentation and participant surveys.
Results

Fire management in plantation forestry

Several participants were concerned that plantation forests posed a significant fire threat to local villages and biodiversity conservation, particularly as plantations had been established on village boundaries after being authorised at the state government level in NSW with no local government input, an area of policy that participants felt needed changing. Expert speakers contributed knowledge to the PAC on fire management from the various forestry jurisdictions (state, national and private), and it was decided that collaborative fire management plans were needed to address landscape level fire threats. A group was formed between the rural fire service and local plantation forestry companies and other forest tenures outside of the PAC to develop improved property maps with fire trails and watering points as well as fire response plans that went beyond the limitations of this study. However, this initiative alleviated fears of PAC members that the issue was being effectively addressed.

The PAC discussed the positive role of fire, as well as fire threats, in the landscape. According to Lindenmayer and Hobbs (2004) and Lindenmayer et al. (2006), fire management for biodiversity conservation at the landscape-level requires use of variable prescribed fires to emulate natural disturbances, typical of Eucalypt forests in Australia to create a range of conditions or heterogeneity. They suggest that while fire may create unsuitable habitats in one area for a given species, there should be other areas the species can survive. In particular, patches of retained and riparian vegetation in plantation forests should be protected together with watering points and open grazing areas that could potentially increase the diversity and populations of fauna species (Lindenmayer and Hobbs 2004).
Socio-economic impacts of plantation forestry

Investigations into socioeconomic impacts of an expanding plantation forestry industry took many avenues to establish an evidence-based understanding of the dynamics involved. Initially, the simulation modelling software _Simile_2 was used as a tool to conceptually map systems and relationships, and then quantitative data was added by the research modeller and alternative management scenarios explored. Participants did not fully engage with the simulation software due to a lack of technical skills, nor did they choose to learn the program when the opportunity was provided. Instead flip charts, excel spreadsheets and PowerPoint slides proved more effective for graphically presenting data due to participant program familiarity.

Changes to demographics

Demographical changes were initially examined that showed results contrary to earlier perceptions among the wider community that rural populations were declining in response to plantation forestry expansion (Leys 2008). Instead populations of all the local towns and villages except one increased since the last census period, increasing from 2,894 in year 2001 to 3,412 in year 2006 in the Upper Clarence catchment (an increase of 18%; ABS Census 2006). In regard to occupancy of residences on properties bought by plantation companies and Forests NSW, findings again were contrary to the widely held perception that plantation dwellings were being left vacant. Data examined for all properties purchased by private plantation forestry companies and Forests NSW showed positive impacts on residential occupancy, with a significant increase in permanent residents and school-aged children (Data provided by R. Stanford, PAC member, FEA representative, 2009).

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2 Simile is a visual modelling environment supported by computer software. Refer to
Table 6.1 illustrates the changes in occupancy for all dwellings on properties after purchase for plantation establishment. Although there was an overall decrease in owner-occupied residences from 66% to 43%, there was an overall increase in full-time occupancy (owner-occupied and full time renters) from 74% to 82%. Of the original 8% of full-time rented residences, 5% had been occupied by farm managers and workers. After purchase, a decreased utilization was reported for this category of tenants. Properties with residences that previously had absentee owners (labelled as occupied part time in Table 6.1; used as weekenders) had been either subdivided and purchased by new owner occupiers or were now rented out full time; further evidence of an increase in overall occupancy of plantation residences.

**Table 6.1 Change to types of occupancy for all residences on plantation properties within the Upper Clarence catchment after purchase by private plantation companies and Forests NSW (Compiled by A. Leys and J. Vanclay from data provided by Rod Stanford of FEA, PAC member, June 2009)**

<table>
<thead>
<tr>
<th></th>
<th>AFTER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Owner occupied</td>
</tr>
<tr>
<td>BEFORE</td>
<td></td>
</tr>
<tr>
<td>Owner occupied</td>
<td>40</td>
</tr>
<tr>
<td>Rented occupied</td>
<td></td>
</tr>
<tr>
<td>full-time</td>
<td></td>
</tr>
<tr>
<td>Occupied part-time</td>
<td>3</td>
</tr>
<tr>
<td>Vacant</td>
<td>8</td>
</tr>
<tr>
<td>Derelict or removed</td>
<td></td>
</tr>
<tr>
<td>TOTALS %</td>
<td>43</td>
</tr>
</tbody>
</table>
Financial viability of major land-use enterprises in the catchment

To ascertain the viability and profitability of plantation forestry, the PAC found it justifiable to make comparisons to other land-uses within the catchment. Profitability of beef cattle and the two major crops maize and soybeans were found to be marginal, with fluctuations in grain prices sometimes resulting in negative returns. For farmers, leasing part of their less productive agricultural land to plantation companies was found to be highly attractive due to the reliability of guaranteed annual lease payments ranging from $200 to $230/ha compared to gross margins of other enterprises (Table 6.2). One disincentive mentioned by a couple of participants was the long contractual tenure of leases ranging from 15 to 20 years.

However, while local plantation companies sought fertile soils for leasing or purchasing, many cropping areas on river flats were not suitable for timber production due to the high incidence of frost. The majority of PAC members believed it was important to preserve a balance between agriculture and forestry within the catchment. Participants favouring a leasing arrangement on the less agriculturally productive parts of properties which could provide an additional source of income to farmers and help maintain local populations and social networks. It was found through modelling that whole farm profitability could be increased substantially when partial forestry leases were combined with traditional beef cattle grazing and cropping. Further, income could be gained from reintroducing beef cattle grazing once plantations were established at around 18 months from planting. For a property scenario of 522 hectares, it was shown that by leasing 200 hectares of this to a plantation company and the balance remaining under unimproved breeder weaner production (90 breeders) that whole farm profits could be increased by 40% net, approximately $8,500 (Aus$) per annum.
<table>
<thead>
<tr>
<th>Enterprise</th>
<th>Average grain yield (t/ha)</th>
<th>DSE livestock rating (DSE)</th>
<th>Livestock carrying capacity (DSE/ha)</th>
<th>Average grain price ($/t)</th>
<th>Average cattle price (c/kg live)</th>
<th>Gross margin ($/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardwood plantation forestry lease annuity</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>200-230*a</td>
</tr>
<tr>
<td>Beef weaners (native pasture)</td>
<td>n/a</td>
<td>10.14*b</td>
<td>4.0*b</td>
<td>n/a</td>
<td>158*b</td>
<td>60*b</td>
</tr>
<tr>
<td>Beef weaners (improved pasture)</td>
<td>n/a</td>
<td>13.82*b</td>
<td>8.0*b</td>
<td>n/a</td>
<td>232*b</td>
<td>134*b</td>
</tr>
<tr>
<td>Maize (minimum-till)</td>
<td>6.5*c</td>
<td>n/a</td>
<td>n/a</td>
<td>290*c,d</td>
<td>n/a</td>
<td>417*c,d</td>
</tr>
<tr>
<td>Soybean (minimum-till)</td>
<td>2.6*c</td>
<td>n/a</td>
<td>n/a</td>
<td>500*c,d</td>
<td>n/a</td>
<td>384*c,d</td>
</tr>
</tbody>
</table>

a. Mr R. Stanford PAC member, local forester, grazier and casual employee of Forest Enterprises Australia (FEA); November 2009 market price range for leasing property by FEA in Upper Clarence

b. Department of Industry and Investment NSW; livestock data sheets for North Coast NSW

c. Mr B. Clarke, Casino District Agronomist, Department of Industry and Investment NSW; average crop yields and grain prices for Upper Clarence

d. Mr M. Smith PAC member, local farmer and grazier, and agricultural service contractor; grain prices are for on farm after cartage costs deducted
**Timber processing and value adding opportunities**

Whilst individual forestry leases could provide positive financial rewards to farmers, a more major landscape concern was the need for a processing facility in one of the nearby regional centres for creating employment opportunities and value adding to the timber estate that would ensure long-term industry viability. According to plantation representatives on the PAC, a processing plant was planned for development within the next 3 years. Currently, many operational jobs in the plantation forestry industry were insecure, particularly for planting and machinery contractors in response to the global financial crisis of 2009 and collapse of major plantation companies based on forestry MIS. Through the use of modelling, the future viability and sustainability of the plantation forestry industry in the catchment was found to be highly dependent on continued growth of the estate to ensure timber volumes were available to support a processing mill and value adding manufacturing opportunities like potential biodiesel production from waste timber after silvicultural thinning and mill processing.

**Impacts on local businesses**

All the local shopfront businesses were provided with a business survey in the village of Woodenbong, the largest urban area in the catchment, upon recommendation from the PAC to collect further socio-economic data. This resulted in a 93% return rate (thirteen out of fourteen) and included the following businesses; pharmacy, arts and craft shops, hotel, bank, post office, machinery contractors and earthmoving, hardware stores, supermarket, machinery engineers and butcher. Due to the high return rate, the results were seen to be representative of the business community in the catchment.

The majority of businesses (62%) were found to have been operating locally for 10 or more years, compared to 23% operating for less than 3 years. Customer volume and volume of sales for the previous 12 months and 5-year periods were found to vary depending on the type
of business, however had declined on average for the proportion attributed to plantation forestry customers (who had the majority of their income derived from direct employment with local plantation companies) over the past 12 months. Thirty-nine percent of businesses reported a decrease in sales and services to plantation customers, while 23% reported no change, compared to 15% reporting an increase to these customers (Figure 6.3). Service, food and maintenance businesses reported overall increases in sale volumes suggested to be attributed to a change in customer base, particularly new settlers moving to town that were renovating homes. Other businesses with non-essential goods and services reported a decline in customer volumes and sales.

**Figure 6.3** Change in trade volume to plantation forestry customers and to total business profits for Woodenbong shopfront businesses over previous 12 month period (October 2008-October 2009). N=13.
An important finding from analysis of the business survey was that there was not a significant correlation between the volume of sales and services to plantation companies and overall change in business profitability ($r = 0.514, P = 0.129, N = 13; \text{not sig. diff.})$. This was contrary to previous findings in semi-structured interviews whereby some participants believed a decrease in trade from plantation forestry customers was having a negative impact on local business profitability (Leys 2008). For many businesses where trade to plantation customers declined, business profits either remained unchanged or increased. These findings suggest that plantation companies were not major customers of local businesses, a finding consistent with Schirmer et al. (2005) and Williams (2008) from other plantation communities in Australia.

For the 12-month period October 2008-2009, 31% of businesses reported a decline in business profits compared to 23% over the previous 5-year period, suggesting the past 12 months have been difficult financially for several businesses (Figure 6.3). At the same time, 31% of businesses reported an increase in profits over the previous 12 months. Machinery contractors reported large declines in business which they attributed to the financial crisis and drying up of plantation work, with employees having to be put off and machinery sold. Maintenance of fire breaks and fertilizer topdressing were two operations reported as being held off by plantation companies during difficult financial times.

**Pesticide impacts on local ecosystems**

The PAC found it useful to document the most commonly used pesticide programs on a per hectare basis and across the major land-uses in the catchment while investigating impacts of pesticides for fair comparison. This paper however focuses on findings from the plantation forestry industry. Participants contributed data on pesticide rates and frequencies based on their own local knowledge and experience. New knowledge was introduced through research literature, government and NGO reports, and media releases for review and deliberation by the
PAC. Expert opinion was also sought to fill knowledge gaps deemed important to participants and as a source of new knowledge. The PAC was actively involved with interpretation of the data and in producing recommendations for improvements in pesticide practice. Pesticide data was collated into tables for visual presentation for PAC deliberation.

Properties of plantation forestry pesticides

The octanol-water partition coefficients (log Kow) shown in the Table 6.3 indicate how chemicals are distributed at equilibrium between organic (octanol) and aqueous (water) phases. This coefficient is commonly used to predict the environmental fate of organic chemicals including pesticides (Stenersen 2004). The higher the coefficient, the greater the likelihood for the chemical to be partitioned to organic phases, suggesting that the chemical will tend to adhere to organic matter in the soil (organo-colloids), and may also indicate a tendency to accumulate in lipids (Copolovici and Niinemets 2005, Kah and Brown 2008). Reports in literature suggest pesticides with log Kow values between 4 and 8 have the potential to bioaccumulate in organisms; however, bioaccumulation is also affected by the molecular weight of compounds. Compounds greater than 600 units weight or 100 g/mol have been found less able to enter animal cells (FIMBAP 2007, Kah and Brown 2008, Rodriguez-Cruz et al. 2006, Stenersen 2004, Tomlin 2006).
<table>
<thead>
<tr>
<th>Pesticide</th>
<th>Rate of application (L or kg/ha)</th>
<th>Active ingredient/s (a.i. name)</th>
<th>Frequency of application (no./year)</th>
<th>Ecosystem load(^c) (grams a.i./ha/appl'n)</th>
<th>n-octanol :water (log Kow)</th>
<th>Half-life (days)</th>
<th>Eco-toxicity risk indicator (X-XXX)(^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Herbicides</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simazine 900</td>
<td>5.5 kg/ha</td>
<td>simazine</td>
<td>1.5/15 yrs(^2)</td>
<td>4500</td>
<td>1.960</td>
<td>60</td>
<td>X</td>
</tr>
<tr>
<td>Glyphosate</td>
<td>2.0 L/ha</td>
<td>glyphosate isopropylamine</td>
<td>5.0/15 yrs</td>
<td>900</td>
<td>-3.000</td>
<td>47</td>
<td>-</td>
</tr>
<tr>
<td>Verdict</td>
<td>0.15 L/ha</td>
<td>haloxy fop-R-methyl ester</td>
<td>0.5/15 yrs(^2)</td>
<td>86</td>
<td>3.320</td>
<td>55</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>diethylene glycol mono ethyl ether</td>
<td>0.5/15 yrs(^2)</td>
<td>77</td>
<td>-0.920</td>
<td>6</td>
<td>-</td>
</tr>
<tr>
<td>Lontrel</td>
<td>0.1 L/ha</td>
<td>clopyralid TIPA salt-aminopyralid</td>
<td>0.5/15 yrs(^2)</td>
<td>51</td>
<td>-2.870</td>
<td>40</td>
<td>-</td>
</tr>
<tr>
<td>(b) Insecticides</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rogor</td>
<td>0.8 L/ha</td>
<td>dimethoate</td>
<td>4.0/3 yrs</td>
<td>240</td>
<td>0.699</td>
<td>7-20</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>cyclohexanone</td>
<td>4.0/3 yrs</td>
<td>450</td>
<td>0.810</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>Fastac Duo</td>
<td>0.5 L/ha</td>
<td>alpha-cypermethrin</td>
<td>2.0/3 yrs</td>
<td>50</td>
<td>6.600</td>
<td>30</td>
<td>XXX</td>
</tr>
<tr>
<td></td>
<td></td>
<td>xylene</td>
<td>2.0/3 yrs</td>
<td>375</td>
<td>4.300</td>
<td>7</td>
<td>-</td>
</tr>
</tbody>
</table>

\(^a\)Simazine was additionally applied on 50% of the plantation area as a follow up post-planting herbicide application together with Verdict and Lontrel for residual weed control, accounting for the 1.5 and 0.5 applications respectively over the average 15-year production cycle. \(^b\)A rating for potential eco-toxicity of the commonly used pesticides was applied using a scale of X low risk to XXX high risk, - otherwise not considered a significant risk under routine applications. \(^c\)Ecosystem load refers to a quantitative measure of the amount of active ingredient applied to the environment per unit area at a particular point in time.
Attitudes towards pesticide use

A broad spectrum of attitudes towards pesticide use was present within the PAC, with some members favouring restricted use and others fully supporting pesticide use to maintain productivity and boost returns. Insect damage to commercial stands of *Eucalyptus dunnii* from the psyllid insect *Creiis lituratus* and various Chysomelid beetle species including *Chrysophtharta sp.*, *Paropsisterna sp.* and *Paropsis sp.* presented challenges to plantation foresters who believed chemical control was their only option through aerially sprayed insecticides Rogor and Fastac Duo (details on active ingredients in Table 6.3). The woody weed *Lantana camara* and cat’s claw creeper *Macfadyena unguis-cati* were claimed to be highly invasive and requiring herbicide control.

Some of the local participants in the study were organic farmers and strongly against the use of aerially sprayed pesticides that could drift onto their properties and contaminate produce and water supplies. Participants representing the Environmental group of stakeholders on the PAC were concerned there was no regulatory compliance regarding use of pesticides in the catchment and believed this was an area that needed improvement at the local and state government level.

Pesticide eco-toxicology risk indicator

A pesticide risk indicator was applied to pesticides based on chemical rates and frequencies most commonly used in plantation hardwood forestry (Table 6.3). From a modelling exercise comparing pesticide use in all the major land-uses, it was found that pesticide usage in hardwood plantation forestry changed dramatically in the years after establishment, with the highest pesticide dependency prior to planting for residual weed control and during early establishment to reduce competitive pressure from weeds. Further, insecticide usage in plantation forestry was specific to Eucalypt species, with *E. dunnii* being particularly
susceptible to insect attack and in need of regular monitoring. Selective spraying was reported to reduce pest outbreaks that could potentially devastate plantations. During the course of the study, representatives from the plantation forestry industry acknowledged that *E. dunnii* had a high reliance on pesticides and were now aiming to plant species less susceptible to insect attack including *E. saligna* (Sydney blue gum) and *Corymbia maculata* (spotted gum). *E.cloeziana* (Gympie messmate) was another species recommended through expert opinion; although it’s lower frost tolerance would restrict site suitability.

**Pesticide footprint of the plantation forestry industry**

Tabulating pesticide footprints for all the major land-uses in the catchment highlighted the lower overall reliance on pesticides in hardwood planation forestry compared to annual crops including maize and soybeans when active ingredients were standardised over an average 15-year production cycle in the catchment. An interesting finding of this study was in the use of the S-triazine residual herbicides (LeBaron *et al.* 2008, Walker and Blacklow 1994), found to have approximately ten times higher footprint in maize cropping through the use of Atrazine compared to use of Simazine in hardwood plantations. While the log Kow levels (ratio of octanol:water solubility) of both these triazine herbicides were found to be less than 4 (atrazine log Kow = 2.34 and simazine log Kow = 1.96) and therefore not expected to bioaccumulate in animals, some scientific literature has claimed there are potential acute and sub-lethal toxic impacts as endocrine disruptors on mammals and amphibians if not used in accordance with the regulatory label (Fan *et al.* 2007, Hodgson and Levi 1996, Horrigan *et al.* 2002).

**Pesticide recommendations by the PAC**

In Australia the S-triazine chemicals are not listed for use in drinking water catchments under National registration of the Australian Pesticides and Veterinary Medicines Authority.
(APVMA) and as such, no levels should be detectable in drinking water supplies. Each state and territory government in Australia have been given the responsibility for monitoring pesticide safety. In NSW, surveillance of rural drinking water quality is under the jurisdiction of local councils, while not having a statutory requirement to monitor water quality, the legislation does require closure of drinking water supplies if they are found unfit for drinking under the Public Health Act of 1991 and if anyone is found polluting public water supplies under the Local Government Act of 1993 (NSW Public Health 1994). Further information on guidelines for use of herbicides around water is provided by Ainsworth and Bowcher (2005) and in plantations by Tomkins (2004) and Jenkin and Tomkins (2006).

In addressing the community concern regarding potential compromise to drinking water standards and adverse impacts on wildlife in local ecosystems from the use of aerially sprayed pesticides in the catchment, the synthetic pyrethroid insecticide Fast-tac Duo in hardwood plantations was considered to present the greatest risk (Yordanova et al. 2009). The relatively long soil half-life (30 days) and lipophilic nature (log Kow of 6.6) of its active ingredient alpha-cypermethrin gives it potential to bioaccumulate, illustrated using an ecotoxicology risk indicator in Table 6.3. For this reason, the PAC recommended restricted use of this chemical and only under extreme caution, potentially phasing its use out all together, with softer (less toxic) alternatives provided in Phillips (2007).

This finding was contrary to previous public perceptions that the insecticide Rogor (active ingredient dimethoate) used in plantations posed the most risk to human and ecosystem health (Leys 2008). Dimethoate was found to have a relatively short half-life, varying from 7 to 20 days in soil with a low log Kow value of 0.699 (Table 6.3) suggesting it is not expected to bioaccumulate. The high water solubility of dimethoate (Johnson et al. 2007) when applied under a sub-tropical rainfall pattern provides argument for significant dilution of this pesticide in the environment that should not present significant health risks at rates and frequencies
(Margni et al. 2002) used by the plantation forestry industry. However due to the nature of organophosphorus pesticides for acute toxicity, it should be used with caution and further toxicology investigations undertaken (Davies et al. 2008, Eddleston et al. 2005).

The investigation further highlighted that the fate of pesticides was highly dependent on the level of runoff and temperature subsequent to application, as well as site characteristics in slope, soil texture and organic matter levels. As such, it was recommended that all users of chemicals considered to have potential ecotoxicology risks not only use them with caution, however the local council monitor for contamination of drinking water supplies, particularly in times of consistent moderate rainfall around planting time to help alleviate fears of local residents. A sophisticated model has been developed by the CSIRO in South Australia called the Pesticide Impact Rating Index (PIRI; Kookana et al. 2005) which was recommended for modification for monitoring likely contamination of surface and ground water supplies by local councils. Further research is recommended in this area.

Evaluating changes in attitudes of PAC members and effectiveness of social learning strategies

Throughout the PAC process, attitudes among participants were monitored, and a general growing awareness and understanding of plantation forestry management and operational practice led to a gradual increase in support for the industry and less controversy. A final evaluation of the study by PAC members provided empirical evidence for a shift in attitudes towards the plantation forestry industry (mean = 2.75, SD = 0.71; equiv. to moderate improvement). Additional comments by participants included: that over the years they had seen “much improvement since the early days”, some preferring “corporate owned rather than public (state) owned plantations” suggesting they were “better managed and pay council rates”.
Analysis of the final evaluation survey highlighted areas participants felt were most effective in the learning process for reducing controversy (Figure 6.4). They were particularly satisfied with the social learning process, finding it fair to contribute equally to dialogue and an interesting process, highly valuing facilitating researchers input and expert opinion and local knowledge. Time efficiency was a factor for some who suggested that meetings went too long, generally lasting 3.5 to 4 hours each, although they always stayed till closure. The PAC rated the findings of the study as helpful in terms of how informative and useful they would be to the broader community. The visual modelling environment _Simile_ also rated highly for usefulness in social learning, however deemed most effective as a tool for researchers due to the high level of technical expertise required to run the program.

The analysis also found 75% of PAC members felt the recent collapse of private plantation companies based on MIS contributed to a more negative image of the industry. While 75% supported private leasing of properties by plantation companies, 100% supported family farms with agro-forestry enterprises. Eighty-eight percent supported mixed species plantations and only 38% supported monoculture timber plantations, which was not unexpected due to discussions on negative impacts of monoculture on biodiversity in the region.
Figure 6.4 Evaluation of social learning study by members of the Participatory Advisory Committee using box plots. N = 11. Note: Similar numbers shown on box plots represent the same participant throughout the evaluation.
Discussion

Evaluation of a case study in social learning provided evidence of effective community engagement between the plantation forestry industry and a rural community where controversies over complex natural resource management issues were resolved. The study used empathetic and intellectual engagement between stakeholders for developing a shared understanding of dynamic problems and the development of collaborative solutions for improving socio-economic and environmental outcomes under existing forestry policy. One of the strengths in the study was the fairness of stakeholders to contribute equally to dialogue. This was fostered through the employment of an independent facilitator who used strategies to minimise power differentials between stakeholders and eliminate risk of creating a biased agenda (Muro and Jeffrey 2008) or a situation of civic elitism by particular self-interest groups (Parkins and Sinclair 2009).

While participatory modelling in its purely analytical form (Voinov and Gaddis 2008) provided a useful entry point for researchers to initiate discussions, it became evident that participants found its application limited due to the high level of technical expertise required to run the _Simile_ program used in this study. A variety of alternative strategies were used which helped motivate and foster engagement with technical competence, consistent with findings of Giupponi et al. (2006, 2008), Mostert et al. (2007) and Pahl-Wostl et al. (2007) including open discussion with local actors, scientific researchers and invited expert speakers to develop an improved understanding of problems, build confidence and capacity for collective decision making.

The use of social research methods to monitor and gauge changes in attitudes as social learning progressed, identified the creation of new knowledge as an important criteria for alleviating fears and reducing controversy within the community by providing empirical evidence to debate perceptions found earlier in the study (Leys 2008), consistent with the
merits of social learning processes reported by Steyaert and Jiggins (2007) and Walker et al. (2006). Another strength identified was the ability of the PAC members including the research team to develop trust and establish alliances. This was demonstrated through the continued attendance by all members at regular evening meetings over the 8-month study period. However, the lack of engagement by marginalised groups including the Indigenous Aboriginal community was of concern to some PAC members, although consistent with findings by McGurk et al. (2006) and McDermott and Schreckenberg (2009) suggesting the need for further research in this area.

The major socioeconomic findings from the social learning process included potential for increasing regional employment opportunities through the development of a processing mill. Future expansion of plantation forestry was found to be most socially acceptable through partial property leasing of private farms to maintain existing social structures and demographics and provide economic benefits to local farmers. Alternately, farmers wanting to retire or move from the region found it very viable to sell out due to the good prices being offered by plantation companies.

Major environmental views expressed by the PAC included promoting future use of the plantation species Eucalyptus saligna, Corymbia maculata and E. cloeziana that offer improved pest and disease resistance and timber properties compared to the most prevalent species E. dunnii. Further research on biodiversity conservation was recommended as it was considered to be compromised by an increasing area of the catchment under monoculture plantation and the removal of hollow remnant trees for wildlife habitat. It was established that effective fire management planning could not be done in isolation; rather there was a need for an integrated approach between different land-managers and fire authorities. The need was recognised for improvements to monitoring known pesticides for potential contamination of waterways, drinking supplies and groundwater by local government. This was suggested to
eliminate concerns and increase confidence of local residents that local water quality standards were being met. Adaptive co-management involved an agreement to move towards the use of softer pesticides by all land users. During this study, a local expert group formed outside the PAC to address a shortfall in legislation regarding management prescriptions for retained vegetation in plantations (further information can be found at Baker et al. 2009).

The findings of this study emphasised the local nature of problematic natural resource management issues, and the importance of understanding the socio-political dynamics of stakeholders early in the diagnostic process to maximise engagement in social learning. Prager and Freese (2009) suggest support from a diverse group of stakeholders enhances legitimacy of the study and the likely acceptance of recommendations within the community. The recommendation by the PAC for integrated collaborative management particularly in the areas of fire management, water quality monitoring, and biodiversity conservation, support a view put forward by Brondizio et al. (2009) that local networks are embedded in larger socio-ecological systems that need to be considered for effective governance of natural resources. This study supports adaptive co-management theory proposed by Walker et al. (2006) where diverse stakeholder groups contribute to the transformation process of local socio-ecological systems and the operationalisation of adaptive governance reported by Folke et al. (2005), an area increasingly recognised as important in the face of a global resource crises and climate change, and associated value changes in society.

**Conclusions**

The development of a robust diagnostic framework supported the effective implementation of a process of social learning supported by participatory modelling to explore controversial issues over plantation forestry expansion in Australia. The process offered a multi-disciplinary platform linking research and community, and built capacity for collaborative problem solving
between diverse stakeholders through knowledge generation, confidence and relationship building, together with the development of group learning skills. Individual attitudes changed throughout the process highlighting the dynamic nature of social interaction, and role of cognitive learning in resolving controversy. For these reasons social learning processes could be used more widely in rural communities where there is conflict over natural resource management.

Limitations were found for the use participatory modelling as a tool of social learning due to the technical skills required to run the visual modelling software 'Simile' used in this study. Therefore participatory modelling would be most useful when working with community groups with high motivation to learn the software or limited to use as a tool by research modellers embedded in broader processes of social learning. In conclusion, social learning can provide a mechanism for intellectual and empathetic engagement of stakeholders. It can assist in eliciting local and expert knowledge to contribute to the improved management of natural resources, supporting the movement towards participatory planning and decision making in environmental legislation and conflict resolution.

**Acknowledgements**

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Chapter 7: Role of social learning in reducing controversy surrounding rapid plantation forestry expansion

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**Declaration by candidate:** This conference proceedings paper presents a summary of preliminary findings which form the basis for more extensive journal publications with Australian Forestry, Regional Environmental Change and Land Use Policy. I declare the nature and extent of my contribution to this chapter of work to be:

<table>
<thead>
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<th>Nature of contribution</th>
<th>Extent of contribution (%)</th>
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<td>Title, key ideas and questions, literature review, framing, writing</td>
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<td>Data analysis</td>
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The following co-author contributed to the publication:

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<tr>
<td>Jerome Vanclay</td>
<td>Principal supervisory role of editing and presentation of some results</td>
</tr>
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**Declaration by co-author**

The undersigned hereby certify that:

- The above declaration correctly reflects the nature and extent of the candidate’s contribution to this work, and the nature of the contribution of the co-author;
- The co-author meets the criteria for authorship in having participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
- The co-author takes public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication; and
- There are no other authors of the publication according to these criteria; potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit.
Role of social learning in reducing controversy surrounding rapid plantation forestry expansion

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Summary

Competing land-uses such as plantation forestry in rural landscapes often stimulates controversy, but there are few documented mechanisms for community engagement that effectively address community concerns. This paper reports an experiment with social learning and participatory modelling in a rural community in the Upper Clarence catchment in subtropical NSW, Australia. Action research was used to develop a flexible and iterative diagnostic framework for critically evaluating the process, which involved a series of meetings to share information and foster mutual learning. Criteria were developed collaboratively between a facilitation team of researchers and local stakeholders engaged in a participatory advisory committee to explore difficult socio-economic and environmental issues. Social learning was found to be an effective process for developing a shared understanding of plantation forestry dynamics.

Keywords

Evaluation framework • stakeholder analysis • participatory modelling • social-ecological systems • empowerment
Introduction

It is commonly observed that rapid land-use change causes community concerns (Thebaud and Batterbury 2001, Barlow and Cocklin 2003), and forestry is no exception. The expansion of plantation forestry has been reported to be associated with controversy in many temperate Australian rural communities (Schirmer et al. 2008, Williams 2008, Williams et al. 2008).

This paper reports on a case study of a sub-tropical region in northern NSW Australia to identify issues of concern within the local community. It explores the utility of participatory modelling to improve community understanding of plantation forestry dynamics and gauges changes in attitudes directly associated with stakeholder participation.

The Australian plantation timber industry has been expanding on average 80,000 hectares per year till early 2009 (Australian Plantation Timber Industry 2006) driven by Australian Government policy to support major expansion in the timber resource by 2020 (MCFFA 1997). Fiscal incentives in support of this expansion were provided through national taxation legislation under Division 394 of the Income Tax Assessment Act 1997 for Managed Investment Scheme (MIS) retail forestry projects (PJCCFS 2009). This incentive was intended to address a gradual decline in public and industrial plantation investment and native forest timber supplies as domestic and export demand for sustainably grown wood and paper products increased (Plantations for Australia 2008), however has been subject to broad criticism (Dargusch 2008).

The release of a progress report on the Plantations for Australia 2020 vision in 2008 however highlighted a broader lack of engagement between commercial forestry companies and communities to address environmental and socio-economic issues resulting from plantation forestry expansion (Plantations for Australia 2008). To date, community engagement in Australia has been limited to the operational level by forest managers, with
little success due largely to lack of trust and transparency within communities towards private plantation companies and limited capacity within the industry (Dare et al. 2010a, b).

This paper supports the need for new participatory discourse in addressing plantation forestry conflict, and argues that community engagement should involve a process of social learning to share knowledge and collaboratively explore for new knowledge, skills and behaviours to help communities adapt and adjust to change. Rolfe (2006) distinguishes adaptation as a function of recovery factors to bounce back from crisis situations, as opposed to adjustment involving the influence of protective factors to maintain functioning. Research into social learning in natural resource management in other countries by Conroy et al. (2002), Keen et al. (2005), Mostert et al. (2007), Muro and Jeffrey (2008) and Steyaert and Jiggins (2007), all provide evidence of processes that co-created new knowledge and a shared understanding of complex and uncertain problems leading to better social outcomes than were previously possible.

Social learning in this paper refers to group processes where knowledge is shared and created between stakeholders with diverse experiences and views on natural resource management for embedding in learning processes that strengthen the capacity to collaboratively manage ecosystems sustainably for human well-being (Bormann et al. 2007, Steyaert and Jiggins 2007). Alternatively, participatory modelling refers to the analytical process of using simulation software (e.g. Simile) to model dynamic natural resource systems and explore alternative scenarios for sustainable solutions to complex problems involving input from diverse stakeholders (Gaddis et al. 2009, Vanclay et al. 2006, Voinov and Gaddis 2008).

Participatory modelling in this research is used as a tool within the broader process of social learning, consistent with work by Pahl-Wostl et al. (2007) who suggest the benefits of this approach are for integrating tacit and explicit knowledge with experiential and cognitive
learning within groups. The level of involvement of stakeholders has been reported to vary depending on skills, resource availability and potential to develop capacity. The process can include knowledge sharing, data collection, setting criteria and agendas, monitoring and evaluation, model construction and interpretation, dissemination of recommendations and implementation of changes to practice and governance (Petts 2001, Gaddis et al. 2009).

There has been limited empirical evidence on strengths and weaknesses of public participation and social learning processes reported in literature, thought to be necessary by Chess and Purcell (1999), McGurk et al. (2006) and Leys et al. (2010) for achieving robust understanding of these processes for wider application. Some of the limited findings have suggested weaknesses reducing success of social learning activities in forest management and include lack of accountability, deficient coordination, ambiguous decision-making processes, inadequate opportunities for Aboriginal involvement, poor attendance, and lack of broader community involvement (McGurk et al. 2006). Strengths included information sharing and improved communication, relationship building, influence of operational and site specific decisions, and conflict management. Gaddis et al. (2009) confirmed participatory processes reduced historical conflict between actors, providing a neutral atmosphere for discussions over water pollution issues in St Albans USA, which had previously been divisive.

This paper reports on the effectiveness of a social learning process incorporating participatory modelling (PM) for achieving effective community engagement to address the need in society to collaboratively explore issues of controversy surrounding land-use change to plantation forestry that has been driven by Australian government policy. It contributes further to the field of evaluation. The paper further supports the need in natural resource management (NRM) to improve regional governance for sustainability through effective community engagement that complements policy and disturbs existing institutional structures allowing change and conflict resolution. The level of this intervention can be uncertain and
dynamic according to Steyaert and Jiggins (2007), and dependent on understanding local contexts of changing values and stakes interacting with local history and culture, and therefore considered in this research.

**Methods**

**Selecting a case study area**

An initial scoping survey of the Upper Clarence region, a 690,500 hectare catchment in northern NSW (Figure 7.1), highlighted a diversity of views held within the community towards plantation forestry expansion and helped confirm that is was suitable for undertaking a participatory case study.

The catchment has a sub-tropical climate with an annual rainfall of approximately 1,100 mm/yr. As of March 2009, 4.0% of the catchment (27,400ha) was under hardwood plantation forest (Figure 7.2) and 0.6% (4,230ha) under softwood plantation, with the balance under agricultural land-uses, predominantly beef cattle and the summer crops soybean and maize, as well as native forests (regrowth and old-growth endemic tree species) in National Parks and State forests. The softwood plantation estate is 100% public NSW State Forest tenure, compared to the hardwood plantation estate which is majority owned and operated by private investment companies.
Figure 7.1 Location map of the sub-tropical Upper Clarence catchment in north-eastern NSW, Australia (Map produced by Greg Luker, GIS Lab SCU, 26/02/2010)

Figure 7.2 Young eucalypt plantation in the sub-tropical Upper Clarence catchment
Gauging importance of landscape scale plantation forestry controversies

In an effort to develop further insights into issues concerning members of the local community, twenty eight key stakeholders representing a diversity of views towards plantation forestry expansion were interviewed on a one-to-one basis (results from these interviews can be found at Leys 2008, and some narrative at Leys and Vanclay 2010a). Interviews were followed up with public meetings held in the case study region to gauge the relative importance of issues using a democratic voting card system that could be explored with a social learning exercise.

An independent professional facilitator was employed to convene and mediate these public meetings to provide all participants with equal opportunity to express views and ask questions, rather than facilitated by forest industry which could have been perceived by some to create a biased agenda. All attendees at the meetings were provided with opportunity to vote on issues they believed to be most important for exploring further with the social learning study. They were asked to vote twice, with their first vote having a voting weight of two (2) points and their second vote one (1) point. All votes were then collated and standardised into percentages, with the final ratings of issues ordered in Table 7.1.

The major issues identified were the need for improved fire management in plantations, socio-economic benefits for local communities, improved community consultation and information sharing, improved collaboration between agricultural producers and the plantation industry to allow for better property planning, and concerns over health impacts from aerially sprayed pesticides (Table 7.1; further information can be found at Leys et al. 2010). One of the major private plantation forestry companies operating in the catchment collapsed during the global financial crisis, and ceased operations during the study period. This was observed to create greater angst and concern regarding the uncertain future for plantation forestry among participants.
It was important to note that the public meetings were held in March 2009, shortly after the extensive and well publicised Victorian bushfires of February 2009 where thousands of homes were destroyed and hundreds of lives lost (ABC 2010). We believed the influence of media from these bushfires may have influenced the voting process, whereby fire management was deemed the major issue concerning the community at the time (Table 7.1). Further evidence of the influence of media from events like the bushfires on the order of importance of issues was provided in results from the initial scoping survey and interviews with key informants (Leys 2008). These suggested more widespread community concerns over environmental issues, including impacts from pesticides, impacts on water flow regimes and endangered species, and clearing and subsequent destruction of regrowth timber. The need for creating local employment opportunities was also rated higher at earlier stages in the study. Therefore, while the results in Table 7.1 illustrate findings for people who attended the public meetings and thought to have been influenced by current events at the time, it could be argued that the order of importance of issues may have been different over a longer time frame.

Further limitations were recognised in the voting system used for ordering the importance of issues. Some participants provided feedback after meetings, suggesting that they had trouble deciding on their second vote, with equally important issues they would have liked to vote on. If participants had been allowed a third vote, the order of importance of issues may have changed.
Table 7.1 Relative importance of community issues relating to plantation forestry expansion (listed from highest priority to lowest).

<table>
<thead>
<tr>
<th>Issue</th>
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<tr>
<td>Fire management planning</td>
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<td>Socio-economic benefits for local communities</td>
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<tr>
<td>Community consultation and information sharing</td>
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<tr>
<td>Collaboration between agricultural producers and plantation industry for improved property planning</td>
</tr>
<tr>
<td>Health impacts from aerial sprayed pesticides</td>
</tr>
<tr>
<td>Infrastructure development; roads and bridges</td>
</tr>
<tr>
<td>Environmental impacts: spread of invasive weeds, reduced water yields and effects on biodiversity</td>
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<tr>
<td>Development of value added timber products</td>
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Engaging stakeholders onto a participatory advisory committee (PAC) to address community concerns

During the public meetings we called for an expression of interest from volunteers to form a self-selected Participatory Advisory Committee (PAC). Twelve (12) people volunteered, representing a wide range of views within the community towards plantation forestry. They agreed to meet once a month on average, a process which continued for a period of eight months throughout 2009. PAC members worked collaboratively with a team of three facilitating researchers to determine which issues were best addressed through a social learning exercise and in which order. Fire management was addressed first, with participants helping contribute and collect further data. Expert speakers were invited to fill knowledge gaps on fire management planning; however floods during the study period of 2009 (ABC, 2009) reversed the order of preference for the investigations. This again highlighted the influence of current affairs and media on what people believe to be important. Pesticide issues
were then explored and then socio-economic impacts. Changes in attitudes were monitored throughout the study using observational documentation and evaluation surveys. Results from evaluation of the social learning study by members of the PAC are reported on in this paper.

**Behavioural guidelines for meetings developed by the PAC**

In an effort to keep PAC meetings friendly, inviting, and free of hostility, the PAC worked in groups to develop a set of behavioural guidelines that they would feel comfortable with. Open discussion then established a set of PAC acceptable behaviours by consensus, presented in Table 7.2.

**Table 7.2 Behavioural guidelines for participatory meetings**

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<tr>
<td>● Provide each participant with the opportunity to express their view</td>
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<tr>
<td>● Be friendly, courteous and helpful to all participants</td>
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<tr>
<td>● Be consistent in attending the scheduled meetings</td>
</tr>
<tr>
<td>● Complete the assigned follow up activities prior to the next scheduled meeting to the best of your ability</td>
</tr>
<tr>
<td>● If there is a problem, discuss it with the facilitation team as early as possible to attempt to rectify the situation</td>
</tr>
<tr>
<td>● Avoid going to the media during the study process</td>
</tr>
<tr>
<td>● Complete and return monitoring and evaluation surveys</td>
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**Evaluation criteria developed in collaboration between PAC members and facilitating researchers**

A review of literature in the field of evaluation of participatory processes in natural resource management highlighted a deficiency in participant involvement. Most evaluations were found to have been conducted by the researchers themselves, such as in work by Gaddis et al. (2009)
and Mostert et al. (2007) and not reflecting true and robust evaluations of participatory processes. Further, Chess and Purcell (1999) suggested that risk is reduced and results are more effective, durable and credible when stakeholders are involved with evaluating processes and outcomes. In an effort to address this gap in research, this study involved members of the PAC working collaboratively with researchers to develop a set of evaluation criteria, presented in Table 7.3.

**Table 7.3 List of criteria for evaluating the participatory learning process**

- Fairness through equal opportunity to express individual views, contribute to agenda and rules of behaviour, monitoring process and outcomes of study
- Cost-effective scenarios explored
- Ecologically sustainable scenarios explored
- Building community capacity by developing group working skills and encouraging socially responsible solutions (i.e. robust solutions)
- Develop a shared understanding of land-use systems over time by sharing local and expert knowledge (i.e. credible scientific knowledge)
- Remain engaged in the study till completion (i.e. not too difficult, interesting);
- Time efficient process
- Improved collaboration and trust between diverse stakeholder groups
- Feedback to public useful (i.e. socially legitimate strategies)
- Reduced land-use conflict
- Developed new culture for deliberating over natural resource issues

**Results**

The development of a shared understanding of plantation forestry dynamics and formation of collaborative working relationships helped reduce controversy over plantation forestry, a finding supported in a hypothesis by Walker et al. (2006). The PAC developed a set of
adaptive co-management practices for addressing the needs for improved fire management planning, sustainable socio-economics benefits to local communities, and changes to pesticide practice for reducing potential negative impacts on local residents and ecosystems (Further information can be found at Leys and Vanclay 2010b, CRC for Forestry Technical Report No. 201). The issue for improving community consultation was addressed through participants compiling and providing local plantation forestry companies with a list of contact details for local community media outlets. Improved collaboration came about from the social learning process itself. Findings and recommendations from the study were made publically available through a final community feedback report for accountability (Leys and Vanclay 2010b).

**Evaluation of social learning process by PAC members**

Members on the PAC expressed satisfaction with the study, particularly in terms of fairness in opportunity to express views, illustrated in Figure 7.3. Even though a couple of participants reported in the evaluation that they thought the meetings which lasted 3.5 to 4.0 hours each were a little long, they always stayed till the end. There was an overall satisfaction with how the community issues of pesticides and socio-economics were dealt with in the social learning process, although less so for fire management. We believe the dry spring of 2009 and bushfires in the local region brought attention and emotion once again to this issue amongst participants. The PAC concluded that further research was required in the area of fire management planning in plantations, as they were still reporting fear relating to potential fire threats from nearby plantation forests, particularly where they bordered small towns and villages in the catchment.

The PAC voted the most useful strategies used in the social learning exercise as sharing of local knowledge, expert opinion, and scientific knowledge and findings from the facilitating research team (Figure 7.3). These results however were not significantly different, which could be explained by the small population size being evaluated (i.e. N=11). Effective
learning techniques included brainstorming in groups, open forum discussions and use of visual modelling environments (Figure 7.3) to explore management scenario's using Simile and Microsoft PowerPoint to display tables and graphs. However, participants found the use of the visual modelling software Simile technically difficult (Figure 7.3), and preferred that its use be restricted to the modeller in the facilitating research team.
Figure 7.3 Evaluation of social learning study by members of the Participatory Advisory Committee using box plots. Note: N=11.

Similar numbers shown on box plots represent the same participant throughout the evaluation.
Evaluation of PAC member attitudes before and after the social learning exercise

Stakeholder analysis techniques were used to produce a force-field matrix to illustrate changes in attitudes of PAC members towards the plantation forestry industry attributable to the social learning process (Figure 7.4). It was found that involvement in the social learning process had a positive influence on participant attitudes, with a mean increase from opposition towards support (mean before = 1.73; mean after = 2.46), this however changed at different rates for the various stakeholder groups as illustrated in the force-field stakeholder matrix in Figure 7.4. The Cattle and Mixed Farming stakeholder group came to the study strongly opposing the industry, however after the social learning exercise they were found to have the largest increase in the level of support (Figure 7.4), with participants suggesting this was due to the increased understanding of plantation forestry dynamics. These findings supported a hypothesis put forward by Pahl-Wostl et al. (2007) that social learning can lead to attitudinal change by individuals in social environments through interaction and deliberation. Further, Lockwood (2010) suggests that social learning can lead to an increased environmental ethic for the well being of ecosystems.

A confounding effect of involvement in the study was the positive influence on the overall capacity of participants for power and influence in decision making over plantation forestry governance in the social learning process, illustrated in Figure 7.4 through an overall mean increase from low to moderate power and influence (mean before = 1.6; mean after = 2.0). This was achieved through the development of a set of adaptive co-management recommendations for the plantation forestry industry by PAC members (Leys and Vanclay 2010b) and assessed through participant evaluation and researcher observation. However, the various stakeholder groups were affected differently, with some groups assessed to have gained more power, being Urban Residential &Tourism, Scientific & Education, Cattle & Mixed Farming, and Environmental stakeholders, as opposed to the Forestry and Governing
Authority groups assessed to have lost some power and influence. This emphasized the importance of processes of social learning for reducing power differentials between diverse groups in society, particularly for empowering those who were marginalised or felt powerless prior to engaging in the participatory process. This supported research by Kapoor (2001) who suggested that participation can clarify communications and helps stabilise power relationships between stakeholders.
Notes:
N=11 number of PAC members who responded to evaluation survey; PAC had 12 members, therefore 92% response rate

abc one-way ANOVA F=9.91, P=0.012, P<0.05: sig. diff. in Sentiment between stakeholder groups prior to involvement in social learning. Values and arrows represent means for each stakeholder group represented.
ef one-way ANOVA F=1.727, P=0.282. Not sig. diff. between stakeholder group sentiments after study.

gh two-way ANOVA F=109.1, P=0.000, P<0.001: sig. diff. in Sentiment between stakeholder groups before and after participation in social learning. F=13.91, P=0.004, P<0.01: sig. diff. within stakeholder groups (repeated measures used Huynh-Feldt multiple comparisons with Bonferroni adjustment). Values represent overall means for each time scale. Arrows represent mean positions for each stakeholder group.
s one-way ANOVA F=12.46, P=0.008, P<0.01: sig. diff. in Power and Influence between stakeholder groups prior to involvement in social learning. Arrows represent mean positions for each stakeholder group.
st two-way ANOVA F=205.5, P=0.000, P<0.001 Sig. diff. in Power and Influence between stakeholder groups before and after participation in social learning. F=3.38, P=0.096 not sig. difference within stakeholder groups (repeated measures used Huynh-Feldt multiple comparisons with Bonferroni adjustment). Values represent overall means for each time scale. Arrows represent mean positions for each stakeholder group.

Figure 7.4 Force-field matrix of changes to stakeholder group attitudes and positions of power and influence in decision making over plantation forestry governance attributed to participation in the social learning study (i.e. gauging stakeholder empowerment. Developed by A. Leys 2010)
Discussion and conclusions

An evaluation framework for a case study of social learning provided empirical evidence that controversy could be reduced over plantation forestry expansion among other land users and citizens through participatory involvement. This was achieved through collaborative investigation and deliberation over creditable scientific data with local actor knowledge and experience, and expert opinion to debate perceptions found earlier in the study (at Leys 2008). These findings were consistent with the merits of social learning processes reported by Steyaert and Jiggins (2007) and Walker et al. (2006).

The evaluation was made more robust through participant involvement in the development of behavioural guidelines that supported a friendly and non-threatening platform for meetings. Participants assisted in the development of criteria for evaluating the social learning process, finding a variety of strategies helped motivate and foster engagement with technical competence of the facilitating research team. Members of the PAC found the sharing of social capital through open discussion with local actors, invited expert speakers mobilised at appropriate times throughout the study, with knowledge and additional findings from the facilitating researchers were most useful for improving understanding of dynamic landscape problems and capacity building for informed decision making.

Another strength identified was the ability of the research team and participants to develop trust and establish alliances among the PAC group. This was demonstrated through the continued attendance at regular evening meetings of the PAC by all members over the eight (8) month study period during 2009. However the lack of engagement by marginalised groups in the community was of concern to a minority of participants, although consistent with findings by McGurk et al. (2006) and McDermott and Schreckenberg (2009), suggesting the need for further research in this area.
A weakness identified in the process by researchers and members of the PAC was an imbalance in the facilitating researcher's workloads. Only one researcher was committed full time to the process, one part-time and one assisting during meetings. This highlighted the need for establishing expectations and roles among the facilitating research team prior to commencement of the study, and ideally for all members to be experienced educators or facilitators in their field of scientific research. Roles have often been defined in literature in terms of Facilitator, Gatekeeper, Evaluator/ Recorder and Modeller, with further details available at Richardson and Anderson (1995), and Vanclay et al. (2006). Further research is being conducted by the authors to develop a Practitioners Toolbox for tailoring social learning studies to the needs of communities based on insights gained from this study, in particular recommendations for a diagnostic framework incorporating facilitation research team requirements and social research strategies.

Participants and facilitating researchers recommend processes in social learning for more widespread application in community engagement to help reduce of controversy over complex and problematic natural resource management landscape issues. Participatory modelling was found to be a useful strategy for visually presenting data and exploring dynamic land-use scenarios when used by the modeller; however the technical expertise required to use the software program Simile did not match with participant skills, expectations and interest or time limitations to learn the program. Alternative visual presentations using tables and graphs were more widely accepted by participants due to their familiarity with commonly used spreadsheet programs.

An interesting observation by researchers from meeting discussions and evaluations by participants in the study was the notion of sound farm management practice. Farming participants felt strongly about the need for the plantation forestry industry to improve land management, and were satisfied when co-management practices were developed that offered
improved practice consistent with standards among their own stakeholder group. Research by Vanclay et al. (2007) suggested that attitudes of Australian farmers towards good farm management practice can be explained through the concept of ‘scripts’ that relate to appropriate social behaviours, norms in society, and values that assist communities preserve farming subcultures. While Olesen and Bindi (2002) reported on the need for adaptation in European agricultural systems in response to climate change through a more multifunctional role of agriculture that could be supported through policy change. Further research is recommended in this field to improve understanding of how ‘scripts’ may influence development of innovation in rural communities and affect the rate of adaptation to change in response to evolving societal needs.

In conclusion, evidence from this study suggests that the application of participatory modelling as an analytical tool in social learning studies is dependent on the willingness and interest among participants to actively engage in the problem solving process. However, the broader process of social learning offered an effective mechanism for exploring landscape natural resource management issues, developing a shared understanding of plantation forestry system dynamics through experiential and experimental experiences, while reducing the level of controversy among participants. An additional outcome was the formulation of a set of adaptive co-management recommendations for sustainable land-use practice and initiatives for further development of the plantation forestry industry in the Upper Clarence catchment that were acceptable to a diverse group of stakeholders.

Acknowledgement

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Chapter 8: Social learning: A knowledge and capacity building approach for adaptive co-management of contested landscapes

Journal: Land Use Policy

Status of publication: Submitted 7 May 2010; published 2011, volume 28(3), 574-584 (please refer to appendix 7.5)

Declaration by candidate
I declare the nature and extent of my contribution to this chapter of work to be:

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<td>Jerome Vanclay</td>
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Social learning: A knowledge and capacity building approach for adaptive co-management of contested landscapes

A.J. LEYS and J.K. VANCLAY

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 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 scarce 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, Berkes 2009, Prager 2010). 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.
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°) 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 nor 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 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 8.1. 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 8.1). 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 8.1). 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 8.1** 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 8.1). 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 8.1). 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 8.1) 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 8.1. 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>
<thead>
<tr>
<th>Entry point</th>
<th>Process</th>
<th>Strategies</th>
<th>Facilitator/s</th>
<th>Outcome/s</th>
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<tbody>
<tr>
<td>1) Pre-study scoping</td>
<td>Identify case study territory</td>
<td>(i) Literature review&lt;br&gt;(ii) Media analysis&lt;br&gt;(iii) Discussion with Local Government Councillors&lt;br&gt;(iv) Research ethics application&lt;br&gt;(v) Finance agreement&lt;br&gt;(vi) Budget proposal</td>
<td>Principal Research Scientist with multi-disciplinary skills in social research and science field/s</td>
<td>Ascertain suitability of case study region&lt;br&gt;Ethics approval&lt;br&gt;Funding and budget approval</td>
</tr>
<tr>
<td>2) Setting the scene: Socio-political assessment</td>
<td>Trust building with local actors</td>
<td>(i) Semi-structured interviews with key informants; convergent interviewing using snowballing technique&lt;br&gt;(ii) Stakeholder analysis&lt;br&gt;(iii) GIS mapping of study area&lt;br&gt;(iv) Preliminary community feedback report&lt;br&gt;(v) Risk analysis</td>
<td>Initially a team of two researchers</td>
<td>Establish understanding of power relations within stakeholder groups&lt;br&gt;Insight on problematic NRM issues within community; differences in views, values and levels of controversy&lt;br&gt;Identify and manage risks</td>
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<tr>
<td>3) Community engagement</td>
<td>Identify problematic issues within community</td>
<td>(i) Open meetings&lt;br&gt;(ii) Advertising &amp; media&lt;br&gt;(iii) Venue hire &amp; catering&lt;br&gt;(iv) Expressions of interest for follow up study&lt;br&gt;(v) Further stakeholder analysis to ensure diversity of views represented</td>
<td>Team of three to four research scientists/educators with predetermined organisational roles&lt;sup&gt;3,4&lt;/sup&gt;: a) Independent facilitator b) Gatekeeper c) Recorder/Evaluator (Principal researcher) d) Modeller</td>
<td>Gauging relative importance of community issues for follow up study</td>
</tr>
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</table>
4) Exploring problematic NRM issues

Collaborative social learning process

| (i) | Social learning process with Participatory Advisory Committee (PAC) paid a nominal sitting fee |
| (ii) | Develop participatory criteria and indicators of success |
| (iii) | Participatory modelling if technical expertise and/or interest of participants |
| (iv) | Invited experts to add creditable scientific and empirical knowledge |

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) | Evaluation survey of participants and non-participants |
| (ii) | 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

6) Governance monitoring

Mechanisms for implementing recommendations

| (i) | NRM Policy analysis |
| (ii) | 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

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 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 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 8.1. 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 8.1) 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.

Acknowledgements

Sincere gratitude is expressed to all participants in the study. The Cooperative Research Centre for Forestry based in Hobart, Tasmania, funded this research under the Vibrant and Sustainable Communities Project 4.3.4- Participatory modelling. We the authors take sole responsibility however for the content presented herein. This research was approved by the Human Research Ethics Committee at Southern Cross University in November 2007 (ECN-07-158). Suggestions by anonymous referees provided valuable insights and contributions to this manuscript.

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).
9.1 Addressing need for innovation in community engagement to resolve conflict over land-use change

Rapid land-use change arising from incentives for afforestation in Australia particularly since the late 1990’s has created tensions in rural communities previously dominated by agricultural enterprises. This thesis aimed to test an innovative and novel approach to community engagement with the plantation forestry industry through the application of a social learning study incorporating participatory modelling for collaboratively addressing and resolving natural resource issues of controversy. This aim was motivated by the need for new and effective mechanisms of community engagement that foster knowledge transfer and development, and promote improved decision making built on factual evidence rather than perception.

Previous research into the social dimensions of plantation forestry landscapes has been limited to the temperate regions of Australia, with major contributions referred to in this thesis from Schirmer (2008a, 2008b, 2009), Schirmer et al. (2005, 2008), Williams (2008), Williams et al. (2003, 2008), Barlow and Cocklin (2003), Dare et al. (2008, 2010a, 2010b) and Lockie (2003). This study reports on findings from a case study of a sub-tropical region in north-eastern NSW, being the Upper Clarence catchment, that explored the effectiveness of social learning for the development of a shared understanding of socio-ecological and economic system dynamics of the plantation forestry industry, while fostering an environment of equal opportunity to share views and develop relationships through local actor empowerment.

It was found in the study that invasive weeds and insect attack in hardwood eucalypt forests were major issues for the sub-tropical region compared to temperate region plantations.
Another major difference was the lack of regional processing and manufacturing facilities for plantation timber in the Upper Clarence catchment of NSW, found to be the major factor challenging the financial viability of the industry. The majority of timber in the catchment was found to be harvested for export pulp wood, where market demand and prices were currently low and transport to the nearest port of Brisbane expensive, making break even profitability difficult.

9.2 Contributions of thesis to literature: Mobilising social capital, social learning, local actor empowerment and participant evaluation

Participants in the study were actively involved in developing guidelines, criteria and indicators for evaluating the success of the social learning exercise implemented through a voluntary participatory advisory committee (PAC). This approach was taken to address an established shortfall in literature for participants to be involved in the evaluation process to make it more robust (McGurk et al. 2006, Laurian and Shaw 2009). Participants further helped in empirical data collection and critical investigation of natural resource management concerns within the local community over land-use change to hardwood plantation forestry from traditional agricultural livestock and cropping systems. A combination of local, expert and scientific knowledge was explored during PAC meetings using strategies including group brainstorming, open forum discussions, visual simulation modelling and tabulation of data. Findings from the study confirmed that conflict between stakeholders with diverse views towards plantation forestry could be reduced through collaborative problem solving in a social learning environment of equal opportunity.

There was evidence that a sense of empowerment was achieved from involvement in the iterative and reflexive social learning study for groups that felt marginalised beforehand, including the farming group. Empowerment was measured as a psychological construct through an increase in self-esteem and confidence and improved inter-personal relationships.
It was based on perceptions and action of participants as a result of collective involvement, a methodology supported in research by Laverack and Wallerstein (2001) previously used in health promotion discourse. Participant evaluations together with researcher surveys and observation helped in the development of stakeholder analysis techniques for measuring and illustrating change in positions of power and influence and attitudes of stakeholders using a stakeholder force-field matrix. These methods contributed to literature in the field of individual and group assessment of attitudes and empowerment, reported to be limited by Laverack and Wallerstein (2001).

Findings of this study contribute to the literature for evaluating the effectiveness of participatory modelling for exploring natural resource system dynamics and alternative management scenarios. Participatory modelling was found to be most useful as a flexible tool embedded into social learning processes to cater for different skill and interest levels of participants. In the initial stages of the study, participatory modelling strategies helped engage PAC members into discussions on controversial issues and start to examine various land management practices, particularly for fire management planning and socio-economics of competing rural industries, however participants chose not to learn the simulation software program ‘Simile’ themselves.

This finding was a surprise, in that PAC members were trusting and happy for the expert modeller on the facilitating research team to use the simulation software as a tool for collating and analysing data to deliberate over and limit their technical involvement. Nevertheless, participants rated the technique of participatory modelling highly in the evaluation for examining system dynamics of plantation forestry, contributing to the success of the study. Similarly, Pahl-Wostl et al. (2007) consider participatory modelling most useful when incorporated as an analytical tool into broader social learning processes, where this
approach has been referred to in literature as Participatory Decision Analysis (PDA) by Voinov and Bousquet (2010).

Therefore, it can be concluded that in this study participatory modelling as a purely analytical tool was not highly effective, however most useful when incorporated as a tool of social learning. This proved a useful risk management strategy to allow other tools to be mobilised such as data tabulation in spreadsheets to cater for participant interest and familiarity with more widely used software programs. Researcher experience with participatory modelling suggests that the tools selected for use are highly dependent on the skills, interest, and type of learners (i.e. auditory, aesthetic and/or analytical) in the group involved. Vanclay et al. (2006) found participants in developing countries to be more interested in visual modelling as they were more questioning and critical of authorities and felt very strongly about contributing to the problem solving process. Alternatively Giupponi (2006) suggests that for participatory modelling to be more effective, stakeholders and experts can be screened for interest and abilities for using simulation software as an initial step in these types of studies.

9.3 Attitudes and confounding effect of personal value systems

Fire management planning in plantation forests was explored, and the additional knowledge contributed by invited expert speakers helped alleviate some fear of bushfire threats from plantation forests to local communities. Socio-economic investigations highlighted findings contrary to previous community perceptions. Rural populations were found to have increased rather than decreased as initially gauged; occupancy rates of dwellings for properties purchased for plantation establishment had increased rather than decreased; and the pesticide ecosystem load per hectare was significantly less for the plantation forestry industry compared to cropping enterprises in the region when standardised over a typical 15
year plantation forestry production cycle. These findings suggested that social research can help provide empirical evidence to contribute further understanding on impacts of land-use change and lead to attitudinal change in participants. This can be achieved in a social learning environment through interaction and deliberation, a view shared in overseas research by Connick and Innes (2003), Pahl-Wostl et al. (2007) and Voinov and Bousquet (2010).

Power relationships in group learning situations have been reported to have a direct influence on processes of knowledge development and fostering attitudinal change (Buchy 2004). In this study, representatives from the plantation forestry industry were initially observed to have greater power, demonstrated by dominance in open conversations and attempts to direct lines of enquiry. Also some of the quieter participants felt this initial dominance and a degree of intimidation, expressed through individual and confidential conversations outside meeting times.

As discussed in the methodology section of Paper 5 (Chapter 8), a variety of learning strategies needed to be introduced to counteract this dominance and provide a fair platform for all participants to be equally involved and have power to influence. Strategies that proved effective for sharing power included brainstorming in groups where all participants were given time to put forward their views in turn and have them recorded, regularly with the use of cognitive mapping on paper flip boards. Further, during open discussions, quieter members of the groups were often prompted to contribute their opinions to elicit valuable local actor knowledge. These views are consistent with findings by Woodhill (2010) and Buchy (2004) about “teaching by being” through participation and power sharing.

My initial perceptions in the early stages of the study where I felt that the plantation forestry industry group had greater power in deliberations over other more marginalised groups such as the farming sector, indigenous and environmental groups within the case study region were based on economic dominance, embodied in the financial affluence of the
The plantation forestry industry became debt ridden and unable to develop infrastructure and maintain the management of properties, themselves becoming a vulnerable group in society. This finding reinforced the philosophies of critical theory that group power in mediations can be transitory in place, space and time, and changes in power between groups can alter political and economic processes as described by Kellner (1989). The resilience of communities to adapt to changes appears to be dependent on the values of the population, and how these affect attitudes and supportive behaviour in times of hardship. Those communities where individuals show empathy and care for the less powerful members appear to be more resilient.

Further research is recommended in the field of stakeholder analysis using critical theory for examining how individual values influence attitudes particularly in the field of natural resource management. While views on most issues explored were consistent within stakeholder groups, in part explained by the concept of scripting by Vanclay et al. (2007), a cross section of views remained within stakeholder groups towards the use of pesticides and their potential impacts on ecosystems and human health after the social learning study. Environmental values appeared to cross stakeholder boundaries, adding a confounding effect to stakeholder analysis. On the other hand Rathzel and Uzzell (2009) argue that transformational environmental education (TEE) should not focus on values and morals, but rather endeavour to develop theoretical understanding and concern about environmental
problems in local actors. These diverse findings suggest that further research is required to improve our understanding on how value systems contribute to attitudes and influence attitudinal change when challenged with new information.

There were some marginalised groups in the community including the Aboriginal community who only had limited representation throughout the study. Their views were transmitted through a local participant who was actively involved in the community although not of aboriginal decent. The lack of full representation of some groups would create some confounding effects on results, however beyond the scope of this thesis to explore.

9.4 Need for new performance based national afforestation policy

It was found that the Managed Investment Scheme (MIS) model supporting plantation forestry expansion through fiscal incentives from the federal government in up-front tax deductions for plantation establishment costs had some major flaws. Several private plantation forestry companies based on MIS for generating investor income to support operational and business management and expansion collapsed during the period of this study, highlighting the distortionary nature of the policy. Further limitations in the regulation of the NSW Plantations and Reafforestation Act and Code of Practice, including legislation for management of retained vegetation and clearing of regrowth timber continued to be areas of contention with other land users. Further research on developing an improved MIS model for retail forestry in Australia is necessary to ensure future viability of the plantation forestry industry.

An improved performance and productivity based model has potential merit for making the plantation forestry industry more sustainable and competitive with other rural industries. The demonstration of sound practice and economic performance that promotes long term sustainable timber production in Australia would likely create a positive identity for the plantation forestry industry, and improve acceptability and ongoing support from other
industries. Changes required by plantation companies for certification, such as with the Australian Forestry Standard and Forest Stewardship Council is likely to assist this process to some degree. However, this is dependent on the employment of independent organisations for compliance certification and regular auditing of private companies, with severe penalties recommended for infringements to improve industry standards.

It is interesting to note that a change to the fiscal environment for afforestation schemes in Great Britain in the late 1980’s led to plantation forestry becoming more socially acceptable (Nail 2008). This was firstly a result of the creation of Woodland Grant Schemes (WGS) for farmers that incorporated investment targets with public benefits requiring access, conservation, and biodiversity protection. More recently forestry policy has devolved in the United Kingdom with separate schemes operating in England, Scotland, Wales and Northern Ireland which are heavily subsidised by the European Union (J. Taylor, Policy Officer for UK Forestry Commission, pers. comm. 2010).

Since 2007, the Woodland Grant Scheme was replaced in Scotland by an alternative land management support scheme for simplifying delivery and access, and promoting further afforestation based on improved performance and competitiveness while continuing to target social and environmental improvements (DFGS 2006). Similarly, England has evolved forestry grant schemes that promote plantation development on agricultural land based on meeting regional targets and improving public access, biodiversity and heritage conservation, protecting water and soils, enhancing the landscape for living and working, while aiming to produce high quality timber (EWGS 2009). Eligible farmers are paid to take agricultural land out of production for establishing plantations, and then paid an annual incentive for maintenance according to specific performance criteria.

While these multi-functional forestry programs have led to improved community and social outcomes, overall afforestation rates in the UK are still considered to be low according
to Koupelovskaya-Buttoud et al. (2009) in regards to climate change targets set for EU support arrangements. Factors limiting further investment have been reported to be increasing land prices as subsidies have been capitalised in land values, debate surrounding food security has been an ongoing disincentive to convert agricultural land to trees, and lack of profitability in forestry.

Similarly Low et al. (2010) discuss alternative policy mechanisms for supporting plantation forestry development for countries other than Australia, including tax-based levies used in Norway and Indonesia based on a forest user accountability system. These levies fund long term plantation investment towards achieving sustainability targets. Alternatively, a forestry cooperative model is presented, such as that supported by the Canadian government whereby funds from a large number of small grower investors are pooled to enhance their purchasing power while promoting sustainable forest usage and independence for rural communities. Further discussion on forestry co-operatives can be found at van Gossum et al. (2005).

The implication for Australia is that given the market failure of the MIS retail forestry scheme during the global financial crisis of 2009-2010, and a current annual trade deficit of approximately $2 billion in forest products, mainly for paper, pulp products and sawn timber (ABARE 2009), policy makers should be exploring alternative transformative afforestation schemes. There is merit for developing an incentive and performance based scheme for Australian farmers through diversifying parts of their properties for plantation establishment, particularly on areas of lower agricultural productivity or where rainfall regimes make cropping marginal, which would spread risk and potentially assist in climate change adaptation. This could be done in conjunction with government assistance for setting up community based forestry cooperatives to maximise economies of scale from collective action in purchasing and marketing.
According to Rojas-Briales (2010), Assistant Director-General of United Nations Food and Agriculture Organisation, governments across the world should be less reluctant to use incentives linked to development, particularly in responding to the urgent need for further afforestation and restoration of existing forests in addressing climate change threats. Rojas-Briales (2010) reports of a global net loss of forests currently of 5.2 Million hectares per year comprised of 13 Million hectares of deforestation mostly in Latin America and continental Africa with Australia also contributing to this loss, and 8.2 million hectares per year from afforestation and spontaneous recovery. These figures suggest that significant changes to forestry policy and governance are required in Australia.

9.5 Research institutions as bridging organisations for linking science with community and multi-levels of governance

In this study, a university research team acted as an effective bridging organisation for developing synergies that linked science with community through facilitating a community-based social learning process. Social capital was effectively mobilised to enhance collaborative problem solving over issues of controversy resulting from expansion of the plantation forest industry. The role of research institutions as bridging organisations for linking vertical levels of governance and horizontal linkages within community is an emerging field in natural resources, with limited reports including Hahn et al. (2006) in Sweden, Wilmsen et al. (2008) in the USA, and Prager (2010) in Australia. Further, Berkes (2009) synthesizes new bridging approaches to co-management, being “the sharing of power and responsibility between the government and local resource users” that allow joint action between multiple parties. This builds on the more traditional approach of adaptive management, described as “learning-by-doing” which was less collaborative in nature. New approaches are increasingly based on knowledge generation and learning.
In Australia it is possible that the federal government could co-finance social learning initiatives through industry Research and Development Corporations (RDC’s) to collaborate with regional universities to help resolve land-use conflicts. This type of work is currently needed with the forestry industry as well as resource mining, natural gas drilling, and renewable energy sectors.

Controversial issues were identified firstly through a scoping survey and semi-structured interviews with key informants, and confirmed at follow up public meetings. Model diagnostic and evaluation frameworks were developed to support more widespread application of social learning studies as a method for addressing and resolving issues of land-use controversy. It is recommended however, that for future studies a longer time frame is used than the three years available for this study. This is to extend monitoring and implementation of practice changes. Long term research funding however would be required and greater resource allocation.

The findings from this study helped develop a robust process methodology for implementing further social learning studies. There were however limitations to the up-scaling of findings in this study as the plantation forestry industry were under no formal obligation to adopt recommendations, nor governing bodies to enforce changes. Recommendations to operational and management practices that could improve sustainability and socio-economic outcomes within the local community however gained appreciable support from the plantation industry. The guidelines for a systematic methodology on social learning however, provide flexibility for up-scaling these processes where necessary, which may be particularly useful where policy initiatives are involved.

Community engagement was found to be most effective when facilitating researchers had education and or facilitation experience and when they were independent and impartial towards the plantation forestry industry for building trust and eliminating potential for bias.
This was a shortfall recognised in work by Dare et al. (2008, 2010a, 2010b, 2010c) who suggested having operational foresters act as facilitators. Facilitating researchers needed skills for identifying participant learning needs and implementing flexible learning strategies to keep participants engaged and interested in the process. Social learning offered intellectual (Dellenbach and Zimprich 2008) and empathetic engagement (Gruen 2009) not previously used in community engagement activities with the plantation forestry industry in Australia. Empathetic engagement relied on mutual consideration and removal of self-protective and defensive behaviours among participants. On the other hand, intellectual engagement depended on motivation to undertake roles in cognitive activities such as concept mapping and problem solving.

The application of a social learning study led to a shared understanding on issues (Appendix 6) based on collaboration and relationship building between participants and with researchers. This supported previous applications of social learning theory in other countries by Conroy et al. (2002), Keen et al. (2005), Mostert et al. (2007), Steyaert and Jiggins (2007) and Muro and Jeffrey (2008) for building local actor capacity for improved problem solving that could lead to better social outcomes than previously possible. It was further found that plantation forestry has intrinsic values that can be incorporated into management. These can include operations that lead to better water quality, improvements to biodiversity conservation, and opportunities for employment and training of youth that can all contribute to an improved sense of well being within the local community.

The need for connecting community-based processes across scales and levels of governance was established, aimed at developing improved management practices for natural resources. Prager and Freese (2009) rated the importance of land users accepting recommended changes to management as paramount to legitimising practice within the wider community. While Brondizio et al. (2009) suggested that participatory processes cannot be
considered in isolation; rather they are connected to other levels of government through either competing or cooperating for authority over natural resources, and are considered interdependent.

For these reasons and the fact that previous models for regional governance of natural resources in Australia have not achieved broad-scale beneficial outcomes, a new systematic methodology was developed for social learning within an adaptive co-management framework. This involved institutionalising community-based processes of social learning into a landscape management model dependent on synergies between diverse sources of social capital. This new mechanism offers linkages for bottom-up processes, based on finding local solutions to local problems, to higher levels of government in order to challenge and influence policy over natural resource management.

9.6 Conclusions: Merits of social learning in transformative environmental education and land-use policy reform

In conclusion, it was discovered that through the operationalisation of a social learning process, stakeholder participation helped reduce natural resource management controversies surrounding expansion of the plantation forestry industry in a unique case study of a subtropical catchment in north-eastern NSW. This was established through an innovative participant driven evaluation highlighting a significant change in attitudes directly attributed to increased knowledge and understanding of dynamic landscape systems. The novel social learning study proved an effective community-based mechanism for engaging local actors to deliberate over plantation forestry issues. It further provided a platform for collaborative problem solving and the development of a set adaptive co-management recommendations that could improve plantation forestry outcomes within the community and landscape while minimising social impacts.
Findings from this study suggest that universities have significant potential for acting as bridging organisations through facilitating independent learning processes that link science with community and vertical levels of governance. They can help foster working relationships and promote local actor empowerment for knowledge transfer and stimulating innovation, together with assisting in future policy development. Through a participatory advisory committee (PAC) setting, a neutral environment for open and frank discussion between stakeholders with diverse views is offered. It is recommended that the financing of proposed social learning studies to help resolve conflicts over natural resource management issues, particularly in the field of land-use change, need to be supported by the industries or governance bodies initiating the change. This should come from joint commitments from federal or state and territory governments responsible for legislating policy change and the industries undertaking the land-use development.

As an iterative and reflexive process, social learning can help build knowledge to strengthen a community's capacity to collaboratively manage ecosystems sustainably for human well-being. This thesis contributes an innovative and rigorous evaluation framework in the form of a systematic methodology for social learning that can support the operationalisation of further processes in communities where conflict exists over the management and allocation of natural resources, in particular over land-use change, and whereby resolution could lead to improved community outcomes. Social learning was found to promote attitudinal change, and is thereby recommended as a useful form of transformative environmental education for assisting rural communities adapt to external influences such as climate and policy change.

The study further identified the potential of social learning processes and participatory modelling for use in deliberating over land-use policy impacts, thereby offering a mechanism for challenging existing policy and contributing to policy reform for improving triple bottom-
line deliverables at the landscape scale. The current political climate of forestry in Australia typified by under-performance and regulation problems of the managed investment scheme retail forestry program for afforestation, together with continued rates of deforestation, offer a valuable opportunity for regional innovation in forestry policy, governance and management processes through improved leadership and collaboration between different land-use sectors.
**Glossary**

*Adaptive co-management:* The use of vision and leadership by groups of stakeholders to collaboratively respond to change by producing innovative and sustainable natural resource management practices, re-allocating resources and enabling policies based on the formation of new knowledge networks or reorganising existing networks where opportunity for adaptation is not available through existing institutions and policy.

*Adaptive strategies:* Pro-active strategies associated with social learning and institutional change based on shared knowledge and experiences for improving long-term outcomes. Some strategies include broadening spatial scales for trading produce that improve mobility and efficiencies in resource use and creating new social networks that help develop a shared understanding of dynamic resource problems.

*Bottom-up approach:* This refers to a stakeholder driven process to develop decision making rules and the formulation of human-induced drivers. It opposes a top-down approach which refers to policy developed by government policy makers through consultation with regional governing authorities and enforced on end users with little to no input from end-users.

*Bridging organisation:* A research organisation such as a university, that facilitates a partnership approach towards linking science with community for the development of collaborative solutions to natural resource problems. It aims to strengthen skills, social networks, self-reliance and organisation in communities through tailoring processes to local needs in context of their socio-political systems and networks.

*Capacity:* The ability to apply knowledge in problem solving processes and innovate to create change.
**Citizen:** A member of a state or nation who holds an allegiance by birth or naturalization and is entitled to full civil rights under existing government legislation.

**Community:** A heterogeneous group of people who live near each other and share common interests, needs and set of institutions.

**Community engagement:** A planned process aimed at working with specific groups of people connected by a special interest or affiliation to address issues affecting their well-being. It is based on inclusiveness to ensure consideration is made of the diversity that exists within a community.

**Conflict management:** Skills and strategy used for reducing negative impacts between stakeholders with diverse views and conflicting value systems.

**Devolution:** Policy that aims to include a more diverse set of local actors in land-use management for empowering marginalised citizens, and improving community livelihoods and conservation of natural resources. Governments give recognition to local customary knowledge and often land rights.

**Empowerment:** An improvement in stakeholder capacity that increases opportunity to contribute to and influence decision making processes over natural resource management. It is a psychological construct based on perceptions, actions and interpersonal relationships that influence an individual’s self-esteem and confidence by participation in group activities.

**Empathetic engagement:** The transfer of affect through knowing and feeling another person’s emotions or cognitive thoughts, and responding compassionately.

**Environmental ethics:** Moral consideration beyond humans to include concern for the well being of individual plants and animals, species and ecosystems.
**Evaluation:** The process of systematically assessing the merit or worth of an act or process.

**Globalisation:** Processes and initiatives that broaden decision making and action to the global scale based on hyper-mobility of resources, people, technology and services, increased communications, and the neutralisation of distance and place.

**Governance:** The interactions among structures, traditions and processes that determine how power and responsibility are exercised, who by and how decisions are made, and the level of citizen or stakeholder involvement in the management of natural resources. Governance can help resolve tradeoffs and provide a vision and direction for sustainability.

**Institutional capacity:** Quality determined by available resources including human, social, financial, and built capital, and the processes that enable governance to be exercised and management to be implemented, including planning, administration, and delivery and engagement activities.

**Integration:** An inclusive and interactive approach to systems analysis considering all components.

**Intellectual engagement:** The preference to actively participate in cognitively demanding activities, including reading, problem solving, abstract thinking and curiosity. It is based on epistemological understanding of knowledge, and helps with social development and sustaining motivation.

**Key informant:** A person interviewed that is considered to be well informed and respected in the community and hold views consistent with their associated constituency.

**Participation:** The involvement of stakeholders in social studies for gathering information and consultation.
**Participatory modelling:** An analytical process using simulation software to model dynamic natural resource systems and explore alternative scenarios for sustainable solutions to complex problems involving input from diverse stakeholders. The level of involvement may vary however, depending on skills, resource availability and potential to develop capacity. The process can include knowledge sharing, data collection, setting criteria and agendas, monitoring and evaluation, model construction and interpretation, dissemination of recommendations and implementation of changes to practice and governance.

**Resilience:** The capacity for social-ecological systems to absorb disturbances by renewing or re-organising while undergoing change caused by external political, economic or environmental threats while retaining similar function and identity, including species and ecosystem processes.

**Self-organisation:** In the field of adaptive co-management, self organisation involves the emergence of formal and informal networks, working in a collaborative and creative process, drawing from a range of knowledge sources and ideas, to resolve issues and move forward in response to disturbance.

**Socio-ecological system dynamics:** The study of integrated or coupled changing systems of people and their environments, and their reciprocal feedbacks.

**Social capital:** Social cohesion, relationships of trust, networks of reciprocity, identity and well being that enable people to act together effectively to pursue shared objectives.

**Social learning:** Knowledge sharing and creation between stakeholders with diverse experiences and views on natural resource management for embedding in learning processes that strengthen the capacity to collaboratively manage ecosystems sustainably for human well-being.
**Stakeholder**: Social actors or institutions that have a significant or specific stake in a given set of resources that acts at various spatial levels (e.g. local, national, international, private or public) and can affect or be affected by resource management problems or interventions.

**Stakeholder analysis**: This is a methodology used to identify and group different categories of people based on characteristics with regard to areas of interest or influence around policy, activity, project or organisational objectives.

**Transformative sustainability**: Processes which create fundamental change to social conditions and behaviours considered to have led to environmental degradation.

**Triple bottom line**: Environmental sustainability, social responsibility and financial viability, used as criteria when judging the overall performance of a company or business entity.
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social-ecological systems: a working hypothesis for a participatory approach.


Appendix 1: Semi-structured interviews

1.1 Information sheet

**Project:** Evaluate the effectiveness of stakeholder participation in developing a shared understanding of plantation forestry dynamics: A case study of the Upper Clarence catchment of north-east NSW.

**Introduction:** My name is Andrea Leys and I am conducting this study as part my Doctorate in Environmental Science at Southern Cross University, Lismore campus.

I will be conducting a series of surveys, interviews and meetings with a cross section of people from the community to identify issues of concern regarding the use and management of natural resources. This will include issues of land-use and their perceived impacts on the environment such as on soil and water properties, as well as societal impacts, including relationships, infrastructure, employment and investment. All groups within the community are invited to participate, including the plantation industry, farmers, cultural groups, governing authorities, environmentalists, scientists and interested citizens.

**Research:**

- This research involves the completion of a Survey to identify issues of concern and people who would be interested in participating in interviews and a modelling exercise. People can choose to remain anonymous at this stage to protect their confidentiality, and return the Survey by post. An ‘Expression of Interest’ form can be returned separately for those wanting to participate further in the study, however don’t want to be identified from the Survey.
Conduct semi-structured interviews with those participants who nominated themselves on the separate ‘Expression of Interest’ form for the further collection of data on stakeholder attitudes, power and influence. This is designed to get some further baseline data to gauge initial perceptions on issues, and relationships between different stakeholder groups, which can then be used to monitor changes throughout and at the completion of the study.

Hold an open meeting to discuss the study with all interested members of the community, and address expectations of participants.

This research involves the selection of a Participatory Advisory Committee (PAC) to work together to model conceptual issues, and then formalise them with the help of a computer aided software package to explore alternative scenarios for the use and management of natural resources. This is a learning exercise aimed at sharing local knowledge and experiences together with any required expert advice from external parties such as scientists, to generate a shared understanding of natural resource dynamics. It is also aimed at developing skills in the use of the computer software modelling package ‘Simile’, so it can be used by interested practitioners after the completion of the study. Several meetings of the PAC will be necessary. Members of the PAC will be paid a retainer and asked to sign a confidentiality agreement.

Research results would be presented back to the community at an open meeting.

**Ethical Risks**: This research has been assessed as ‘low risk’, and therefore minimum discomforts are expected for the participants. Should any discomfort arise, please contact either myself or the supervising researcher whose contacts are listed below to address problems early. Data collected will be kept confidentially by the researchers from the University for collation and analysis.
**Publication of results:** Information from this study will be used in research publications. If you consent to information you provide being published, please sign the attached ‘Consent Form’.

**Enquiries:** For any further information or general enquiries regarding this study please contact either;

Andrea Leys: PhD Candidate

School of Environmental Science and Management

Southern Cross University

PO Box 157

Lismore NSW 2480.

Phone (Office): 02-66203158

Mobile: 0438875935

Email: aleys10@scu.edu.au

Professor Jerry Vanclay: Principal supervisor.

Acting Head of the School of Environmental Science and Management

Southern Cross University

PO Box 157

Lismore NSW 2480.

Phone (Office): 02-66203147

Email: jerry.vanclay@scu.edu.au
Consent: This research has been approved by the Southern Cross University Human Research Ethics Committee. The approval number is ECN-07-158. If you have any concerns about the ethical conduct of the research, you should write to the following person:

Ethics Complaints Officer,
Human Research Ethics Committee,
Southern Cross University,
PO Box 157,
Lismore, NSW 2480
Email: sue.kelly@scu.edu.au

All complaints are investigated fully and according to due process under the National Statement on Ethical Conduct in Human Research and this University. Any complaint you make will be treated in confidence and you will be informed of the outcome.
1.2 Consent form

Evaluate the effect of stakeholder participation in developing a shared understanding of plantation forestry dynamics: A case study of the Upper Clarence catchment of north-eastern NSW.

Research Investigators; Andrea Leys and Jerry Vanclay

Name of participant: ___________________________________________________

I have read and understood the explanation of the project – Evaluate the effect of stakeholder participation in developing a shared understanding of plantation forestry dynamics: A case study of the Upper Clarence catchment of north-eastern NSW.”

- I understand that the project is being conducted for research;
- I understand that information disclosed from surveys, interviews and meetings will be recorded;
- I am 18 years of age or above;
- I consent to participate in the project;
- I acknowledge that the possible effects of my participation in the project have been explained to me to my satisfaction;
- I have been informed that I am free to withdraw from the project at any time without explanation or prejudice; and
- I have been informed that the confidentiality of the information I provide will be safeguarded subject to any legal requirements.

Signature _________________________________ Date _______________

(Participant)
1.3 Semi-structured interview questions

Introduction:

- Researcher introduces themselves.

- Explains purpose of this research;
  a. Identify which dynamic systems the community would like studied.
  b. Using participatory modelling, how does a better understanding of social-ecological dynamics influence attitudes?

- Explain how this study integrates into the wider Communities CRC-Forestry project which aims to increase understanding of the social dimensions of forestry through addressing socio-economic impacts, community attitudes, and strategies for community engagement.

- Provide a copy of the information sheet, consent form and expression of interest to participate in further stages of the study.

- Provide opportunity for participant to ask questions or comment at this stage.

- Ask participant if they agree to have the interview audio recorded.

- Ask participant to sign the consent form, and if interested complete and sign the expression of interest form.

  Note: Comments in grey colour relate to reflection and justification for asking questions. However, questions are a guide only, with opportunity to explore particular areas of concern to participants and emerging themes.

Theme 1: Social

(1) I’d like to start with asking you to tell me a little about your rural interests and the community you live in. Can you tell me more about your farming/forestry interests and how long you have been on this property/associated with the industry?
(After the stakeholder has responded, prompt with the following questions. Note "a" is only relevant to land owners. Commence with "b" if not a land owner).

(a) Have you made any recent changes to the enterprise mix on your property/s?

(Find out the current proportions of their enterprise mix, what initiated these changes, and whether they are happy with choices made)

Provide insights into current pressures for land-use or enterprise changes.

(b) Do you like living in the community?

(Why/why not? Explore neighbours, other land users, services such as banking, health, education, supplies & equipment and agricultural extension)

Provide an indication of whether certain groups or individuals like living in their rural community under the current pressures. Unhappy individuals may provide different views.

(c) Is there a strong sense of community among people you know?

(Do they participate in any community activities, feel a sense of belonging and rurality within the community, respect cultural heritage?)

Identify whether the community still values rurality in the sense of strong community ties and participation.

(d) Do you use forests for any recreational pursuits?

(Bushwalking, shooting, camping, bird watching, motorbike riding, horse riding? Would you like private plantations to be accessible?)

Identify alternative uses of forests and importance of access.
(e) Looking at the following photos of various landscapes, could you comment on features which appeal to you?

("Traditional" grazing scene, plantation forest, native forest, dairy, macadamia plantation, annual crop?)

Looking to assess people’s perceptions towards different landscapes.

(2) Can you tell me a little about who you believe has power to make decisions on natural resources?

(Prompt with whom do they believe to have the most power over natural resource management? Follow with more in depth questions)

Looking to see who has power to make informed decisions on natural resources, identify where that power comes from (such as through local knowledge, legislative rights, scientific knowledge, pre-existing rights etc), and assess whether landholders understand the decisions that are made.

(a) Who has the most power?

(Power and influence of different groups rated 1(low) to 5(high).

Changes desired?)

(b) Where do they get their power from?

(Sources)

(c) Are they efficient with making informed decisions?

(Sound and fair decisions?)

(d) Who should have the power?

(Why? Changes that could be made?)

(e) Land owners only

As a landowner, are you satisfied with the current political process used to develop, implement and enforce regulations over your land?
(3) Have there been any changes to the social makeup of the community?

(Explore whether changes to land use, economic or climatic conditions have contributed to this)

Insights into how land-use change may have social impacts on the community.

(a) Do you consider this good or bad for the community? (How?)

(b) Do other people in the community share similar values to yourself towards the environment?

(Conservation, custodians, developers, pro-developers? Is this an issue?)

Theme 2: Economic

(1) I’d like to now ask a few questions about the economics of the various land-uses.

Can you tell me more about changes that have occurred to land values over the last 5 years?

(When the stakeholder has exhausted their answer, make sure they have covered the following areas)

Establishing whether changes to land-use and land values have been positive at the individual level, community level, and ecological level. Any conflicts here can help inform modelling decisions.

(a) What do you believe have been the driving forces behind the changes to land values? (eg. Land-use change, commodity prices, climate change, global economy?)

(b) Do you believe these changes to be positive or negative for you personally? (Explain)

(c) Do you believe these changes to be positive or negative for the community? (Explain)
(d) Do you believe these changes to be positive or negative for the environment? *(Explain).*

(e) Do you see any changes in the future to the viability of various enterprises? *(i.e. Beef, timber, dairy, horticulture, tourism)*

(2) Can you tell me about which industries are the major employers in the region, and what you believe their prospects are for the future?

*(Types of employment, short and long term employment)*

Establish which industries currently provide the most employment opportunities, which industries are perceived to have potential for growth, and identify any need for new industry development.

(a) Are there adequate employment opportunities within the community?

*(Which industries, changes in the future, personal contribution?)*

(b) Can you see any opportunities for new industries in the region?

*(Value adding, new products or services)*

(c) Landholders only.

Do you have any off-farm income? *(Is it necessary to remain on the land?)*

*Insight into the viability of current business enterprises, and their attitude & willingness to change and diversify.*

(3) Do you integrate the use of any recent technological advances into your business?

*(What, who helped educate and implement. Competency at computing?)*

*Assess their capacity to embrace new technologies and ability to use computers if they express an interest in the computer modelling stage.*
Theme 3: Ecological

(1) I’d like to now to ask you some questions relating to local ecology, specifically conditions of the local water, soils and biodiversity status. Have you noticed any changes to these over recent years?

*(Once the stakeholder has answered, explore the following areas)*

*Provide insight into impacts of various land-uses and legislation on biodiversity to identify any specific systems for modelling.*

(a) Have you noticed any changes to water quality and yield due to land-use change? *(Not as a direct result of the previous long lasting drought or recent flood)*

(b) Have you noticed any problems with soil erosion and fertility under different land-uses? *(Explore whether changes to management practices, or changes to land-use have contributed to this?)*

(c) Have you noticed any changes to the wildlife populations in the local area? *(Suggest rate as declining, no noticeable change, or improving. If changes noticed, get them to explain what factors they believe have contributed to this)*

(d) Say you had an endangered species on your property, do you believe the species would do better without the current legislation, instead with new controls and incentives? *(Explore any specific management practices used to protect these species and how this could be improved through new controls).*

(e) Have you noticed any changes to the abundance of weeds, pests or disease in the area?
(Explore causes, controls used, what improvements could be made to management? Fire regimes i.e. low or high intensity burns, frequency?)

(2) Does the current legislation adequately provide all landholders with sufficient protection and control over noxious weeds and feral animals?

(*Native Vegetation Code of Practice, Plantations and Reafforestation Code of Practice. Rural Lands Protection Board, EPA, Local Council, Industry & Investment NSW*)

(3) Does current legislation restrict how you operate your business?

(Cover areas such as what do you believe have been the driving forces behind the development of existing policies? Have these policies influenced your opinion towards whether you support or oppose particular industries?)

Provide insight into their level of understanding of the driving forces for policy development for the protection of natural resources at a larger scale.

(4) Is there anything that could be done to improve the ecology of the local area?

(Improve understanding of ecology and dynamics? Change regulation, power shifts in authority to produce more sustainable practices?)

Assess social capital in the area of ecological dynamics, and interest in developing a further understanding through modelling.

(5) Does the industry you are involved with provide any ecological services to the local community?

(Look at utilities such as food or timber, environmental benefits, employment, recreation)

Prompting participant to think beyond their farm gate to the level of community.

(6) Can you suggest anything the forestry industry could do differently to improve relationships and better integrate into the community?
(Such as provide value-adding industries like a timber processing plant, biodiesel plant; increased local employment in operational activities such as silviculture and harvesting; production of more valuable timber species)

Identify areas in forestry that could be explored in modelling stage.

(7) Do you have an issue you would like to explore with simulation modelling and expert help? (Explain)

Provide participant with the opportunity to address any other issues that could be explored in participatory modelling.

Theme 4: Support for plantation forestry industry

(1) Can you tell me how you rate your current level of support for the plantation forestry industry within the catchment? (one answer only)

(a) Highly supportive (b) Supportive (c) Neutral (d) Opposed (e) Highly opposed

(2) What reasons can you give towards your above answer?

(Thank participant for their contributions. Offer them the opportunity to join a mailing list for a summary of results).

..........................................................
Appendix 2: Participatory Advisory Committee (PAC)

2.1 Expression of Interest form

- I would like to express my interest in participating on a Participatory Advisory Committee (PAC) to deliberate and explore issues surrounding regional natural resources issues relating to plantation forestry expansion in the Upper Clarence catchment of northern NSW.

- I would like to be part of the group which meets at;
  
  Woodenbong (7pm Thursdays, monthly) ………………………..Tick box □
  
  or

  Bonalbo (7pm Wednesdays, monthly) ………………………..Tick box □

- I don’t want to participate on the PAC for the social learning study, however I would like to be sent regular updates on how the study is progressing;………………………………………………………Tick box □

- I understand that the project is being conducted for research, and results will be published subject to confidentiality of individual participant names;

- I understand that information discussed at meetings may be recorded;

- I am 18 years of age or above, and consent to participate in the study;

- I have been informed that I am free to withdraw from the project at any time without explanation or prejudice; and
I am not a government employee, and would like to receive a nominal payment of $50 per session to help cover expenses for participating on the PAC. Tick box □

Name of participant: ___________________ Phone or email _____________________

Contact address:  ________________________________________________________

Major stakeholder group you identify with in your day to day business or interest activities:

*Please tick one box only*

- Cattle farming  □
- Cropping and mixed farming, including horticulture □
- Forestry / plantations □
- Scientific / education □
- Environmental □
- Urban residential / business □
- Recreational and tourism □
- Other (name: ______________________) □

Signature _________________________________ Date _______________

(Participant)

Please return preferably by the end of this meeting, or mail to the following address by Friday 13th March 2009:

Ms Andrea Leys
School of Environmental Science and Management
Southern Cross University
PO Box 157
Lismore NSW 2480
This research has been approved by the Southern Cross University's Human Research Ethics Committee. The approval number is ECN-07-158. If you have any concerns or queries, please contact the principal supervising researcher:

Professor Jerry Vanclay
Head of School, Environmental Science and Management.
Southern Cross University
PO Box 157
Lismore NSW 2480.
Phone (Office): 02-66203147
Email: jerry.vanclay@scu.edu.au
2.2 Statement by a supplier form for sitting fee payments

[Document image]

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Appendix 3: Local Business Survey

3.1 Survey of local businesses

Survey number:__________
Date: ________________

Aim: To assist local participant on PAC to collect data on impacts on local businesses from plantation forestry expansion using a survey. (Please place a tick in appropriate box/s).

Questions:

1) What type of your business do you operate? _____________________________

2) How many years have you been involved with this business?

☐ Less than 1 year ☐ 1-3 Years ☐ 4-6 Years ☐ 6-10 Years ☐ 10 or more years

3) Has there been a change in the total volume of sales and services to your business over the past 12 months?

☐ Vast decrease ☐ Decrease ☐ Unchanged ☐ Increase ☐ Vast increase

4) Has there been a change in total volume of sales and services to your business over the past 5 years (only answer is applicable)?

☐ Vast decrease ☐ Decrease ☐ Unchanged ☐ Increase ☐ Vast increase

5) Has there been a change in the total volume of products or services to plantation forestry customers from your business over the past 12 months? (These are customers that you are aware of who gain the majority of their income from permanent, casual and/or contract employment with the plantation forestry industry).

☐ Vast decrease ☐ Decrease ☐ Unchanged ☐ Increase ☐ Vast increase
6) Has there been a change in your business profits over the **past 12 months**?

- □ Vast decrease
- □ Decrease
- □ Unchanged
- □ Increase
- □ Vast increase

7) Has there been a change in your business profits over the **past 5 years**?

- □ Vast decrease
- □ Decrease
- □ Unchanged
- □ Increase
- □ Vast increase

8) List the reasons you believe for the above changes to your business

________________________________________________________________________

9) Do you believe there is a **lack of property** available for renting and restrictions to land subdivision for building in the local area that is limiting growth in population?

- □ Yes
- □ No
- □ Undecided

10) Would you like to see an increase in the local **population**?

- □ Yes
- □ No
- □ Undecided

11) Do you see a positive **outlook** for your businesses in the local area?

- □ Very limited
- □ Limited
- □ Unchanged
- □ Good
- □ Very good

12) Do you believe there are sufficient **goods and services** available from local businesses to support the local population?

- □ Very limited
- □ Limited
- □ Unchanged
- □ Good
- □ Very good

13) What particular **new businesses** would you like to see establish around town to help service the local community better?

________________________________________________________________________

________________________________________________________________________
Appendix 4: Final Evaluation Surveys

4.1 Information sheet

**Project:** Evaluating community attitudes towards plantation forestry expansion in the Upper Clarence catchment.

**Introduction:** I am Andrea Leys, a PhD candidate from The School of Environmental Science and Management at Southern Cross University who has been facilitating a participatory study to address natural resource management concerns related to the expansion of the plantation forestry industry. The Upper Clarence catchment of Northern NSW was selected as a case study area after a scoping survey of the region revealed some contention with other land-uses and local residents.

**Research:** A study is being conducted to assess changes in attitudes towards the plantation industry over time since the commencement of the study in early 2008. Different groups of people from a diverse and representative range of stakeholders within the community are to be surveyed for a final evaluation of the study. The groups to be surveyed include full participants who were involved till the completion of the study, including having been involved with a social learning study at Woodenbong. People who did not participate in the Woodenbong group study will also be surveyed to assess attitudes as a control for comparison.

Findings from the Woodenbong social learning study are available to the public through a report and are enclosed for those who expressed interest at an earlier stage.
This study is jointly funded by the Cooperative Research Centre for Forestry and Southern Cross University.

**Ethical risks:** This research has been assessed as ‘low risk’, and therefore minimum discomfort is expected for participants. Should any discomfort arise, please contact either myself Andrea Leys or the supervising researcher through the contacts below. Data collected will be kept confidentially by the researcher for collation and analysis.

**Publication of results:** Information from this study will be used in research publications with anonymity. At no stage during the reporting process are individuals identified. By returning your completed survey you are consenting to results being used in publications.

**Enquiries:** For further information or general enquiries regarding this study, please contact either of the principal researchers:

Andrea Leys on mobile 0438 875 935 or email aleys10@scu.edu.au or Professor Jerry Vanclay at office on 02-66 203 147 or email jerry.vanclay@scu.edu.au

**Consent:** This research has been approved by the Southern Cross University Human Research Ethics Committee, approval number is ECN-07-158. If you have any concerns about the ethical conduct of the research, you should write to the following person: Ethics Complaints Officer, HREC, Southern Cross University, PO Box 157, Lismore, NSW 2480, Email: sue.kelly@scu.edu.au. All complaints are investigated fully and according to due process under the National Statement on Ethical Conduct in Human Research and this University. Any complaint you make will be treated in confidence and you will be informed of the outcome. For consent you need to be 18 years of age or above. Please return your completed survey in the self addressed envelope provided by Tuesday 6th April 2010.
4.2 Final evaluation survey: Full participants on Participatory Advisory Committee

**Evaluation Survey No. 1**

**Plantation forestry expansion in the Upper Clarence catchment**

(Instructions: Please circle the most appropriate answer for each question).

1) Please rate your overall level of satisfaction with the study facilitated by Southern Cross University that you have participated in to address issues relating to

<table>
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<tr>
<th>i) Very unsatisfied</th>
<th>ii) Unsatisfied</th>
<th>iii) No influence</th>
<th>iv) Satisfied</th>
<th>v) Very satisfied</th>
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2) Do you believe that the participatory process used in the study helped increase your understanding of particular concerns in the Woodenbong community surrounding:

2.1 Fire Management in plantations?

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<th>i) Very poorly</th>
<th>ii) Poorly</th>
<th>iii) No influence</th>
<th>iv) Helpful</th>
<th>v) Very helpful</th>
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2.2 Impacts from Pesticides used in plantations?

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<th>i) Very poorly</th>
<th>ii) Poorly</th>
<th>iii) No influence</th>
<th>iv) Helpful</th>
<th>v) Very helpful</th>
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2.3 Potential socio-economic benefits of the plantation industry to the community?

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<th>i) Very poorly</th>
<th>ii) Poorly</th>
<th>iii) No influence</th>
<th>iv) Helpful</th>
<th>v) Very helpful</th>
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3) Rate the process in relation to how interesting you found the process?

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<th>i) Very un-interesting</th>
<th>ii) Un-interesting</th>
<th>iii) Non-committal</th>
<th>iv) Interesting</th>
<th>v) Very interesting</th>
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4) Rate your level of satisfaction with the different learning strategies used in the process for helping to improve your understanding of the dynamics of plantation forestry?

1.1 Brainstorming in groups

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<th>i) Very Unhelpful</th>
<th>ii) Un-helpful</th>
<th>iii) Neutral</th>
<th>iv) Helpful</th>
<th>v) Very helpful</th>
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1.2 Open discussions

i) Very Unhelpful  ii) Un-helpful  iii) Neutral  iv) Helpful  v) Very helpful

1.3 Visual models using computer simulations

i) Very Unhelpful  ii) Un-helpful  iii) Neutral  iv) Helpful  v) Very helpful

1.4 Expert opinions from guest speakers

i) Very Unhelpful  ii) Un-helpful  iii) Neutral  iv) Helpful  v) Very helpful

1.5 Local knowledge contributed by participants

i) Very Unhelpful  ii) Un-helpful  iii) Neutral  iv) Helpful  v) Very helpful

1.6 Input from research team from Southern Cross University

i) Very Unhelpful  ii) Un-helpful  iii) Neutral  iv) Helpful  v) Very helpful

2. Do you believe the process was fair in terms of opportunity to express your
individual views?

i) Very Unfair  ii) Unfair  iii) Limited  iv) Fair  v) Very fair

3. Has your working relationship with representative/s of the plantation forestry
industry changed as a result of this process?

i) Worse  ii) No change  iii) Slight improvement  iv) Sound improvement  v) Greatly improved

4. Can you attribute this change in working relationships with plantation companies
to any other of the following (Please circle if appropriate):

i) Personal discussions initiated at the open meeting at Woodenbong or Bonalbo
ii) Personal discussions only through correspondence by phone, email or letters
iii) Property visits by plantation representatives
iv) Personal discussions at local field days and shows
v) Discussions at meetings organised by local Council
iv) Other (Please name): ____________________________________________
5. Please rate the level of difficulty you had in relating to and understanding the visual computer modelling simulations as they were used in this process.

| i) Too difficult | ii) Difficult | iii) Some understanding | iv) Easy | v) Very easy |

6. Do you believe the models produced will be informative and therefore useful to the community in addressing concerns relating to plantation forestry?

| i) Useless | ii) Limited use | iii) Moderately useful | iv) Helpful | v) Very helpful |

7. Has the process used been time efficient?

| i) Very inefficient | ii) Inefficient | iii) Adequate | iv) Efficient | v) Very efficient |

8. Would you consider participatory modelling as used in this process to be an effective way to deliberate over land-use conflicts?

| i) Definitely not | ii) Limited help | iii) Some help | iv) Helpful | v) Very helpful |

9. List the positive aspects of the process:

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

10. List the negative aspects of the process:

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
11. Which specific concerns do you have regarding ecological impacts of plantations in the local area?


12. What changes have you noticed to the social demographics (population and age groups) within the local community as the plantation industry has expanded?


13. Please rate your feelings towards a sense of place in the community.

   i) None    ii) Limited    iii) Adequate    iv) High    v) Very high


14. How have your feelings towards a sense of place changed as plantations have expanded?


15. Do you think plantation forestry has the potential to offer economic benefits to the local community?

   i) None    ii) Limited    iii) Moderate    iv) High    v) Very high


16. What potential economic benefits can you see?


17. Please circle any of the following land options that you support in principle for plantation establishment:

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<tbody>
<tr>
<td>i) Privately leased properties by corporations</td>
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<tr>
<td>ii) Corporate owned property</td>
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<tr>
<td>iii) State land (public)</td>
<td></td>
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<td>iv) Family farms with agro-forestry enterprises</td>
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18. Do you support any types and uses of plantations? Circle appropriate answers.

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<tr>
<td>i) Mixed species plantations</td>
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<td>ii) Monoculture plantations</td>
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<td>iii) Plantation timber for pulp wood</td>
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<td>iv) Plantations for sawn timber</td>
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<tr>
<td>v) Plantations grown as biomass for renewable energy i.e. bio-fuels and electricity</td>
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<td>vi) Plantation by-products (e.g. thinnings/processing waste) for pulp wood</td>
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<tr>
<td>vii) Plantation by-products (e.g. thinnings/processing waste) as biomass for renewable energy production i.e. bio-fuels and electricity</td>
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<td>viii) Plantation by-products (e.g. thinnings/processing waste) towards biochar for fertilizer</td>
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<tr>
<td>ix) Plantations grown for offsetting carbon emissions</td>
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19. Which if the following options best describes your attitude towards the plantation forestry industry **prior to commencing the study** with the participatory advisory committee at Woodenbong facilitated by Southern Cross University researchers?

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<td>i) Strongly opposed</td>
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<td>ii) Opposed</td>
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<td>iii) Neutral</td>
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<td>iv) Supported</td>
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<td>v) Strongly supported</td>
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20. Which if the following options best describes your attitude towards the plantation forestry industry **after the study** during 2009 as a member of the participatory

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<td>iii) Neutral</td>
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<td>iv) Supported</td>
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<tr>
<td>v) Strongly supported</td>
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264
21. Can you attribute any of the following to your change in attitude (If there was one)?

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<tr>
<td>i)</td>
<td>Increased understanding of plantation forestry operations and business due to your involvement as a PAC member deliberating over issues;</td>
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<tr>
<td>ii)</td>
<td>Increased understanding of the plantation forestry industry due to personal observations and/or experiences</td>
</tr>
<tr>
<td>iii)</td>
<td>Communications with plantation forestry representatives outside the PAC meetings;</td>
</tr>
<tr>
<td>iv)</td>
<td>Failure of some private plantation companies during the global financial crisis;</td>
</tr>
<tr>
<td>v)</td>
<td>Media reports</td>
</tr>
<tr>
<td>vi)</td>
<td>Other (Please name): __________________________________________</td>
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</table>

22. Which level best describes the power you felt towards entering into discussion and contributing your views on plantation forestry at the commencement of participatory advisory committee meetings?

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<td>ii)</td>
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<td>iii)</td>
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<td>iv)</td>
<td>Moderate</td>
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<tr>
<td>v)</td>
<td>High</td>
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</table>

23. Which level best describes the power you felt towards entering into discussion and contributing your views on plantation forestry towards the end of the participatory advisory committee meetings?

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<td>i)</td>
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<td>ii)</td>
<td>Very Low</td>
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<td>iii)</td>
<td>Low</td>
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<tr>
<td>iv)</td>
<td>Moderate</td>
</tr>
<tr>
<td>v)</td>
<td>High</td>
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</table>

24. Do you feel your contributions were able to influence the decision making processes within the PAC meetings?

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<tbody>
<tr>
<td>i)</td>
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<td>ii)</td>
<td>Very Low</td>
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<td>iii)</td>
<td>Low</td>
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<tr>
<td>iv)</td>
<td>Moderate</td>
</tr>
<tr>
<td>v)</td>
<td>High</td>
</tr>
</tbody>
</table>
25. Please circle the **main stakeholder group** your associate with during your day to day business, or area of interest (one only).

| i) Forestry                                      |
| ii) Farming (grazing, cropping, mixed farming, dairy, horticulture) |
| iii) Education and scientific                   |
| iv) Environmental                                |
| v) Governing authority (e.g. Local council, Industry and Investment NSW) |
| vi) Recreation and tourism                       |
| vii) Urban residential / business                |
| viii) Other (Please name) ______________          |

26. Could you please indicate **your age** at your last birthday?

  ___________ Years

27. What is your **gender**?

| i) Female                                      |
| ii) Male                                       |

28. How many years have you lived in the Upper Clarence catchment?

  ___________ Years

29. What is your post code of your principal residence?

  Post code ___________

  ........................................ Thankyou for your time .....................
4.3 Final evaluation survey: Control i.e. Non-participants in social learning study at Woodenbong

**Evaluation Survey No. 2**

**Plantation forestry expansion in the Upper Clarence catchment**

(Please circle the most appropriate answer/s)

1. Which following option best describes your **attitude** towards the plantation forestry industry around **12 months ago** (Start of 2009)?

   | i) Strongly opposed | ii) Opposed | iii) Neutral | iv) Supported | v) Strongly supported |

2. Which following option best describes your **current attitude** towards the plantation forestry industry?

   | i) Strongly oppose | ii) Oppose | iii) Neutral | iv) Support | v) Strongly support |

3. Can you attribute any of the following to your **change in attitude** (If there was one)?

   | i) Increased understanding of plantation forestry management and business operations due to attendance at public meetings held in the catchment in March 2009 |
   | ii) Increased understanding of the plantation forestry industry due to personal observation and/or experiences |
   | iii) Private dealings with plantation forestry representatives |
   | iv) Financial collapse of some private plantation companies during the global financial crisis |
   | v) Media reports |
   | vi) Local council meetings and/or information |
   | vii) Other (Please name): __________________________________________ |

4. Do you have any current concerns regarding plantation forestry in your local area?

   ______________________________________  ______________________________________  ______________________________________  ______________________________________  ______________________________________
5. Please rate your feelings towards a sense of place in the community.

<table>
<thead>
<tr>
<th>i) None</th>
<th>ii) Limited</th>
<th>iii) Moderate</th>
<th>iv) High</th>
<th>v) Very high</th>
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</thead>
</table>

6. Have your feelings towards a sense of place changed as plantations have expanded?

Please describe.

_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________

7. Do you think plantation forestry has potential to offer economic benefits to the local community?

<table>
<thead>
<tr>
<th>i) None</th>
<th>ii) Limited</th>
<th>iii) Moderate</th>
<th>iv) High</th>
<th>v) Very high</th>
</tr>
</thead>
</table>

8. What potential economic benefits can you see?

_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
9. Do you support any of the following types and uses of plantations? Circle appropriate answers.

i) Mixed species plantations
ii) Monoculture plantations
iii) Plantation timber for pulp wood
iv) Plantations for sawn timber
v) Plantations grown as biomass for renewable energy i.e. bio-fuels and electricity
vi) Plantation by-products (e.g. thinnings/processing waste) for pulp wood
vii) Plantation by-products (e.g. thinnings/processing waste) as biomass for renewable energy production i.e. bio-fuels and electricity
viii) Plantation by-products (e.g. thinnings/processing waste) towards biochar for fertilizer
ix) Plantations grown for offsetting carbon emissions

10. Please circle the main stakeholder group you associate with during your day to day business, or area of interest (one only).

i) Forestry
ii) Farming (grazing, cropping, mixed farming, dairy, horticulture)
iii) Education and scientific
iv) Environmental
v) Governing authority (Local council, Industry and Investment NSW)
vi) Recreation and tourism
vii) Urban residential/business
viii) Other (Please name) ________________________________

11. Could you please indicate your age at your last birthday?

_________________ Years
13. What is your gender?

i) Female  

ii) Male

14. How many years have you lived in the Upper Clarence catchment?

_________________ Years

15. What is the post code of your principal residence?

Post code __________________

...............  Thankyou for your time .................
Appendix 5: Technical Report No. 1

Use of participatory modelling in addressing land-use conflict over plantation forestry- Stage 1 Gaining insights: A case study on land-use change in the Upper Clarence catchment of northern NSW.

**Publisher**: Southern Cross University Digital Printing Services for the School of Environmental Science and Management and CRC for Forestry.


**Declaration by candidate**

I declare the nature and extent of my contribution to this chapter of work to be:

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<thead>
<tr>
<th>Nature of contribution</th>
<th>Extent of contribution (%)</th>
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<tr>
<td>Title, key ideas and questions, literature review, framing, writing</td>
<td>100</td>
</tr>
<tr>
<td>Data analysis</td>
<td>100</td>
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<tr>
<td>Presentation</td>
<td>100</td>
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</table>

Candidate’s signature: [Signature]

Date: 2-8-10
Use of Participatory Modelling in addressing land-use conflict over plantation forestry
Stage 1 – Gaining insights

This study is part of Project 4.3.4 of the Commonwealth CRC Forestry project on Forested Communities. It is being undertaken to evaluate the effectiveness of Participatory Modelling as a tool for community engagement in understanding the social-ecological dynamics in a landscape where plantation forestry is expanding. Using Participatory Theory, the study aims to develop an improved consultative process with key stakeholder groups in identifying major issues through a community survey, interviews, and meetings, then addressing these natural resource issues through a social learning study.

A Case Study on land-use change in the Upper Clarence catchment of Northern NSW.

Photo above: Stag tree providing wildlife habitat near Woodenbong.

Author
Ms Andrea Leys
PhD Candidate, SCU, Lismore
andrea.leys@scu.edu.au

Acknowledgements
Professor Jerry Vanclay of Southern Cross University & Dr Jacki Schirmer of ANU

Special points of interest:
Insights into attitudes and perceptions of key stakeholders towards land use change to plantation forestry.
Preliminary recommendations for changes to management, planning and policy for improving the sustainable use of natural resources at the community level.

Photo above: Logging a Spotted Gum regrowth forest, Upper Duck Creek.

Inside this report
October 2008:

Introduction  274
Background  276
Methodology  282
Results  286
Conclusions  312

Photo: Multiple-use plantation with cattle grazing near Bonalbo
All photos by Andrea Leys, 2008.
The purpose of this report is to provide the Upper Clarence community with feedback from interviews that were conducted to gain insights on issues of controversy surrounding the expansion of the plantation forestry industry in the local catchment.

This report has been proof read by Professor Jerry Vanclay of Southern Cross University, Dr Jacki Schirmer of the Australian National University, Dr Kathryn Williams of The University of Melbourne, and members of the CRC Forestry “Communities” Project Steering Committee. Interviews were conducted with a variety of key stakeholders recommended as representing a diversity of views within the community. Findings and recommendations are reported herein.

Any further enquiries can be made to the author Andrea Leys (PhD EnvSc Candidate, BRurSc Hons., GradDipEd) on mobile 0438 875 935 or email andrea.leys@scu.edu.au, or the project supervisor Professor Jerry Vanclay on 02 66203147 or email jerry.vanclay@scu.edu.au.
**Introduction**

Australian landscapes have undergone significant land-use change since white settlement. In the Upper Clarence catchment of Northern NSW large beef cattle holdings first set up by English squatters in the 19th Century including Tooloom, Dyraaba, and Koreelah Stations went through a wave of subdivision into smaller beef cattle enterprises with their own dairies. The dairies produced buttermilk for local butter factories of which a significant amount of produce was exported to England. More recent deregulation of the dairy industry, combined with increasing land prices and input costs put dairying under pressure, with only seven remaining operational from an estimated number over one hundred.

Cattle grazing has been the predominant land-use in the 20th century, however as beef cattle profit margins declined on a competitive open world market, land-use has been under pressure to change to more profitable enterprises or expand the size of holdings once again. Cropping of maize and soybean has increased in the region in response to increases in grain prices. The other major land-use change has been to hardwood Eucalypt plantation forestry, with around 60,000 ha in the North Coast region planted by the Managed Investment Scheme companies Forest Enterprises Australia and to a lesser extent Great Southern Plantations Limited and Wilmott Forests, with plans to double this area in upcoming years. This change from early European agricultural land-uses whereby farms were owned and managed by families to what are now predominantly absentee corporate owned and managed plantation companies has created considerable concern within the community over the use of natural resources and the viability of the industry for providing sustainable social, ecological and economical outcomes within the region.

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3 Source: Mr Lindsay Passfield, Kyogle Councillor, Woodenbong, 2008.
A case study approach is being undertaken with the Upper Clarence rural community to evaluate the effectiveness of participatory modelling at the local level in addressing natural resource issues. Stage 1 of the study has consisted of a participatory survey open to all interested people in the catchment and semi-structured interviews with key informants from a variety of stakeholder groups. The aim of the initial stage has been to provide insights into perceptions behind the major natural resource issues relating to plantation forestry expansion. Stage 2 will follow consisting of meetings and the use a participatory modelling exercise using a computer simulation program aimed at exploring and developing a shared understanding of the complex and dynamic issues associated with land-use change. It is hoped that a supportive collaborative network can be established between diverse community groups which will lead to improved decision making skills and an increased community capacity to deal with natural resource issues.

This case study is based on the theory that it is through the exploration social dimensions and a learning environment that individuals and groups within a community can better adapt to changing landscapes through developing a greater understanding of the dynamics of the systems involved. Challenges for the community can lie in needing to make changes which may test existing administration and organisational boundaries. Many academics and policy makers have theorised that regional prosperity requires cooperative and collective action, however there continues to be a lack of effective strategies for engaging participants from groups with diverse and often conflicting interests, monitoring progress and measuring long term benefits of changes initiated. There appears to be an opportunity for interception at a transition or establishment phase in land-use change that community engagement could be used effectively in helping promote healthy debate based on scientific findings and local social capital to challenge or accept whether new landscape options are in fact more sustainable in the long term for a particular region. Participatory
modelling is one strategy that can be used to explore land-use debates, and I propose it could only be effective at this transition or establishment stage of new industry development creating land-use change when individuals and groups start to voice negative sentiment and concerns.

For Stage 1 of the study, an analysis of the main findings follows. The analysis helped identify the major natural resource issues of concern over plantation forestry expansion, together with some suggestions by participants for areas which could be improved, and tradeoffs with the community to help offset negative impacts and improve the viability and acceptability of commercial plantation forestry within the catchment.

**Background**

The Upper Clarence Catchment has the major Clarence River flowing through it. The headwater of this river is in the Upper Tenterfield Shire between Tenterfield and Urbenville. Mean annual rainfall ranges from 1076 mm per year at Urbenville at the northern end of the catchment to 1222 mm per year at Tabulam at the southern end of the catchment. Rainfall is summer dominated, falling predominantly in the months of December through to March, however the rainfall is considered reliable. Mean monthly maximum temperatures range from 27 to 28 (Tabulam – Urbenville) degrees Celsius in January down to 3 to 7 degrees Celsius in the month of July\(^4\).

\(^4\) Source: [www.bom.gov.au](http://www.bom.gov.au)
The area of the Upper Clarence Catchment is 690,723 hectares in size, of which 68% is considered forested (Source: Department of Natural Resources, Macro Water Planning Process, March 2008). Soil types range from low to moderate chemically fertile Kurosols and Chromosols with well defined horizons of sandy loam topsoils down to heavier clay subsoils, with the Chromosols being susceptible to soil structural decline. Higher fertile Vertisols exist on the alluvial flats and lower reaches around the Clarence River. Younger Kandosols and Rudosol soils are found on the upper slopes and ridges with moderate chemical fertility.5

Examination of demographic statistics showed the overall population of the Kyogle Shire remained relatively stable over the five year period between the years 2001 to 2006

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5 Source: John Grant, Soil Scientist, Southern Cross University, Lismore, 2008. More information can be found at site www.asris.csiro.au
recorded at 9,185 in Year 2001 to 9264 in Year 2006. Many rural villages recorded a population increase including Urbenville and surrounding parishes (277 to 316), Mallanganee (92 to 120), Tabulam and surroundings parishes (272 to 290). Kyogle and Bonalbo villages on the other hand experienced small declines in total populations with Kyogle recording a drop from 2,798 to 2,736 and Bonalbo from 368 to 313. The population in most rural parishes remained unchanged or with slight increases such as from 118 to 136 in the Haystack to Tooloom area.

Commonwealth taxation legislation that allows full deductions for plantation forestry establishment has been an important driving force behind land-use change to private plantation forestry industry in Australia by managed investment schemes. This legislation was introduced in an effort to maintain and expand harvestable timbered areas in response to the increasing domestic and international demand for timber, less timber being made available from state forests, as well as the government initiates to reduce greenhouse gas emissions and sequester carbon. The 2020 Plantations vision⁷ has also provided encouragement and support for the expansion of plantation forestry.

According to “Australia’s Plantations 2006”⁸ report, Australians alone consume around 22 million cubic metres of timber and paper products annually, and most comes from the 1.8 million hectares of plantation forests, 57 % of which are under softwoods, mainly radiata pine, and 43 % hardwoods, mostly bluegum. Fifty eight percent of plantations are privately owned, 37% publicly owned, and 6% are jointly owned nationally. According to the “Australia’s Plantations 2006” report the plantation forestry

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⁷ Plantations 2020 Vision. “Plantations for Australia: The 2020 Vision is a strategic partnership between the Commonwealth, State and Territory Governments and the plantation timber growing and processing industry aimed at enhancing regional wealth creation and international competitiveness through a sustainable increase in Australia's plantation resources, based on a notional target of trebling the area of commercial tree crops by 2020”. For further information refer to www.plantations2020.com.au.
industry contributes to the combined Australian forestry and timber industries annual turnover of $18 billion.

Land-use change impacts on the social constructions of rural communities, which in turn impacts on how ecological systems are managed. These cycles of change can be encompassed in the study of social-ecological system dynamics. Several studies found that when productive land is converted to plantation forestry, public and other land users are much less likely to be supportive compared to reafforestation to reverse land degradation or mitigation.9

The Northern Rivers Private Forestry group (NRPFDC) has produced a report on the residual and small log resource and processing opportunities in the North Coast region10. They have found for the current 60,000 ha of hardwood plantation in the entire North Coast region, of which 50 % is managed by Forests NSW and the remainder privately owned and managed, and the 580,000 hectares of native forest, that there is an economic justification for a processing plant for smaller diameter timber and residues from processing and logging around Casino or Kyogle. They suggest there is considerable potential for using small logs to produce sawn timber, plywood, hardboard, glued laminated beams, outdoor furniture components, roof trusses and round wood for landscape and structures. Further opportunities exist for use of forestry residues in the production of biofuels is suggested in this report, and supported by Professor Jerry Vanclay of Southern Cross Universities School of Environmental Science and Management whom recommends their use in second generation biodiesel production using the Fischer – Tropsch process as an alternate fuel production method to help mitigate against climate change.

In the Kyogle Local Government Area (LGA) alone there has been a 20 % recorded increase in land area planted with plantation timber species from 11,363 ha in 2001 to 13,586 ha by the end of 2005. The neighbouring Tenterfield LGA of which the upper north-east section forms part of the Upper Clarence catchment, area under plantation forestry increased by 51 % from 3,444 ha in 2001 to 5,205 ha by the end of 2005\(^\text{11}\).

Meanwhile employment in silvicultural operations is increasing as the benefits to wood quality are increasingly being recognised. According to Dr Kevin Glencross from the School of Environmental Science and Management, Southern Cross University, thinning plantations has been shown to significantly improve wood quality of the final harvested product. In Chile, where plantation forestry is expanding at one of the highest rates in the world, work done by the University Austral de Chile by Professor Antonio Lara and his team, found an additional ecosystem service benefit of thinning forests was in increasing water flow yields, found to be increased by an average of 37% in second growth *Nothofagus* forests. This resulted from reduced interception and reduced evapotranspiration rates in thinned stands particularly over the summer months.

Further, companies have been expanding leasing contracts which can offer sound financial rewards. Farmers who lease their properties or parts of to plantation companies often remain in their homes, and they can derive income from grazing cattle once plantations have established around 3 years and continue until tree canopies close, around 8-16 years.\(^\text{12}\) Plantation forestry is also increasingly becoming a diversified enterprise in many mixed farming operations allowing farmers to produce for more lucrative markets and be better insulated from future shifts in commodity prices, and possibilities for carbon sequestration and trading. Smaller scale plantation forestry by individual landowners has

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12 Source: Mark Stanton-Cook, DPI Plantations, Wollongbar, NSW.
been found to generate less conflict within communities as opposed to large scale company operated plantations.\textsuperscript{13}

According to Rod Stanford a local farmer and contractor of Forest Enterprises Australia (FEA), the gross margins for leasing land to plantations on 2007 prices was around $220/plantable ha, compared with cattle breeding enterprises estimated around $54/ha in the Upper Clarence region. He found the gross margins after taking into account the plantable area of properties to trees which ranges from 40-85% depending on the quality of the land, ends up being around three times as much for leasing land to plantations compared to cattle breeding enterprises on unimproved country. This equated to gross margins in 2007 of $130 / breeder area for cattle compared to $ 420 / breeder area under plantation forestry, where the country supports from 1 breeder per 2 to 4 hectares. These financial incentives from plantation companies are underlying land-use changes in many rural communities in Australia, including the Upper Clarence, however at the same time generating concerns and conflict over perceived social and ecological impacts.

According to the _Australia’s Plantation 2006_ National report from the Bureau of Rural Sciences, ecological impacts vary considerably over the production cycle. For example, soil disturbance is only of major concern at planting, which is once in 10-30 years depending on the species and market targeted. Most soil loss however had been found to occur from roads, which they claimed can be mitigated against if there is good design, correct drainage measures and maintenance, which are all standard requirements under the Code of Practice by certified plantations, of which currently account for around half of Australia’s plantations. Fire breaks are also a requirement under the Code of Practice for plantations.

\textsuperscript{13} Schirmer, J., 2007. Plantations and social conflict: exploring the differences between small-scale and large scale plantation forestry. \textit{Small-Scale Forestry}, \textit{6} (1).
It would seem then if plantation expansion and management follows the strict guidelines set out by the NSW Plantations and Reafforestation Act 1999 and Plantations and Reafforestation Code of Practice 2001 administered and regulated by the State Industry and Investment NSW Department, the plantation industry has many ecological services it can provide to rural communities in Australia. In Chile where there is currently 2.2 million hectares under Eucalypt and Pine plantations according to Professor Antonio Lara in 2008, and they are growing at a rate of 4.5% per year in land area, the need for addressing ecosystem services becomes paramount for justifying their expansion socially and politically. Chile takes an integrated trans-disciplinary approach in tackling forest policy based on the provision of ecosystem services at the watershed level including the provision of high quality water supplies, biodiversity preservation, maintenance of soil fertility, creation of recreational opportunities, together with a balanced need for the supply of timber to generate capital.

In conclusion, many studies have identified issues people in rural communities have in relation to plantation forestry expansion. More studies are required however as to how best to engage communities to identify issues of concern and to initiate land-use planning at the landscape or community level which better integrate the needs of all community groups. This is necessary for community acceptance of the plantation forestry industry through ensuring sustainable ecosystem services are provided. This study plans to address this.

**Methodology**

An initial scoping survey was conducted to identify potential stakeholders for participation in semi-structured interviews and to help start identifying the major natural resource management (NRM) issues within the case study area. This survey was sent out through
the postal system to around 700 households in plantation areas in the catchment within a monthly edition of a Kyogle Council newsletter, with a return rate of 10%. Participants were then selected to participate in interviews that were seen to represent a diversity of views, however were not necessarily representative of the whole population due to the limited sample size.

Five major groups were identified within the community from the initial survey that were seen to represent this diversity of views towards land-use change to plantation forestry, as well as broader related issues. This was done to examine more closely the plantation forestry industry and its relationships to other systems within the catchment. Twenty eight key stakeholders who identified themselves as belonging to one of the following five groups agreed to participate in interviews:

- Cattle & mixed farming
- Forestry industry
- Environmental, urban, recreation and tourism
- Governing authorities
- Scientific and education

Semi-structured interviews were conducted on a one to one basis, with questions based on social, economic and environmental criteria, however open ended enough to allow for hidden or emerging themes and to ascertain when no new information was forthcoming from stakeholders, upon which point no further interviews were conducted. A brief summary of the main areas participants were asked to comment on under each theme follows:

**Theme 1: Social**

(i) Personal connections with land and community, including rural enterprises.

(ii) Use of forests as an amenity for recreational pursuits.
(iii) Sense of belonging in rural community and demographic changes.
(iv) Efficiency of current political processes in developing and implementing NRM policy.
(v) Communications between industry groups. Where and how improvements could be made.
(vi) Positive and negative social impacts of plantation forestry expansion for community.
(vii) Interest in participatory modelling for improving knowledge, skills and community capacity.

Theme 2: Economic
(i) Changes in land values and impacts on individuals and community.
(ii) Viability of various enterprises in the region (Beef cattle, dairy, cropping, horticulture, tourism, forestry, organics).
(iii) Current employment opportunities and future prospects on an industry basis.
(iv) Need for off farm income.
(v) Use of technology in their businesses. Access to technology.
(vi) Positive and negative economic impacts of plantation forestry expansion on community.
(vii) Opportunities for value adding industry.

Theme 3: Ecological
(i) Noticeable changes in water quality and yields due to land-use change.
(ii) Problems with soil erosion and soil fertility under different land-uses.
(iii) Noticeable changes to wildlife populations and what factors they think may have contributed to changes.
(iv) Efficiency of endangered species legislation, and opportunities for improvement.

(v) Efficiency of control measures for noxious weeds and feral animals.

(vi) Noticeable changes in the abundance of weeds, pests and disease in the region and areas where improvements in management could be made.

(vii) Positive and negative ecological impacts of plantation forestry expansion on the local community.

The interview process also allowed for identifying further key stakeholders using the snowballing effect, that is by recommendation of others looked up to for being well informed within the community. Data was analysed using the qualitative analysis program NVivo\textsuperscript{14}. Data was initially sorted in the themes social, ecological and economic. Nodes were then created to represent the issues as they were presented in the data and then interview data presented as individual references coded to these nodes. All references relate to a singular view point from individual participants. Results are presented in tables and graphs below.

The insights gained from analysis of the interviews using NVivo will be used in the next stage of the study which will involve computer modelling using the visual modelling environment Simile\textsuperscript{15}. The modelling stage is aimed at mapping the major natural resource issues with interested stakeholders, modelling dynamics, and exploring sustainable options for natural resource use, allocation and management, and possible tradeoffs. Several meetings with groups in Bonalbo and Woodenbong are anticipated for

\textsuperscript{14}NVivo is a program by QSR International, \url{www.qsrinternational.com}.


For more information refer to \url{www.simulistics.com}.
formalising the model, and involving industry and scientific representatives to provide further expert knowledge on issues and options. These results will then be summarised and made available in a report.

**Results**

The major six to seven issues for each of the three themes ecological, social and economic have been identified from analysis of the semi-structured interviews and are contained in the following table (Table 1). The most important issue for each theme was identified by having the most references to it, however inclusive of either positive or negative views from the 28 key stakeholders interviewed across all stakeholder groups.
<table>
<thead>
<tr>
<th>Ecological</th>
<th>Issue</th>
<th>Number of references</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tree health and timber quality</td>
<td>19</td>
</tr>
<tr>
<td>2</td>
<td>Biodiversity conservation</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>Invasive weeds</td>
<td>15</td>
</tr>
<tr>
<td>4</td>
<td>Threatened &amp; endangered species</td>
<td>13</td>
</tr>
<tr>
<td>5</td>
<td>Fire hazard &amp; fuel reduction</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>Feral animals increasing</td>
<td>11</td>
</tr>
<tr>
<td>7</td>
<td>Chemical spray contamination</td>
<td>10</td>
</tr>
<tr>
<td>Social</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Maintain sense of community &amp; support</td>
<td>14</td>
</tr>
<tr>
<td>2</td>
<td>Decline in schools &amp; service industries</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>Lack of employment opportunities</td>
<td>11</td>
</tr>
<tr>
<td>4</td>
<td>Recreation &amp; tourism</td>
<td>9</td>
</tr>
<tr>
<td>5</td>
<td>Cattle to plantation land-use change</td>
<td>8</td>
</tr>
<tr>
<td>6</td>
<td>Politics &amp; legislation</td>
<td>8</td>
</tr>
<tr>
<td>7</td>
<td>'Tree changers'</td>
<td>8</td>
</tr>
<tr>
<td>Economic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Tax laws: Managed investment schemes</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>Lack of employment opportunities</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>Cattle farming declining</td>
<td>14</td>
</tr>
<tr>
<td>4</td>
<td>Need processing plant</td>
<td>13</td>
</tr>
<tr>
<td>5</td>
<td>Plantation forestry expansion</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>Regional development infrastructure</td>
<td>12</td>
</tr>
</tbody>
</table>

The importance however of some of the other issues identified and represented in the following Graphs 1 to 3 have not been underestimated and therefore some comment will be made on these as well.
Graph 1: Number of references made to economic issues by participants interviewed

<table>
<thead>
<tr>
<th>Economic Issue</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon trading Plantation industry</td>
<td>8</td>
</tr>
<tr>
<td>Lack of employment opportunities</td>
<td>4</td>
</tr>
<tr>
<td>Operations contracting</td>
<td>4</td>
</tr>
<tr>
<td>Skills shortage</td>
<td>5</td>
</tr>
<tr>
<td>Processing plant</td>
<td>13</td>
</tr>
<tr>
<td>Roads &amp; pipelines</td>
<td>12</td>
</tr>
<tr>
<td>Value adding industry</td>
<td>9</td>
</tr>
<tr>
<td>High land prices</td>
<td>8</td>
</tr>
<tr>
<td>Cattle farming declining</td>
<td>9</td>
</tr>
<tr>
<td>Cropping increasing</td>
<td>14</td>
</tr>
<tr>
<td>Dairy industry</td>
<td>12</td>
</tr>
<tr>
<td>Increasing plantation area</td>
<td>7</td>
</tr>
<tr>
<td>Planteration joint ventures</td>
<td>9</td>
</tr>
<tr>
<td>Increasing agricultural industry support</td>
<td>4</td>
</tr>
<tr>
<td>Changing tenures of timber resource</td>
<td>7</td>
</tr>
<tr>
<td>Native Vegetation Act</td>
<td>5</td>
</tr>
<tr>
<td>Regional development political</td>
<td>5</td>
</tr>
<tr>
<td>Tax Laws - MIS Schemes</td>
<td>4</td>
</tr>
<tr>
<td>Silviculture thinning &amp; pruning</td>
<td>8</td>
</tr>
</tbody>
</table>
Graph 2: Number of references made to social issues by participants interviewed

<table>
<thead>
<tr>
<th>Issue</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landscape aesthetics</td>
<td>7</td>
</tr>
<tr>
<td>Recreation &amp; tourism</td>
<td>9</td>
</tr>
<tr>
<td>Crime</td>
<td>4</td>
</tr>
<tr>
<td>Cultural heritage</td>
<td>3</td>
</tr>
<tr>
<td>Healthy &amp; peaceful lifestyle</td>
<td>5</td>
</tr>
<tr>
<td>Isolation</td>
<td>7</td>
</tr>
<tr>
<td>Low socio-economic community</td>
<td>2</td>
</tr>
<tr>
<td>Sense of community &amp; support</td>
<td>2</td>
</tr>
<tr>
<td>Technology access</td>
<td>5</td>
</tr>
<tr>
<td>Community consultation</td>
<td>6</td>
</tr>
<tr>
<td>Corporate responsibility &amp; initiatives</td>
<td>8</td>
</tr>
<tr>
<td>Comfortable retirement</td>
<td>6</td>
</tr>
<tr>
<td>Cattle to timber/land use change</td>
<td>3</td>
</tr>
<tr>
<td>Land prices too high</td>
<td>3</td>
</tr>
<tr>
<td>Jurisdictions</td>
<td>5</td>
</tr>
<tr>
<td>Absentee land owners</td>
<td>5</td>
</tr>
<tr>
<td>Ageing population</td>
<td>4</td>
</tr>
<tr>
<td>Lack of employment opportunities</td>
<td>5</td>
</tr>
<tr>
<td>Loss of farming families</td>
<td>5</td>
</tr>
<tr>
<td>Schools &amp; service industries</td>
<td>4</td>
</tr>
<tr>
<td>Tree changes</td>
<td>3</td>
</tr>
<tr>
<td>Politics &amp; legislation</td>
<td>7</td>
</tr>
<tr>
<td>Comfortable retirement</td>
<td>8</td>
</tr>
<tr>
<td>Police</td>
<td>8</td>
</tr>
</tbody>
</table>
Graph 3: Number of references made to ecological issues by participants interviewed

<table>
<thead>
<tr>
<th>Issue</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservation</td>
<td>18</td>
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<tr>
<td>Rare &amp; endangered species</td>
<td>13</td>
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<tr>
<td>Chemical spray contamination</td>
<td>10</td>
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<tr>
<td>Burning windrowed timber</td>
<td>6</td>
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<tr>
<td>Habitat destruction</td>
<td>3</td>
</tr>
<tr>
<td>Carbon storage</td>
<td>2</td>
</tr>
<tr>
<td>Fire plans</td>
<td>6</td>
</tr>
<tr>
<td>Fuel reduction</td>
<td>7</td>
</tr>
<tr>
<td>Native Vegetation Act</td>
<td>6</td>
</tr>
<tr>
<td>P &amp; R Code too inflexible</td>
<td>2</td>
</tr>
<tr>
<td>Feral animals</td>
<td>5</td>
</tr>
<tr>
<td>Invasive weeds</td>
<td>2</td>
</tr>
<tr>
<td>Soil compaction</td>
<td>15</td>
</tr>
<tr>
<td>Soil erosion</td>
<td>19</td>
</tr>
<tr>
<td>Soil fertility</td>
<td>6</td>
</tr>
<tr>
<td>Water quality</td>
<td>6</td>
</tr>
<tr>
<td>Water yields</td>
<td>11</td>
</tr>
<tr>
<td>Tree health &amp; timber quality</td>
<td>7</td>
</tr>
</tbody>
</table>

The major issues identified and the respective numbers of references have been graphed according to which stakeholder group the reference was sourced. This provides the reader with further information on which types of issues were important to each stakeholder group interviewed in the study. Graph 4 demonstrated that most references to ecological issues came from the cattle and mixed farming stakeholder group, whereby this particular group felt that invasive weeds were a major issue arising from the lack of management in native as well as plantation forests. Issues pertaining to plantation forestry as well as broader issues to other linked systems such as vegetation management will be discussed.

Several participants interviewed discussed invasion and lack of control measures for Giant Parramatta Grass (*Sporobolus fertilis*) particularly in private plantations and native NSW State Forests and National Parks who were considered to be under resourced. Several participants commented on the adaptability of this introduced weed in this region, making it very abundant and therefore expensive and hard to control with herbicides. It can only be grazed when very short, then becoming too sharp and hard to graze.

Several participants also mentioned Privet, Cats Claw, Lantana and Camphor Laurel as invasive weed problems in plantations, particularly around creeks and gullies, and not enough was being done for their control. Lantana was additionally providing habitat for the Bell Bird Miner pest which was contributing to the Eucalypt dieback problem now common in the wetter areas of the region.

Graph 4 also illustrates that all stakeholder groups interviewed had views on the biodiversity issues of conservation and rare, threatened and endangered species. Several participants commented on the positive action seen in the community from local Landcare groups, particularly in looking after areas seen to have high conservation value. Evidence such as placing nesting boxes and weed control in these areas where mentioned. It was
apparent however that there was a general consensus that Landcare initiatives were not having a large enough impact at the regional level to protect these areas of high conservation, with a much greater need for more broad scale government initiatives to manage these area. Also highlighted in interviews was the lack of employment opportunities and if the government was prepared to offer training and employment initiatives in the areas of silvicultural practices, weed control and fire prevention this could help tackle some of the community’s ecological issues on a broader scale which could have longer lasting positive impacts.

It was also suggested that buffer areas around plantations could be better managed to protect biodiversity values, and that monoculture plantations were bad for biodiversity. Since *Eucalyptus dunnii* (Dunns White Gum) was the major species planted in the region, several participants suggested that they would like to see the plantation forestry industry plant more indigenous species for landscape and biodiversity values, believing that a preventative approach to protecting biodiversity would be much more acceptable in the community. It was suggested by one participant that gliders needed lots of mixed timber corridors that were currently inadequate, and that the lack of old remnant trees being kept under plantation development was creating a lot of competition for remaining habitat trees by mopokes, rosellas, possums, ravens, galahs and paradise rifle birds. This participant had noticed many of these species fighting for hollows to nest.

One participant suggested that retaining larger clumps of trees in old grazing paddocks and strips along creek lines when planting plantations provide good habitats, and felt it important that plantation companies recognise and maintain these ecological values. One issue this participant mentioned was that the focus to date had been on threatened species. However believed it was just as important to look after species not yet threatened.
Several participants regarded the conversion of many areas of state forest to national parks has put considerable pressure on remaining areas of crown resources from logging. Government initiatives have been perceived to be very destructive to the timber industry and ecology of forests and were based on a political agenda rather than a sound science basis. Many participants believed state forests and national parks could be sustainably managed through joint and collaborative private and state organisations with selective logging, weed and feral pests control, maintenance of access roads and watering points to create multiple use forests with higher ecosystem service values, including opening these areas back up to the public as a recreational amenities and allow adequate access for fire fighters in the event of fires. Many of these forested areas closed up by State and Commonwealth governments have developed dangerous fuel loads according to many
participants, particularly around the villages of Tabulam, Woodenbong, Urbenville and Bonalbo.

One participant mentioned research being conducted by State Forests NSW which suggested timber quality of eucalypts could be maintained by occasional low intensity burns within the first 10 years whilst significantly reducing fuel loads and potential fire hazards in neighbouring areas.

Native kangaroo grass was considered a valuable fodder grass in the region for its reliability. It was however considered to be sensitive to disturbance when land was cleared and prepared for plantation establishment. It also was considered to die out when the tree canopy closed, with the pasture left of little value for grazing cattle, an option preferred by many farmers to supplement income from land leased out to private plantation companies. Several participants mentioned thinning and pruning of plantations to maintain some pasture on the forest floor. This has been limited due to the lack of a local processing plant to cater for small diameter timber and residues from these silviculture operations.

Threats were also mentioned to Proteacea species in the region from clearing native regrowth for plantation establishment. One of the major issues mentioned was the lack of scientifically based guidelines for managing the retained vegetation in plantations for biodiversity and conservation under the NSW Plantation and Reafforestation Code of Practice. Further the lack of auditing and compliance checks, as well as limited ecological skills of the staff by the regulatory body Industry and Investment NSW was mentioned by numerous participants. Further investigation into this issue highlighted the lack of funding by the Industry and Investment NSW to employ adequate staff number for plantation compliance checks.
The majority of participants agreed that legislation protecting rare and endangered species was too restrictive for private land holders. Further, stewardship grants and Voluntary Conservation Agreements for privately owned native forest were not acceptable due to covenants being required to be placed on legal freehold titles which could further restrict land-use options, as well as lack of accountability for how funds were spent. An example given was if the Powerful Owl (*Ninox strenua*) lived in a remnant tree, you were further restricted from cutting down any trees within a 200m radius of this habitat tree. It was therefore considered a disincentive for farmers to report findings of endangered species, with a couple of participants also mentioning having seen spotted quoll in local gullies however refused to report the findings. Participants on the other hand believed that a government incentive scheme providing financial benefits to farmers to manage private native forests on an area basis would be a much more effective way to protect and manage
biodiversity values. Further the need for scientific help in identifying species was raised by several participants, which could be integrated into an incentive scheme.

The plantation forestry industry felt that the Endangered Species Act prescriptions were too general, and that areas they had been required to fence off were thought to be detrimental to the preservation of certain species, including *Grevillea masonii* a small shrub which is believed to be sensitive to weed competition and lack of fire.

Tree health and timber quality was important to mainly the forestry and cattle and mixed farming groups. Psyllids infestations were considered widespread in eucalypt plantations in the region, often leading to plantations being killed with herbicides, dozed out and replanted, usually with the same species Dunns white gum (*E. dunnii*). On the other hand the plantation forestry industry defends the use of *E. dunnii* for its quick growth and frost tolerance properties, good papermaking qualities and sound solid wood products in sawn timber. Further, the limitations imposed by the managed investment schemes (MIS) prospectus are to provide the investor with returns on their investment within 14 years (or 13-15 years for unpruned trees), and therefore a harvestable product is required at this age which most other species could not provide. Other common species grown for properties such as solid wood produced over time and wood fibre include Sydney blue gum (*E. salingna*) coastal blackbutt (*E. pilularis*) and spotted gum (*Corymbia maculata*).

The need for urgent thinning and pruning of plantations is suggested by several participants to ensure the future quality of saw logs and future viability of the industry. One participant suggested that thinning to 1000 stems per hectare to produce 100 m3/year is realistic in this region. It was mentioned by many participants that they could understand why plantation forestry companies were buying up land in the Upper Clarence due to the 40 inch rainfall, mild temperatures, sub tropical climate and good soils suitable for fast tree
growth. However it was thought that the timber yields of 40 tonnes / ha / year being proposed may be over estimated and likely to be closer to 15 to 18 tonnes / ha / year.

Quality control over seedling selection in nurseries was also mentioned. A long time contract planter had found that he was often required to plant trays of Eucalypts that showed poor vigour which he could then correlate to poor establishment in the stands years down the track.

Spray contamination was found to be particularly important to the Environmental, urban, and recreational and tourism group, shown in Graph 4 below. Many participants complained of broad scale use of the insecticide ‘Rogor’ (dimethoate) in plantations close to built up areas, particularly the villages of Bonalbo and Woodenbong, and near their town water supplies including the sub-catchment areas at Peacock Creek and ‘The Gorge Station’ which supplies Bonalbo drinking water. ‘Rogor’ was considered an effective insecticide for psyllid control in eucalypts by the forestry industry. Another problem with its widespread use was that it was perceived to kill bees, impacting negatively upon a local organic apiary and other organic farming ventures in the region.

Spray contamination over rural villages was of major concern, with a couple of participants recommending local councils should be given greater jurisdiction back from the State government over local planning of plantations. One option suggested would be to prevent plantations being established within a certain distance from built up areas, with buffers of mixed native species to also help maintain their visual amenity. Best practices with chemical use age were urgently requested of plantation companies. However in defence, plantation companies believed absentee landowners were an issue in that there was difficulty in contacting them and notifying of aerial spraying. One participant believed that chemical herbicides and insecticides were used less as a plantation gets older, and that
the chemical use age over the production cycle of a plantation is less than with annual agricultural cropping and grazing enterprises.

Currently all planning, certification and compliance was at the state government level. Under the NSW P & R Act 1999 regional liaison committees were set up to make sure contributions were collected from timber companies for local government to be able to fund and upgrade roads and infrastructure, and manage and resource fire services. These committees were formed in the region according to a couple of participants however contributions under the Act would have been restricted to only newly planted plantations which at the time would have not generated much income making the scheme unprofitable, and also there was conflict arising from perceived bias that other heavy truck uses would not be levied, such as dairy, cattle and grain trucks. Several participants believed it was detrimental to communities that local councils had no control over environmental impacts or that they could not collect levies for road repair and maintenance from plantation companies, believing this law should be changed. One participant mentioned a model in southern NSW being implemented with the help of the federal government to address these issues called TIRES.\textsuperscript{16}

One plantation forestry company suggested that under the P & R Act 1999 they were required to build access roads that may not be used for 10-15 years, and that they had to maintain them throughout this time, which was considered unfair upfront capital expenditure.

\textbf{Part 2: Economic issues.}

Graph 5 illustrates the importance of economic issues to the cattle and mixed farming stakeholder group, whereby the declining cattle industry and the taxation laws supporting managed investment schemes in plantation forestry had the most references. Mixed views

\textsuperscript{16}TIRES is an evaluation model used in several plantation regions across Australia.
on this decline were expressed with some believing cattle farming was now not as profitable as it used to be and timber offered the community an alternative industry which could be more viable. Further the high land prices which were considered to have doubled to $7000 / ha dryland over the last five years were making expansion of the cattle industry unviable under current profit margins. One participant suggested that land prices over $4900 / ha were unsustainable for cattle farming based on a carrying capacity of 1.22 breeder units / ha (or 1 beast / 3 acres) around Bonalbo, commenting also:

—Timber should not be in the higher rainfall areas that are good reliable food growing areas. I can only justify timber plantations on the poorer soils that have regrowth problems”

High land prices had positive impacts with several participants commenting that older farmers could retire with dignity and comfort when selling for good prices to plantation companies. A couple of quotes follow:

—The average age of a farmer is 59 years. A lot of land holdings are now too small. They used to support families; however they are no longer viable. I can see the attraction to these farmers who can’t afford the high land prices to expand who make the decision to take the cash and run offered by MIS timber companies.”

—Social benefit is there for older grazing couples allowing them to leave farming with dignity by selling for very good prices to retire comfortably. It can also help them help their children who can’t afford to return to the land by providing some funds for them elsewhere.”

Further implications of a change in land-use from cattle farming to plantation forestry has been the reduced supply of cattle for the local meatworks, whereby stock are
having to be sourced from further afield. These higher transport costs together with higher fuel prices were believed to be having detrimental effects on the Casino Meatworks, a major employer in the region. This was creating long term uncertainty in the local cattle industry.

Federal legislation on Managed Investment Schemes (MIS) were considered by the farming group to be providing unfair market advantages to plantation companies, and driving up land prices to unviable levels for other industries to remain competitive and viable. Most participants strongly opposed these current MIS schemes on these bases, believing “competition would be OK if fair”. One participant believed the impact of forestry tax legislation Australia wide was resulting in “food being taken out of peoples mouths, that is from those people who get out of bed and do a hard days work”. (Refer to Graph 7 which demonstrates the attitude of participants to MIS Plantation companies).
Some additional quotes from participants from the cattle and mixed farming group included:

—Don’t support the MIS plantations scheme due to the unfair tax advantage they have over other land-uses. The whole structure is inequitable, creating a superior land-use all to support the governments 2020 Vision to increase land under timber. I would like to see rights under the P & R Act brought closer to the Native Vegetation Act to put on a more even par”.

—The MIS plantation companies are large corporations and are not community based. Profits go outside the region to investors”.

—Oppose the MIS schemes because they have contributed to the inflated land prices forcing local farmers to work harder to get more land”.

—The MIS schemes have 100% tax deductibility upfront to investors for planting trees, even though the land is owned by the plantation companies. This federal tax legislation is choking people out of the region from local farms and villages. The world is short of protein and food. How could our federal government support policy which reduces food producing country? I believe this legislation was set up as a knee jerk reaction to perceptions of the powerful conservation lobby movement to protect the environment. Perceptions have had more influence than facts. They have not put value on crops and pastures, increased fire hazards, reduced water yields, and monoculture issues such as increased reliance on herbicides and insecticides. Farmers can only harvest 10% of water runoff, whereas timber companies can harvest 100%, as most have no runoff coming out of plantations.”

On the other hand plantation companies found the MIS provided them with a suitable vehicle to help address the nations deficit in structural timber, created largely by
less and less resources being available from crown forests. Further, they believed they were helping in the climate change debate by sequestering carbon and offsetting greenhouse gases. Several participants from the farming group believed that carbon trading would be an inevitable market for MIS schemes in the catchment. One participant from the environmental group commented “I would like to see the complete equations for carbon dynamics under plantation forestry compared to other land-uses to address my concerns about its validity”.

Several farmers had concerns regarding their lack of eligibility for carbon credits. One participant commented that;

— trees logged prior to 1990 and allowed to regrow are not eligible for carbon credits through the Kyoto Protocol. So farmers who have actively managed native forests for many years cannot access carbon credits for sustainably managing native timber reserves and protecting biodiversity. It seems wrong, as native forests lock up much more carbon than plantation timber”.

Value adding opportunities were suggested by several participants including use of hardwood chips to make products such as Weathertex, masonite, and composite hardboards. These alternatives were suggested as possibly more viable than currently exporting wood chips through Brisbane.

The Forestry and Environmental, Urban and Recreational and Tourism groups felt strongly about the need for a local processing plant (Graph 5) to help process small diameter plantation timber and residues from thinning and pruning as the hardwood plantation estate matures. This was considered a feasible option by plantation companies, with planning underway for a processing mill to create F17 timber kiln dried boards from E. dunnii. Existing mills didn't have adequate machinery for processing small diameter logs, and nor was it cost effective to consider this long term with machinery already set up
for larger native logged timber resources. However, one mill did offer the opportunity to process some plantation timber in the interim few years until the new processing plant was up and running. At present there is considered to be an enormous waste of resource sitting in the landscape because there are no local processing facilities to take the logs to.

Most participants wanted to see centralised facilities in the catchment for the timber industry to make handling larger volumes economic and to provide job opportunities for local people. Currently job opportunities were believed to be mainly casual or temporary in planting and earthmoving. Most felt that as the plantation estate matured more job opportunities would be made available, however they wanted long term stable employment if the industry was to remain sustainable. One local plantation company suggested they had plans to potentially create 350 to 400 jobs from processing their timber resource based on 100,000 tonnes / year annually initially up to 1 million tonnes / year by 2014. They also expressed the need for harvesting and transport contractors when their mill was up and running and would create contracts up to 5 year terms. Skills shortages were identified as an issue by the forestry industry.

**Part 3: Social issues.**

Graph 6 demonstrated the importance of employment opportunities to several stakeholder groups, however particularly the forestry and farming groups who claimed the region was a low-socio economic community\(^\text{17}\) and needed greater opportunities. Participants believed the people had a high sense of community and provided reliable support for each other however, particularly within the farming community. As land and housing prices were going up, 'tree changers' were moving into local villages, which was considered positive as many contributed to local volunteer groups including Lions, Landcare, Hall, Rural Fire Brigade, and Show Society. On the other hand, one participant mentioned that there was a

\(^{17}\) This refers to low average household incomes compared to other regions of Australia.
threat the community was being lost to the aged and underprivileged that either can’t or don’t contribute back to the community, and that it was also difficult for the community to provide back to them due to lack or resources and services.

Views on declines to schools numbers and closing or threatening closures to service industries were also made by most of the stakeholder groups (Graph 6). One of the major social impacts of plantation expansion suggested by participants was the loss of farming families from the region which had numerous negative impacts for the community including reduced student numbers in the schools including Urbenville, Bonalbo Central and Old Bonalbo. School teacher numbers declined in response, or were in threat of declining. It was suggested by another participant that alternatively schools on the region were going to close down anyway due to agricultural and dairy downturns. Some quotes from participants included:

—“Trees are displacing local families off farms”

—“Local cattle property between Woodenbong and Urbenville has been sold for $7000 per hectare. It has improved pasture with a carrying capacity of 600 beef breeders. It had 31 dams put in, each costing around $5000 to put in. Lots of infrastructure is now wasted. Local diesel sales to the property will be lost from the farm enterprises, there will be no repairs to machinery, no school children, no labour for stock management and fencing, no local shopping, no electricity, loss of two homes and two full time jobs, lost livestock carrier work, and lost rural supplies. Also full dispersal of stud cattle. Loss of cattle that would have gone to casino saleyards and local meatworks. There is a huge social cost through diminishing work and produce to and from the property.”

—“When plantation companies buy grazing properties, this can result in farmers being displaced without immediate employment. There is a window with phases of discomfort where impacts seem great. However experience has shown that these
displaced farmers tend to get employment back in the farming industry. This is one of the dynamics of the timber industry”.

—Schools have closed in the region that were going to close anyway due to agricultural and dairy downturns”.

Local service and supply shops were believed to also be negatively impacted by population changes, including local grocers and mechanics. Diminished work and produce to and from farming properties that had changed to plantations was believed to be creating a huge social cost in the region. It was reported that a local hardware shop had a loss of local trade and sales from farm supplies by nearly half over the last few years. A look at population dynamics over the 5 year period from 2001 to 2006 demonstrated total population figures remained relatively stable. Investigations in this study however showed that there was an increasing aged population, with significant increases in tree changers”, that is retirees looking for a quieter lifestyle away from the coastal fringe. Many homes had been subdivided off plantation properties and sold off as lifestyle blocks. Whilst other homes remained vacant or were used as sheds on plantation properties rather than being rented out due to risks previously mentioned from unreliable tenants.

Cultural heritage was important for most participants in the study. Many cultural sites are in the region, such as at The Gorge property and Tooloom Falls areas. Local cultural groups were considered to be well integrated in the region, with many in sound employment and harmony with other groups, particularly around the Woodenbong region. It was suggested however that plantation companies needed to improve their consultative process with local indigenous groups so cultural sites were not impacted upon in plantation development. Although cultural assessments were done by the DPI NSW when authorising plantations, many cultural sites were not listed for protection and privacy reasons.
Therefore is suggested that this needed to be addressed at the local level in the future with local tribal elders in the community.

Maintaining a visual amenity was important for local participants. Plantations have changed the landscape to a tree consuming one. Grazing land was perceived to be more acceptable visually for looking more productive in that food could be produced off it. One middle aged mixed farmer commented that “you know some days I look up at the hills behind the house and I feel like crying” (Why?) “it’s the trees you know. I just miss the look of the open grazing hills I grew up with”. Most participants agreed they could not stop plantation expansion, however some balance must be achieved to maintain the visual amenity of the catchment for future generations and to encourage tourism.

One participant who had lived in the catchment for 60 years commented on having seen several land-use changes in his time, emphasizing that the catchment was originally a timber area, only later being cleared for agricultural pursuits of grazing and cropping.

“in the 1930’s this land was clear felled for Hoop Pine for use as structural timber in housing construction. Cedar was also cut. Then farms were set up as dairies till the 1960’s, when beef cattle and cropping on the lower flatter areas took over.”

Joint ventures whereby farmers leased sections of their properties, generally the less productive agricultural land to plantation companies was found to provide sound financial rewards, whilst being able to remain on their properties and retain their rural lifestyle. Leasing land to plantation companies generally achieved returns around $220 / hectare of plantable area. One problem perceived here was the need to incorporate stump removal into contracts so farmers were not left with paddocks unable to be cropped or sown back to pasture within a short period of time after the leases ran out. Another issue which concerned one participant was the clause in the lease contracts from one of the
Managed Investment Plantation Schemes was that if a fire was to go through a leased plantation within the first 10 years after planting, the lease period reverted back to time zero.

A summary gauging the attitudes of participants from the five stakeholder groups interviewed towards Managed Investment Scheme plantation companies operating in the Upper Clarence was recorded as either supporting or opposing them in principle, and is demonstrated in Graph 7 following. Please note that this is not a representation of the opinions of the entire community, and therefore may not reflect representative stakeholder groups. It is a summary of the views of the set of key informants who participated in the interviews.

Graph 7: Gauge of participants support for managed investment scheme (MIS) plantations by stakeholder group at commencement of study

<table>
<thead>
<tr>
<th>Stakeholder Group</th>
<th>Participants supporting</th>
<th>Participants opposing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plantation/Forestry</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Cattle/mixed farming</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Governing authority</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Scientific/research</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Environmental/urban/tourism</td>
<td>1</td>
<td>7</td>
</tr>
</tbody>
</table>

Number of participants interviewed: 12
Graph 7 demonstrates that at the commencement of the study, all participants interviewed from the plantation and forestry industries supported the Management Investment Schemes operations. The majority of the participants from the remaining stakeholder groups opposed plantations run by MIS schemes, with nine out of ten participants from the cattle and mixed farming group opposing, two out of three of the governing authority group opposing and seven out of eight of the combined Environmental/Urban/Tourism and Recreational group opposing.
Graph 4: Number of references made by participants from each stakeholder group to the seven major ecological issues identified.
Graph 5: Number of references made by participants from each stakeholder group to the six major economic issues identified.

- Lack of employment opportunities
- Processing plant
- Regional development infrastructure
- Cattle farming declining
- Increasing plantation area
- Tax Laws - MIS Schemes

- Environmental, urban & tourism
- Scientific
- Governing authorities
- Cattle & mixed farming
- Forestry
Graph 6: Number of references made by participants from each stakeholder group to the seven major social issues identified.
Conclusions

Stage 1 of this participatory study was conducted to gain insights into broad scale social, economic and ecological issues concerning the community as a major structural change in land-use is underway from traditional beef cattle farming to plantation forestry in the Upper Clarence rural community. Issues regarding plantation forestry were focussed on however some broader issues were also addressed as part of a holistic systems approach. Reference was made to interviews with key informants from a diverse range of stakeholder groups to identify the major concerns, as well as note suggestions for reasonable and acceptable tradeoffs with the plantation forestry companies expanding in the region.

In general participants felt that the Upper Clarence community provided a healthy and peaceful lifestyle. The climate was mild and the reliable rainfall meant it was a pleasant environment to live in. Many participants however believed plantation forestry companies had a corporate responsibility to better engage with the community and provide services back to the community as acceptable tradeoffs for negative impacts created from their expansion. Several initiatives recommended by participants included:

- Increase sponsorship of local festivals by plantation companies;
- Contribute resources to service response groups including the fire brigade and SES;
- Form partnerships to create youth training programs in areas short staffed in the industry including weed management and fuel reduction, silviculture operations including thinning and pruning, and preparing cleared timber for sale as fencing posts and firewood;
- Employ onsite managers on plantations to live in existing homes, encouraging families back onto properties and help maintain local working populations and communities;
- Release a publicity statement on strategies and plans that plantations companies have within the community, including carbon trading, sawn logs, timber residue, high value cabinet timber and provision of processing facilities;
- Act as corporate citizens by abiding by the rules of legislation and best practices;
- Improve cleaning of vehicles and equipment when moving between properties as a preventative measure to minimise the transfer of weed seeds, pests and diseases in transit and to other destinations;
- Buy and employ locally;
- Provide infrastructure levies to local councils to help maintain and upgrade roads, causeways and bridges from the time of development not only at harvest which is being proposed in the new Plantations and Reafforestation Act reviewed and proposed for release in early to mid 2009 (Tony Dawson, 2008: Industry and investment NSW - Plantations Division);
- Develop multiple use plantations which would be much more acceptable within the community. Integration of cattle grazing into plantations could be achieved on a greater scale if plantations were actively thinned and pruned. They could be opened for recreational purposed such as for horse riding;
- Create opportunities for the population base including investment in urban development to give back to local villages. Most local villages were believed to have a lack of urban residential, and there was a lot of demand for people locally to purchase blocks of land. This could be done on land owned by plantation companies neighbouring villages, such as found around Woodenbong and Bonalbo;
- Plantation companies should be more pro-active in making use of scientific research in regards to silviculture and management of plantations which could improve weed management, reduce fire hazards, and increase the quality of timber produced, and better protect biodiversity values. Several participants suggested the need for retaining larger areas of remnant timber, and providing larger buffer zones between roads and plantations and built up areas and plantations;
- Consider a more widespread use of mixed species plantations which have the potential to offer greater ecosystem services; and
- Form a collaborative consultative committee to facilitate discussion between community representatives, local government and forestry industry to look at planning and projections, as well as environmental and social issues that could be addressed by an ongoing process to ensure sustainable resource use and sound catchment management for the provision of ecosystem services.

There were also several changes to land-use policy and government planning recommended by participants to encourage a more sustainable forestry industry. These suggestions are summarised below:

- Development of government initiatives to provide adequate guidelines for the management of retained vegetation within plantations and education back to land holders;
- Need for policy changes on logging crown reserves that allow sustainable logging practices and enforce improved weed control, together with maintenance of access routes to aid in fuel hazard reduction and fire control.

Collaboration and action between all forestry groups could help achieve this;
Demand for increase funding at the State Government level for DPI NSW auditing division to provide regular compliance checking of plantations. This would provide more confidence within the community that the Plantations and Reafforestation Act is being complied with;

Development of a government incentive scheme for farmers to manage private forests for biodiversity conservation within the catchment to help counteract negative effects on biodiversity by monoculture plantations; and

Improve protocols on aerial spraying of insecticides by plantation forestry companies to protect neighbouring farmers from contamination of their produce, as well as protect urban and rural water supplies.
Appendix 6: Technical Report No. 2

Social learning study of plantation forestry in the Upper Clarence catchment of north-eastern NSW. Stage 2 – Final community feedback report.

Publisher: CRC for Forestry, Hobart, Tasmania.


Declaration by candidate
I declare the nature and extent of my contribution to this chapter of work to be:

<table>
<thead>
<tr>
<th>Nature of contribution</th>
<th>Extent of contribution (%)</th>
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<tbody>
<tr>
<td>Title, key ideas, literature review, framing, writing, presentation</td>
<td>95</td>
</tr>
<tr>
<td>Data analysis</td>
<td>100</td>
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</table>

The following co-author contributed to the publication:

<table>
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<th>Name</th>
<th>Nature of contribution</th>
</tr>
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<tbody>
<tr>
<td>Jerome Vanclay</td>
<td>Principal supervisory role of editing and advice on data presentation.</td>
</tr>
</tbody>
</table>

Declaration by co-author
The undersigned hereby certify that:

- The above declaration correctly reflects the nature and extent of the candidate’s contribution to this work, and the nature of the contribution of the co-author;
- The co-author meets the criteria for authorship in having participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
- The co-author takes public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication; and
- There are no other authors of the publication according to these criteria; potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit.
Technical Report 201
Social learning study of plantation forestry in the Upper Clarence catchment of north-eastern NSW

by A Leys 1,2
& J Vanclay 1,2

Public report

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March 2010

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w w w . c r c f o r e s t r y . c o m . a u
Foreword

The purpose of this report is to provide the Upper Clarence community with feedback from a participatory study exploring key issues regarding plantation forestry in the local catchment. These issues were raised at public meetings in March 2009. The report summarises conclusions drawn by a participatory advisory committee (PAC) comprising 12 volunteer members representing a variety of stakeholder groups and a diversity of views. This group of volunteers participated in a social learning process investigating issues over an eight-month period from April to November 2009.

A draft copy of this report was given to all PAC members to provide an opportunity to comment and suggest changes. This is the final amended report. Findings and recommendations presented in this report were based on knowledge shared by participants and the facilitating researchers from Southern Cross University, together with expert opinion sought to fill knowledge gaps and further enhance understanding of socio-ecological and economic systems.

This study forms part of a broader project evaluating participatory modelling for use in resolving landscape natural resource controversies, and is a subproject of the Cooperative Research Centre (CRC) for Forestry (based in Hobart, Tasmania), researching the social dimensions of communities in forested landscapes. This research was approved for Andrea Leys and Jerry Vanclay by the Human Research Ethics Committee at Southern Cross University on 14 November 2007 (approval number ECN-07-158).

In this report we have endeavoured to represent the views of the PAC, which may not necessarily reflect the views of the authors, the CRC for Forestry, or Southern Cross University. Any further enquiries can be made to the principal author Andrea Leys PhDEnvSc candidate (SCU), BRRurSc(Hons)(UNE), GradDipEd(UNE) on mobile 0438 875 935 or email aleys10@scu.edu.au, or co-author Professor Jerry Vanclay on (02) 6620 3147 or email jerry.vanclay@scu.edu.au.
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Summary

This report summarises findings of a participatory exploration of plantation forestry in the Upper Clarence catchment (north-eastern NSW) to provide the local community with feedback on issues raised at public meetings held in March 2009. An initial scoping survey completed in January 2008 indicated a diversity of views was held towards plantation forestry within the community, and therefore it was deemed a suitable area for conducting a case study to explore the utility of participatory modelling to improve community understanding. Semi-structured interviews were followed up with 28 key stakeholders in March and April of 2008 to develop further insights into issues of controversy (Leys, 2008). Public meetings were then held to provide the community with an opportunity to present views in an open forum situation with plantation forestry representatives in attendance. The relative importance of key issues concerning the community was determined through a card voting system. These issues were further explored in a social learning study with a participatory advisory committee (PAC) formed by 12 self-selected interested volunteers who held a range of views towards plantation forestry.

The PAC met regularly for eight evening meetings, lasting 3.5 to 4 hours each, held on average once a month over an eight-month period from April to November 2009. During these meetings the PAC discussed local knowledge on issues of controversy, and provided their own hard data for collating and modelling. Where participants identified gaps in their knowledge and understanding, experts were invited to talk to the group. The research team from the School of Environmental Science and Management at Southern Cross University were also asked to gather scientific literature for the PAC to deliberate over. This summary provides an overview of the major findings and recommendations of PAC members from
this social learning study to address key community concerns relating to plantation forestry expansion.

Fire management

The PAC investigated community concerns about fire management issues and developed the following consensus views:

- The PAC believed that improved maintenance was required on fire trails, access to watering points, and fire breaks within the plantation forestry estate.
- The PAC believed that fuel loads on forest floors needed to be reduced through active management, including increased grazing pressure, weed control using herbicides, and silvicultural thinning.
- The PAC recommended that no further plantations should be developed near local towns and village boundaries.
- Neighbouring ungrazed pasture paddocks, national parks and state forests were believed to pose a threat to plantation forests in the event of fire, and also needed active fuel hazard reduction.
- The PAC recommended that collaborative and consistent fire management plans needed to be developed between managers of all forest tenures and the NSW Rural Fire Service in order to improve fire planning and response times.

Socioeconomic benefits to local communities

The PAC investigated socioeconomic impacts of plantations through a combination of findings from a survey of local businesses, views of key informants from previous interviews within the community, and investigation of past research on social impacts in other regions of Australia. They developed the following consensus views:
• It was felt that significant economic benefits to local communities and regional centres would only be possible after a processing mill was established in the region. It was believed that a processing mill would provide flow-on benefits to the community from additional infrastructure and essential services needed to support employees and their families, such as in education, health, housing, electricity, water and waste management.

• Investment opportunities were seen to exist for value-adding timber manufacturing such as fibre board and biofuel production.

• Improved employment opportunities were anticipated in harvesting and haulage operations as the early plantation estate was reaching maturity in the catchment.

• The most favourable scenario for further plantation expansion was believed to be through partial property leasing, which was seen to minimise negative social impacts on the community.

• Local populations were found not to have declined in response to plantation forestry expansion.

• Dwelling occupancy rates had increased for properties purchased by private plantation companies and Forests NSW; however, there was an overall change from owner-occupied to more rentals, and a loss of farm managers and workers.

• Of the 13 local shopfront businesses that responded to a business survey, 38% reported an increase or no change in trade volume to plantation forestry customers over the previous 12-month period from October 2008 to October 2009. Declines were reported by 39%. This was only marginally different to the 31% of businesses that reported declines in total business trade from all customers. In contrast, 62% of local businesses reported either unchanged or increased total business profits over
the same 12-month period, suggesting that many local businesses were remaining viable through the global financial crisis. The majority of businesses surveyed (62%) were found to have been operating for 10 years or more in Woodenbong, indicating a resilient local economy.

Community consultation, collaboration with agricultural producers and information sharing

The PAC discussed community views on communication and information sharing, and drew on information from previous interviews with key stakeholders. They developed the following consensus views:

- Many people in the local community felt that regular media updates on operations and property transfers by private plantation companies would improve transparency of the industry to the public, and reduce fear of the unknown. A list of local community newsletters was compiled and provided to plantation forestry companies as an opportunity for regular correspondence.

- Good neighbour policy guidelines from other states and territories (not legislated in NSW) were suggested for providing useful models for local plantation companies to follow in order to improve neighbour relationships.

- It was felt that collaboration with the farming community could potentially improve productivity from properties through cattle agistment, improved grazing management and sustainable land management practices, and could reduce conflict believed to be due to a lack of communication and transparency.
Pesticide use

The PAC investigated the use of pesticides in plantation forestry and other land-uses through a combination of practical experience and enterprise data provided by participants, data sourced from Industry and Investment NSW by participants, scientific research explored by the researcher Andrea Leys, and discussion with local agronomists and scientific experts in the field of pesticide ecotoxicology. They developed the following consensus views:

- It was believed that consumer demand was driving a market for food and fibre products that require less chemical input during production, and that this demand could offer a useful marketing tool for the plantation forestry industry in the catchment.

- The total chemical footprint per hectare for perennial hardwood crops of eucalypt species was found by the PAC to be less than 10% of that used in the annual crops of maize and soybeans when adjusted for a typical 15-year production cycle (e.g. of the s-triazine herbicides, the average environmental load of the active ingredient simazine used in hardwood forestry was 0.45 kg/ha/yr compared to the active ingredient atrazine used in maize cropping of 4.5 kg/ha/yr).

- Fastac Duo, a synthetic pyrethroid insecticide, was found to be used on a small proportion of the plantation forestry estate (approximately 3%) for control of Chrysomelid beetles. The attention of the PAC was drawn to the presence of alpha-cypermethrin, which is reported to have the potential to bioaccumulate in ecosystems and have acute toxic effects on non-target animal species. The PAC recommended that all land managers should aim to improve pesticide practice,
including more vigilant site monitoring, greater use of protective gear, and use of alternative softer insecticides where possible.

- It was recommended by the PAC that plantation forestry companies respond to pesticide concerns by continuing to explore the use of alternative plantation tree species that may require less pesticide use. The PAC considered the value of species such as *E. saligna* (Sydney blue gum) and *Corymbia maculata* (spotted gum). *E. cloeziana* (Gympie messmate) was another species suggested as suitable for frost-free sites due to its superior wood properties and pest resistance.

**Outcomes**

- A final evaluation survey of members of the PAC found that the level of controversy was reduced among PAC members through their involvement in the social learning study, which involved diverse stakeholders developing a shared understanding of the dynamics of plantation forestry, and working collaboratively towards adaptive management practices aimed at improving ecological and economic outcomes while minimising negative social impacts on the local community.

- The PAC found that fairness through equal opportunity to express individual views, and the provision of an interesting and engaging learning environment were important criteria in the success of this study.

- Independent facilitation that fostered reflection on expert opinion, scientific data and local knowledge helped improve understanding of diverse views and build problem-solving capacity among participants.
The PAC felt that the potential for the plantation forestry industry to be a well-integrated, viable and sustainable alternative industry within the region was yet to be realised due to the immature stage of much of the plantation estate.

Several members of the PAC felt that controversy within the community was likely to continue to some degree while fiscal incentives (in the form of taxation legislation for managed investment scheme retail forestry) continued to be supported by the federal government.

Introduction to study on plantation forestry expansion

Expansion of plantation forestry in Australia has been met with controversy at the local community level. Findings by Williams et al. (2003, 2008), Williams (2008), Schirmer et al. (2008), and Barlow and Cocklin (2003) report on the socially contentious nature of this change for various temperate regions in southern Australia from traditional agricultural land-uses including dairying, cropping, and sheep and cattle production. The diversity of views found towards social, economic and environmental impacts of an expanding plantation estate has warranted further studies to help develop our understanding of the dynamics of plantation forestry at the landscape level—in particular to provide empirical evidence to better inform the debate.

In this study we set out to investigate a subtropical region of Australia where plantation forestry expansion was occurring and where controversy existed, and selected the Upper Clarence catchment in north-eastern NSW for a case study. We aimed to add a further dimension to previous research in this area by conducting an experiment that explored the utility of participatory modelling to improve community understanding and test whether attitudes changed in response to participatory involvement. This report presents the findings of this study to the local Upper Clarence community.
Conclusions drawn by a participatory advisory committee (PAC), representing a variety of stakeholder groups and diversity of views, are presented in this report. These 12 people met over an eight-month period to investigate and discuss issues of plantation forestry. Their conclusions draw on knowledge shared by participants and the facilitating researchers from Southern Cross University, together with expert opinion that was sought to fill knowledge gaps and further improve understanding of socio-ecological and economic systems. As such, it is important to note that this report primarily represents the views of the PAC, and may not necessarily reflect the views of the authors, the funding agency (CRC for Forestry), or Southern Cross University.

The Upper Clarence catchment covers 690 723 hectares and is located in the upper north-eastern corner of NSW (Figure 1). It has undulating slopes (Figure 2), a summer-dominant rainfall of approximately 1100 mm per year and an average temperature range of 28 °C maximum in January to 3 °C minimum in July. Frosts occur regularly during winter months. As of 2009, 27 400 hectares or 4% of the land area of the catchment was planted to hardwood eucalypt forests, and 4200 hectares or 0.6% of the catchment to softwood pine plantations.
Figure 1: Australian plantation forestry plantings and Upper Clarence catchment location map

Key:
- Hardwood forestry plantations
- Softwood forestry plantations
- Upper Clarence catchment, NSW, Australia


Methodology

This study used a participatory action research (PAR) methodology which involved local community participants identifying natural resource management issues relating to plantation forestry expansion, helping collect and analyse information, and exploring scenarios for collaborative improvements at the landscape level. Social learning in a participatory advisory committee (PAC) setting was found to be an effective technique for developing a shared understanding of the socio-ecological system dynamics in the Upper Clarence catchment, determined through an evaluation survey of members (Leys &
Vanclay, 2010). This innovative participatory method could be used more widely as a community engagement tool for examining complex interdisciplinary natural resource management issues, providing an alternative to top-down management procedures which have often been found to be ineffective (Lockwood, 2010; Marshall, 2008; Wallington & Lawrence, 2008). For useful references on participatory techniques see Prabhu et al. (2003), Vanclay et al. (2006) and van den Belt (2004).

**Figure 2:** Undulating slopes of the Upper Clarence catchment with a young eucalypt plantation

A professional independent facilitator was hired for open meetings to provide an impartial and fair process for identifying major issues to explore in the social learning study. Approximately 70 people attended an open public meeting held at Woodenbong (Figure 3) and 23 at Bonalbo. Local village populations were recorded at 333 in Woodenbong and 313 in Bonalbo in the most recent ABS 2006 census. All who attended the public meetings were provided with the opportunity to vote twice on issues that were of most concern to them personally. Their first preference was awarded a greater voting weight of 2, and their second preference was given a weight of 1. The results from the open meetings can be
found in Table 1. For further details on the development of this evaluation framework see Leys et al. (2010).

It is important to note that the public meetings were held in March 2009, shortly after the extensive and well-publicised Victorian bushfires of February 2009. We believed this may have influenced the voting process, whereby fire management was deemed the most concerning issue at both Woodenbong and Bonalbo (Table 1). The voting system used also provided limitations, as some participants suggested afterwards that they had some trouble deciding on their second vote, as there were equally important issues they would have liked to vote on. Further evidence of the influence of recent events such as the bushfires on the order of importance of issues was provided in results from the initial scoping survey and interviews with key informants (Leys, 2008). These suggested more widespread community concerns over environmental issues including impacts from pesticides, impacts on water flow regimes and endangered species, and clearing and subsequent destruction of regrowth timber. The need for creating local employment opportunities was also rated higher at earlier stages in the process.
Figure 3: Public meeting at Woodenbong Golf Club, March 2009

Table 1: Relative importance of issues relating to plantation forestry expansion

<table>
<thead>
<tr>
<th>Issue</th>
<th>Voting weight (%) at each meeting venue</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Woodenbong</td>
</tr>
<tr>
<td>Fire management</td>
<td>25</td>
</tr>
<tr>
<td>Socioeconomic benefits for local communities</td>
<td>24</td>
</tr>
<tr>
<td>Community consultation and information sharing</td>
<td>18</td>
</tr>
<tr>
<td>Collaboration between agricultural producers and plantation industry for improved property planning</td>
<td>11</td>
</tr>
<tr>
<td>Health impacts from aerially sprayed chemicals</td>
<td>11</td>
</tr>
<tr>
<td>Infrastructure development: roads and bridges</td>
<td>7</td>
</tr>
<tr>
<td>Development of value-added timber products</td>
<td>3</td>
</tr>
<tr>
<td>Environmental impacts: spread of invasive weeds, reduced water yields and effects on biodiversity</td>
<td>1</td>
</tr>
</tbody>
</table>
Verbal feedback to the facilitating researchers by local plantation forestry representatives in attendance at the public meetings reported they were very pleased with discussions and progress made. There was an opportunity during a mid-session break for local participants to talk individually with plantation representatives. Several participants who came with concerns about not knowing who to contact in neighbouring plantation companies regarding issues such as fencing had their concerns resolved through the simple exchange of business cards with the names and phone numbers of the appropriate people to follow up with, including fencing contractors needed to undertake necessary repairs.

An ‘expression of interest’ form was provided to all attendees of the public meetings in an effort to form a participatory advisory committee (PAC). A total of 12 interested and concerned participants from various stakeholder groups within the community formed the self-selected PAC. They were seen by the research team and other PAC members to represent a cross-section of views within the community towards the plantation forestry industry (Figure 4). The PAC met regularly for eight evening meetings, 3.5 to 4 hours each, on average once a month over an eight-month period from April to November 2009. While the process was open to all interested parties, we were unable to engage people from the indigenous Aboriginal community, alternative life-stylers, and recent arrivals—which some PAC members felt may have reflected a more passive level of community involvement by these groups. For further information on engaging marginalised groups see Hill and Williams (2009). Participants were asked to avoid media comment until findings from the study had been finalised and the report agreed upon for publication. Members of the PAC helped develop a set of criteria to evaluate the effectiveness of the study, and are listed in Table 2.

The PAC used a variety of means to investigate issues regarding plantation forestry. Initially the group commenced building a visual model of fire management through a
process of group brainstorming and hand-sketched models on large notepads, then moving on to open discussion for formalising systems and data for inclusion in a “Simile” model constructed by the research modeller using computer software. Gaps in data were identified by the PAC, and guest speakers were invited to subsequent meetings. Additional research literature was sourced by both participants and researchers to further discussion and build knowledge. A point was reached where participants were happy with the shared understanding reached on fire management issues and discussion turned to pesticide and socioeconomic issues.

Again a simple model was built for socioeconomic issues through a compilation of data from participants, experts and researchers firstly using “Simile”, then transformed into an Excel spreadsheet with which PAC members were more familiar. A business survey was conducted to obtain further information on impacts of plantation expansion on local businesses. Again a point was reached where PAC members were happy with the shared understanding gained on socioeconomic issues, and knowing that local timber processing options were to be explored further by one of the researchers. Pesticide modelling was more difficult as PAC members brought a lot of raw data along to meetings and did not share a clear sense of how to compare the data. Andrea Leys was then encouraged by the PAC to compile data, seek expert advice and conduct further research between meetings to present to the PAC. More details on investigations are provided in the following section.
**Figure 4:** Participatory advisory committee brainstorming in groups at Woodenbong

**Table 2:** List of criteria for evaluating the participatory modelling process

<table>
<thead>
<tr>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fairness through equal opportunity to express individual views, contribute to agenda and rules of behaviour, monitoring process and outcomes of study</td>
</tr>
<tr>
<td>Cost-effective scenarios explored</td>
</tr>
<tr>
<td>Time-efficient process</td>
</tr>
<tr>
<td>Ecologically sustainable scenarios explored</td>
</tr>
<tr>
<td>Building community capacity through developing group working skills and encouraging socially responsible solutions (i.e. robust solutions)</td>
</tr>
<tr>
<td>Develop a shared understanding of land-use systems over time through sharing local and expert knowledge (i.e. credible scientific knowledge)</td>
</tr>
<tr>
<td>Remain engaged in the study till completion (i.e. not too difficult, interesting)</td>
</tr>
<tr>
<td>Improved collaboration and trust between diverse stakeholder groups</td>
</tr>
<tr>
<td>Feedback to public useful (i.e. socially legitimate strategies)</td>
</tr>
<tr>
<td>Reduced land-use conflict</td>
</tr>
<tr>
<td>Developed new culture for deliberating over natural resource issues</td>
</tr>
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</table>
Findings of study

Fire management in plantation forests

Fire management was the first issue addressed by the PAC, determined as having the highest priority from prior public meetings. Members of the PAC were all of the view that fire management planning by plantation forestry companies needed to be done collaboratively at the landscape level with all other forestry land managers including NSW National Parks and Wildlife Service, Forests NSW, and private native and plantation forestry owners, along with the NSW Rural Fire Service. (Figure 5 shows local landscape fire.) Fire management was initially addressed through information sharing between the various forestry groups to ascertain the level and scope of active fire hazard reduction burns planned and possible under current legislation to reduce the major perceived threat for bushfires (the build up of dry fuel on forest floors). Further scientific reports provided by both PAC members and facilitating researchers were discussed in both group situations and open forums.

Some important findings from discussions included the need for improved fire management plans by plantation forestry companies in collaboration with the local volunteer Rural Fire Service. In particular, detailed property plans and signage of access roads and watering points, and the provision of maps with symbols consistent with other mapping systems (e.g. national parks) were requested by some participants and the local Rural Fire Service to allow safe and prompt response to bushfire alerts in plantations. Also, inventories of firefighting equipment between the various forestry and volunteer parties were requested by a representative of the NSW Rural Fire Service in attendance to allow improved planning and response times, and to help ascertain where more equipment might be required. Current feedback suggested that communication between the plantation
forestry industry and the Rural Fire Service had improved and fire management plans for the local estate were under development. The recent global financial crisis however was reported to be hampering active management efforts by plantation forestry companies due to limited financial resources, particularly in relation to routine fertiliser applications and fire trail maintenance (M. Smith, PAC member, 2009). A successful capital raising venture by Forest Enterprises Australia in late 2009 indicated a returning confidence in the plantation investment market according to Rod Stanford (PAC member and FEA employee, 2009).

The possible bushfire risks posed by the proximity of plantations to local towns and villages was of major concern to several key informants interviewed prior to the social learning study, as well as to members of the PAC, particularly as several plantations had been established on the boundaries of the villages of Bonalbo and Woodenbong. The extensive and devastating bushfires in Victoria during early February 2009 (Greenlivingpedia, 2009) were considered to have increased the level of concern among residents of the catchment (these fires were brought up in discussion on many occasions). The majority of PAC members agreed that they would like to see local government councils in NSW have greater power over land-use planning. Currently the NSW state government has jurisdiction over plantation authorisation through the Department of Planning, and compliance under the NSW Plantations and Reafforestation Act (revised December 2009), and has not in any way restricted establishment close to towns and villages in this catchment according to a local government councillor and participant in the study. Members of the PAC who had been actively involved with firefighting efforts in plantations reported on situations in which eucalypt plantations actually slowed down the rate of fire spread compared with open grass paddocks where fire speed was seen to build up more rapidly.
Through discussion of various views among PAC members it was decided that the major manageable threat for bushfires in the catchment was not only fuel build-up on forest floors, but also dry matter build-up in grazing country. The computer software program ‘Simile’ was used to initiate discussion using a visual modelling environment to explore fire hazards under different land-uses. The PAC decided that there was an urgent need for increased action on fuel-reduction burning in forestry estates and the reintroduction of grazing into plantations once trees were established to help keep fuel levels to a minimum (Figure 6). A NSW National Parks and Wildlife Service representative in attendance responded by proposing greater areas for future fuel-reduction burning. According to one PAC member, Forests NSW had noticeably increased surveillance at local fire tower facilities to improve response times to fires within the catchment.

However, local farmers on the PAC were afraid that fuel-reduction burns might escape into neighbouring properties and litigation could result. Collaborative discussions alleviated these fears. The various forestry groups claimed that litigation was not their preferred way to deal with the issue, instead preferring improved communication,
including notification of all neighbours and the Rural Fire Service for better responses if fires were to escape. Maps provided by an invited NSW National Parks and Wildlife Service speaker illustrated extensive areas of rainforest with vegetation types that were not likely to burn under low to moderate fire regimes due to the subtropical climate in the catchment.

The PAC followed up discussions on fire risks by also exploring the roles of fire in the landscape. Information sourced by the principal researcher suggested that fire management for biodiversity conservation at the landscape level required use of variable prescribed fires to emulate natural disturbances, typical of eucalypt forests in Australia, and create a range of conditions or heterogeneity, based on a theory that if unsuitable habitats were created in one area for a given species, there should be other areas in which the species could survive (Lindenmayer & Hobbs, 2004; Lindenmayer et al., 2006). The protection of patches of retained vegetation, riparian vegetation, watering points, and open grazing areas that could potentially increase the diversity and populations of fauna species in plantation forests was crucial for fire management practices according to reports from Lindenmayer and Hobbs (2004).
A point was reached at which some of the members of the PAC felt that fire management in plantation forestry was being addressed adequately outside the PAC through collaboration between plantation companies and the NSW Rural Fire Service, and that the other identified issues should be given priority due to the limited time and resources available to this study. Two local floods during the study period of 2009 appeared to reduce the focus on the fire management issue temporarily, until hot dry winds and low rainfall returned in the spring of 2009 as the social learning study was in its final stages. At this point it was proposed by all members of the PAC that further research should be conducted into fire management within the catchment in a follow-up study through Southern Cross University.

**Socioeconomic impacts**

Investigations into socioeconomic impacts of an expanding plantation forestry industry took many avenues to establish an evidence-based understanding of the dynamics involved, with the initial aid of the computer software program ‘Simile’ to provide a visual map of systems and relationships using various sources of quantitative data. When
researchers became aware that some of the PAC were having difficulty with the "Simile" model due to a lack of familiarity with this analytical process, data was transformed into an Excel spreadsheet with which participants were more familiar and comfortable. Personal business data was provided by members of the PAC; additional enterprise data was collected by participants from Industry and Investment NSW; further economic data was collected through a survey of local shopfront businesses in Woodenbong by a member of the PAC; previous findings by Schirmer (2008, 2009) from other plantation regions were discussed; and the principal researcher collected data from the Australian Bureau of Statistics on demographics upon the recommendation of the PAC.

Demographic changes were examined, showing results that were contrary to the widely-held perception that rural populations were declining, found earlier in the study in interviews with key informants. Instead, populations of the local villages of Woodenbong, Tabulam, Mallanganee, and Urbenville were found to have increased since the last census records. Only the village of Bonalbo was found to have declined in population. Total population figures, which included farm residents, were higher overall at 3412 in the 2006 census compared with 2894 in 2001 for the Upper Clarence catchment.

In regard to occupancy of residences on properties bought by plantation companies and Forests NSW, findings again were found to be contrary to the widely-held perception that rural homes were being left vacant, found in earlier interviews with key informants. Data examined for all properties purchased by private plantation forestry companies and Forests NSW showed positive impacts on residential occupancy, with an increase of 13 permanent residents and 16 school-aged children (data provided by R Stanford, PAC member, FEA representative, 2009). By mid-2009, a total of 93 properties in the catchment had changed tenure for plantation establishment, including 32 properties leased and a further 61 purchased freehold, of which 28 had no residential dwellings on them to begin with.
On the remaining 33 properties, there were 38 available residences. Figure 7 illustrates the changes in occupancy in these 38 residences after purchase. Although there was an overall decrease in owner-occupied residences from 66% to 43%, there was an overall increase in full-time occupancy (owner-occupied and full-time tenants) from 74% to 82% (Figure 7 margin totals). Of the original 8% of full-time rented residences, 5% had been occupied by farm managers and workers. After purchase, a decreased utilisation was reported for this category of tenants. Properties with residences that previously had absentee owners (labelled as occupied part time in Figure 7; used as weekenders) had been either subdivided and purchased by new owner-occupiers or were now rented out full time; offering further evidence of an increase in overall occupancy of plantation residences.

**Figure 7**: Percentage types of occupancy for all residences on plantation properties within the Upper Clarence catchment before and after purchase by private plantation companies and Forests NSW (compiled by A Leys and J Vanclay from data provided by Rod Stanford of FEA, PAC member, June 2009)
To ascertain the viability and profitability of plantation forestry, the PAC found it justifiable to compare it to the other major land-uses within the catchment. Profitability of beef cattle and maize and soybean crops were found to be marginal, with fluctuations in grain prices sometimes resulting in negative returns. For farmers, leasing areas of less productive agricultural land to plantation companies was found to be highly attractive for the reliability of guaranteed annual lease payments ranging from $200–230/hectare compared with the gross margins of other enterprises. Gross margins for beef cattle ranged from $60/ha for weaners on native pasture to $134/ha for growing out weaners on improved pasture. Gross margins for maize averaged $417/ha after variable costs based on an average grain price of $290/tonne on farm and yield of 6.5 tonnes grain/ha. Gross margins for soybeans were $368/ha based on an on-farm price of $500/tonne and average yield of 2.6 tonnes/ha (compilation of data from B Clarke of Industry and Investment NSW and M Smith, PAC member, local farmer and rural contractor).

However, while local plantation companies sought fertile soils for leasing or purchasing, many cropping areas on flats were not considered suitable for eucalypt timber production due to the high incidence of frost. Some plantation representatives and the majority of the PAC members recognised the importance of preserving a balance in agricultural and forestry country within the catchment by favouring a leasing arrangement on the less agriculturally productive parts of properties, which could provide an additional source of income to farmers and help to preserve local populations and communities. A PAC member presented calculations showing that leasing part of a typical property could increase income and reduce income volatility when partial forestry leases were combined with traditional beef cattle grazing and cropping. Further income could be gained from reintroducing beef cattle grazing once plantations were established (at around 18 months from planting), either by the owner or on an agistment arrangement. For a property
scenario of 522 hectares it was shown that by leasing 200 hectares for plantations and retaining the balance under unimproved breeder weaner production (90 breeders), that whole-farm profits could be increased by 40% or approximately $8500 per year based on current market prices for cattle (in mid-2009) and lease payments of $220/ha.

Whilst individual forestry leases could provide positive financial rewards to farmers, a greater landscape concern was the need for a processing industry to be located in one of the nearby regional centres to create employment opportunities and value adding to the timber estate to ensure long-term industry viability. According to a plantation representative on the PAC, a processing plant was planned for development within the next three years at either Casino or Grafton on the rail line for cost-effective transport of timber and timber products, as opposed to road transport only (Figure 8).

**Figure 8:** Truck transporting timber through Yabbra State Forest

Currently many operational jobs in the plantation forestry industry were found to be insecure, particularly for planting and machinery contractors, in response to the worldwide
The financial crisis of 2009 and collapse of the company Great Southern Ltd. The PAC found Great Southern Ltd to have been primarily based on managed investment schemes (MIS) for generating capital, which put it in a more vulnerable position in the financial crisis than some other plantation companies operating in the catchment. Great Southern Ltd was found to have an estate of approximately 5700 hectares in the catchment, compared with 13,000 hectares under Forest Enterprises Australia management as at early 2009. It was projected by a plantation representative on the committee that operations and leasing were expected to improve in early 2010 as confidence in world financial markets improves and investment in the industry slowly returns. It was discussed by members of the PAC that a recent capital-raising venture by one of the local plantation forestry companies had proved successful, and that considerable competition among companies to take over the responsible entity of the collapsed Great Southern Ltd indicated an underlying confidence with the industry. Gunns Ltd has recently taken over management of the Great Southern Ltd plantation estate.

The future viability and sustainability of the plantation forestry industry in the catchment, however, was found by the PAC through the modelling process to be highly dependent on future growth of the estate to ensure timber volumes were sustainable to support a planned regional processing mill and proposed value-adding manufacturing businesses.

The PAC wanted further information about socioeconomic impacts of plantations and so requested that all the local shopfront businesses in Woodenbong be surveyed, as it is the largest village in the catchment. One of the PAC members distributed the business survey, developed by the principal researcher Andrea Leys with input by the PAC. There was a 93% return rate (thirteen of the fourteen businesses) including a pharmacy, arts and craft shops, hotel, bank, post office, machinery contractors and earthmoving, hardware stores,
supermarket, machinery engineers and butcher. Due to the high return rate of surveys, the results were viewed by the PAC to be representative of the business community.

The majority of businesses (62%) had been operating locally for 10 or more years, compared with 15% operating for 6 to 10 years and 23% operating for less than 3 years. These figures suggest Woodenbong has a long-term stable business base. The customer volume and volume of sales for the previous 12 months and 5-year periods were found to vary depending on the type of business; however, customer volume and volume of sales attributed to plantation customers (customers whose income was mainly derived from direct permanent, casual or contract employment with plantation forestry companies) had declined on average over the past 12 months. 38% of businesses reported a decrease in sales and services to plantation customers, while 23% reported no change. 15% reported an increase and 23% did not respond to this question (Figure 9). Service, food and maintenance businesses reported overall increases in sale volumes attributed to a change in customer base, particularly new settlers moving to town and renovating homes, and to technological advances in business administration. Other non-essential goods and service businesses reported a decline in customer volume and sales, with suggested reasons being the decline in through traffic from Warwick due to deteriorating road conditions and difficult financial times.
An important finding from the business survey was that there was not a significant relationship between the volume of sales and services to plantation companies and overall change in business profits (i.e. correlation coefficient $r = 0.51$, significance level $P = 0.13$, sample size $N = 13$). This suggested that for some businesses where the ratio of trade to plantation customers declined, business profits either remained unchanged or increased, and vice versa. Additionally, it could suggest that employees of plantation companies did not constitute a large proportion of the customer base of most businesses—a view held by the majority of PAC members. 31% of businesses reported a decline in business profits over the past 12 months (Figure 10) compared with 23% over the previous 5-year period, suggesting that the past 12 months had been financially challenging for some types of businesses. At the same time, 31% of businesses reported an increase in profits over the
previous 12 months which was greater than the 23% over the previous 5-year period, and mainly for the service, food and hardware stores.

Machinery contractors reported declines in business which they attributed to the financial crisis and drying up of plantation work, with employees having to be put off and machinery sold. Maintenance of fire breaks and fertiliser topdressing were two operations reported as being postponed by plantation companies during difficult financial times (M Smith, PAC member, farmer and rural contractor, 2009).

**Figure 10:** Change in profitability for Woodenbong shopfront businesses over previous 12-month period (October 2008 – October 2009) \((N = 13)\)

Of the 93% of all shopfront businesses in Woodenbong that responded to the survey, 85% believed that local population growth was restricted by lack of availability of rental properties and local government limitations to rural subdivision, with a significant demand
from young families reported by PAC members. This was contrary to an earlier public perception found in interviews with key informants that plantation companies were causing a decline in population. The current 40 hectare minimum subdivision limit in the Kyogle Shire was considered restrictive by all PAC members. 69% of local shopfront businesses in Woodenbong wanted to see population growth, whilst 31% were undecided. Local businesses were asked what further businesses were needed in Woodenbong to help service the existing population. The majority suggested a combined coffee shop and bakery, as well as a motel and aged-care facility. Other businesses recommended included a timber manufacturing business, guided motorbike rides, farm clothing, tradespeople, and a return general goods transport service to Brisbane. Signage at the Kyogle turnoff for Woodenbong businesses was recommended to attract visitors. 46% of those businesses surveyed rated current sales and services as either ‘very limited’ or ‘limited’ for the existing local population.

Communication between plantation forestry industry and community

It was found both in interviews with key informants and in public meetings that many people felt that the plantation forestry industry needed to improve community engagement to better inform local residents of changes to property ownership and management operations that could have negative impacts upon their businesses. Several participants in the study felt there was a lack of transparency regarding plantation companies’ intentions to purchase property, including suggestions that plantation companies were more interested in the potential for carbon trading to maximise investor return rather than careful tree species selection and silvicultural management. However, PAC members agreed that a maximum carbon price around $20/tonne was likely, and this value would be significantly less than plantation timber prices provided by foresters on the PAC ranging from $40–
45/tonne for small diameter sawlogs, and therefore was not considered the driving force behind plantation expansion, contrary to previous findings.

**Pesticide use**

For investigating the impacts of pesticides used in the plantation hardwood industry, the PAC found it useful to model the most commonly used pesticide programs on a per hectare basis and across the major land-uses in the catchment for fair comparison (Appendix 1). The research investigator Andrea Leys was assigned the task of collating the data on pesticide rates and frequencies provided by members of the PAC, researching for further data sources and seeking expert opinion to complete the model. This avenue of investigation was taken as members of the PAC had difficulty sharing a clear sense of how to compare the large amount of data brought in by participants, and deciding how findings should be presented back to the local community. Data was tabulated into a model and presented visually at meetings to provide participants with the opportunity to comment, recommend changes, and identify areas in which further information was needed. This section was peer reviewed upon recommendation from the PAC by research scientists in the field of pesticide ecotoxicology and modelling (CSIRO, South Australia) to ensure results were robust.
Table 3: Pesticide application rates used in hardwood plantation forestry in the Upper Clarence catchment and corresponding material data (compiled by A Leys from data provided by PAC members and sources: Extonet, 2009; FSC, 2009; QDPI Infopest, 2009; APVMA, 2009; MSDS, 2009; Tomkins, 2004; Eddleston et al., 2005; Jenkin & Tomkins, 2006; Copolovici & Niinemets, 2005; Johnson et al., 2007; Tomlin, 2006; LeBaron et al., 2008; Yordanova et al., 2009)

<table>
<thead>
<tr>
<th>Pesticide</th>
<th>Rate of application (L or kg/ha)</th>
<th>Active ingredient/s (a.i. name)</th>
<th>Frequency of application (no./yr)</th>
<th>Ecosystem load (grams a.i./ha/appl’n)</th>
<th>n-octanol: water ratio (log Kow)</th>
<th>Half-life in soil (days)</th>
<th>Eco-toxicity risk indicator (X – XXX)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Herbicides</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simazine 900</td>
<td>5.5 kg/ha</td>
<td>simazine</td>
<td>1.5/15 yrs(^a)</td>
<td>4500</td>
<td>1.960</td>
<td>60</td>
<td>X</td>
</tr>
<tr>
<td>Glyphosate</td>
<td>2.0 L/ha</td>
<td>glyphosate isopropylamine</td>
<td>5.0/15 yrs</td>
<td>900</td>
<td>-3.000</td>
<td>47</td>
<td>-</td>
</tr>
<tr>
<td>Verdict</td>
<td>0.15 L/ha</td>
<td>haloxy top-R-methyl ester</td>
<td>0.5/15 yrs(^a)</td>
<td>86</td>
<td>3.320</td>
<td>55</td>
<td>-</td>
</tr>
<tr>
<td>Diethylene glycol mono ethyl ether</td>
<td>0.5/15 yrs(^a)</td>
<td>77</td>
<td>0.920</td>
<td>6</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Lontrel</td>
<td>0.1 L/ha</td>
<td>clopyralid TIPA salt-aminopyralid</td>
<td>0.5/15 yrs(^a)</td>
<td>51</td>
<td>-2.870</td>
<td>40</td>
<td>-</td>
</tr>
<tr>
<td>(b) Insecticides</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rogor</td>
<td>0.8 L/ha</td>
<td>dimethoate</td>
<td>4.0/3yrs</td>
<td>240</td>
<td>0.699</td>
<td>7-20</td>
<td>X</td>
</tr>
<tr>
<td>Cynlohexanone</td>
<td>4.0/3 yrs</td>
<td>450</td>
<td>0.810</td>
<td>5</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Fastac Duo</td>
<td>0.5 L/ha</td>
<td>alpha-cypermethrin</td>
<td>2.0/3 yrs</td>
<td>50</td>
<td>6.600</td>
<td>30</td>
<td>XXX</td>
</tr>
<tr>
<td>Xylene</td>
<td>2.0/3 yrs</td>
<td>375</td>
<td>4.300</td>
<td>7</td>
<td>-</td>
<td>-</td>
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</tr>
</tbody>
</table>

Notes:

a. Simazine was additionally applied on 50% of the plantation area as a follow up post-planting herbicide application together with Verdict and Lontrel for residual weed control, accounting for the 1.5 and 0.5 applications respectively over the average 15-year production cycle.

b. A rating for potential ecotoxicity of the commonly used pesticides was applied using a scale of X = low risk to XXX = high risk, – = otherwise not considered a significant risk under routine applications.

c. Ecosystem load refers to a quantitative measure of the amount of active ingredient applied to the environment over a given area at a certain point in time.
The information in Table 3 provides details of active ingredients of commonly used pesticides in hardwood plantation forestry. Table 3 illustrates a common indicator known as the \( \text{n-octanol to water partition coefficient} \) (log Kow) used for assessing chemical solubility in fatty tissue. In particular, it helps in predicting the environmental fate of organic pesticides. The higher the coefficient (log Kow at 25 \(^\circ\)C), the greater the likelihood the chemical will adhere to organic matter in the soil. Higher coefficients may also indicate a tendency to accumulate in fatty tissue of organisms. Literature suggests pesticides with log Kow values between 4 and 8 have the potential to bioaccumulate in animals (Kah & Brown, 2008), particularly aquatic organisms; however, further research is recommended to improve our understanding of impacts. For more information on pesticide findings by the PAC, see Leys and Vanclay (2010).

A broad spectrum of attitudes were represented within the PAC, with some members favouring restricted use and others supporting pesticide use to maintain productivity and boost returns. Insect damage to commercial stands of \( E. \text{ dunnii} \) from the psyllid insect \( Creiis \text{ lituratus} \) and various Chrysomelid beetle species including \( Chrysophtharta \text{ sp.} \), \( Paropsisterna \text{ sp.} \) and \( Paropsis \text{ sp.} \) presented challenges to plantation foresters who believed chemical control was their only option through aerial application of the insecticides Rogor and Fastac Duo (details of active ingredients in Table 3 and Appendix I). (Figure 11 illustrates a \( E. \text{ dunnii} \) stand suffering from insect psyllid damage in the Upper Clarence.)

Some of the local participants in the study were organic farmers and were strongly opposed to the use of aerially applied pesticides due to their concerns of potential drift onto their properties and contamination of their produce and water supplies. They were concerned about unknown long-term effects on their health (Margni \textit{et al.}, 2002); however, no local evidence was found to support this concern. Participants representing the
environmental group of stakeholders were further concerned about a perceived lack of regulation of pesticide use in the catchment, and believed that this needed to be improved at the local and state government levels. PAC members agreed that there was need for high standards in application of pesticides, thorough recordkeeping including GPS data on flight paths and wind speed, and community liaison and notification of all neighbours of intentions to spray.

A pesticide risk indicator has been applied to the pesticides in Table 3 based on chemical rates and frequencies most commonly used for plantation hardwood forestry. Data is provided on the amounts of active ingredients per hectare for single applications, and then adjusted for an annual pesticide load to take account of application frequencies over the production cycle for the various land-uses (Appendix I). In particular, hardwood plantation forestry pesticide usage was found to change considerably in the years after establishment, with the highest pesticide dependency prior to planting for residual weed control and during early establishment to reduce competition from weeds.

Further, insecticide usage in plantation forestry was found through investigation by the PAC to be specific to eucalypt species, with *E. dunnii* particularly susceptible to pysllid insect and Chrysomelid beetle attack. The PAC found that only some local plantation forestry companies monitored regularly for pests. This monitoring allowed cost-effective and environmentally sound practices through selectively spraying only the infested areas of plantations (R Stanford, PAC member, FEA, 2009). It was therefore recommended by the PAC that all plantation forestry companies regularly monitor for pests to reduce overall pesticide use in the catchment and to reduce the incidence of pest outbreaks that could potentially devastate plantations.
During the course of the study, representatives from the plantation forestry industry acknowledged that *E. dunnii* increased their reliance on pesticides and that they were now aiming to plant species less susceptible to insect attack including *E. saligna* (Sydney blue gum) and *Corymbia maculata* (spotted gum). According to forestry consultant Mick O’Neill (pers. comm.), *Eucalyptus cloeziana* (Gympie messmate) required greater recognition not only for its insect resistance, but also for its growth potential, sound timber qualities and potentially higher-value end-products. However, a lack of seed collection is currently limiting its propagation in native forest nurseries, and it is less frost-tolerant than *E. dunnii*. Foresters on the PAC agreed with this recommendation. (Figure 12 illustrates a healthy young plantation forest.)

The pesticide footprint model (Appendix 1) further illustrated the lower overall reliance on pesticides in hardwood plantation forestry compared with annual crops grown locally, including maize and soybeans, when active ingredients were standardised over an average
15-year production cycle in the catchment. An interesting comparison by the PAC found the s-triazine herbicides, which are residual in nature (atrazine half-life in soil being around 80 days and water soluble; simazine 60 days and less soluble in water), had an approximately 10-times higher footprint in maize cropping through the use of atrazine compared with the use of simazine in hardwood plantations. The log Kow levels (ratio of octanol to water solubility) of both these triazine herbicides was found to be less than 4 (atrazine log Kow = 2.34; simazine log Kow = 1.96) and they were therefore not expected to bioaccumulate in animals (Walker & Blacklow, 1994; Stenersen, 2004; LeBaron et al., 2008). The PAC suggested that further scientific research was required in this area of pesticide ecotoxicology to better understand potential impacts of pesticide application rates commonly used in the field.

The PAC found that follow-up applications of simazine occurred in around 50% of plantations at establishment to achieve residual weed control. Data on chemical labels provided by a PAC member indicated that simazine should not be reapplied on country treated in the past 12 months, due to the potential for the development of herbicide resistance in weeds. The other commonly applied s-triazine herbicide, atrazine, found by the PAC to be regularly used for residual weed control in maize, included similar recommendations on its label to simazine: that it should not be applied in consecutive years in order to minimise herbicide resistance in weeds.
There was considerable community concern regarding the potential effects of the use of particular pesticides on drinking water standards in the catchment. This concern was found in interviews with key informants, in public meetings, in the views of some PAC members, and in phone calls received by the principal researcher from residents in the community throughout the duration of the study. The pesticides found to have the most potential for adverse impacts on wildlife in local ecosystems and/or drinking water supplies were Fastac Duo (used in hardwood plantations and illustrated in Table 3 using an ecotoxicology risk indicator), atrazine and chlorpyrifos if used together in maize, and Spinnaker used in soybeans. This was due to their long half-lives, water solubility and/or potential to bioaccumulate, and the high toxicity level of their active ingredients. In the case of atrazine and chlorpyrifos, atrazine was found to have a synergistic effect on chlorpyrifos by increasing its level of toxicity when applied in the same growing season (LeBaron et al., 2008; Stenersen, 2004).
The investigation highlighted that the fate of pesticides depends on the level of runoff and the temperature subsequent to application of the chemical, together with site characteristics such as slope, soil texture, pH and level of organic matter (Rodriguez-Cruz et al., 2006). As such, it was recommended by all PAC members that land managers use caution when using chemicals considered to pose ecotoxicological risks; however, only some PAC members agreed that the local council based at Kyogle (or the local council in collaboration with chemical users) monitor for contamination of drinking water supplies, particularly in times of consistent moderate rainfall around planting time, to help alleviate fears of local residents. This highlighted the diversity of views held towards pesticide use both on the PAC and within the local community.

Local pesticide testing agencies include the Environmental Analysis Laboratory at Southern Cross University’s Lismore Campus, and Industry and Investment NSW at the Wollongbar Agricultural Research Institute. Whilst costs of testing were found through PAC investigations to be around $150 per test, if a self-regulatory system was undertaken by chemical users or the local council, testing could be specific to the pesticide in question and costs could be minimised. It was also recommended by the majority of PAC members that preference in management operations be given to use of less toxic (softer) chemicals where these were available. Tomkins (2004) and Jenkin and Tomkins (2006) provide further detail on the criteria surrounding pesticide use in plantation forestry for certification under the Forest Stewardship Council and Australian Forestry Standard.

A sophisticated model called the Pesticide Impact Rating Index or PIRI (Kookana et al., 2005) has been developed by the CSIRO in South Australia. This was suggested by the principal researcher as having potential for modification and use in monitoring possible contamination of surface and groundwater supplies by local councils.
Other findings

Concerns about clearing regrowth were raised by several stakeholders during interviews (Figure 13), and requests were made for increased compliance checks and auditing by the plantation regulatory authority (Industry and Investment NSW). In particular, impacts on wildlife conservation, including removal of endangered Proteaceae spp. and remnant habitat trees, caused concern for several farming and environmental stakeholders. Under current legislation in the NSW Plantations and Reafforestation Act (Revised Dec 2009), plantation companies have been legally able to clear tree regrowth since 1990. Members of the PAC discussed this issue and it was found that some land users were not aware that they could also apply to clear regrowth (i.e. that clearing was not restricted to plantation companies only). Several participants throughout the study discussed the ability of individual landholders to develop property vegetation plans (PVP) for areas of native forest and apply to harvest up to 20% under the Native Vegetation Act. One of the participants in the study from Industry and Investment NSW, John Macgregor-Skinner, held a training and field day for local land managers to learn more about private native forestry harvesting, how to measure timber growth parameters and manage forests for biodiversity and productivity values.
Discussion and recommendations

The following recommendations were made by the PAC for adaptive management practices and industry development to improve the socio-ecological and economic outcomes from the plantation forestry industry in the Upper Clarence catchment.

Development and location of processing facilities

The PAC recommended that plantation forestry companies continue to work collaboratively with local councils to determine a feasible site for a timber processing mill and advance development to ensure the economic and social viability of the industry within the region.
Changing land subdivision rules to promote population growth

The most recent census figures demonstrated an overall slight increase in population growth; however, the PAC found that current limitations to rural subdivision of 40 hectares within the Kyogle Local Government Area was the major restriction on population growth—particularly around the township of Woodenbong, where rental properties and small rural residential properties were claimed also by local residents to be scarce. This was contrary to earlier findings by Andrea Leys in interviews with key informants that an expanding plantation forestry industry was deemed to be causing a decline in rural populations. The PAC found evidence of an overall net increase in population on all properties purchased by plantation forestry companies and Forests NSW within the catchment. As a result, the PAC recommended that Kyogle Council address rural land subdivision policy to allow for future population growth in and around small towns and villages within the catchment.

Improved communication and correspondence between plantation forestry companies and local farmers and community

Whilst significant progress had been observed by the principal investigator towards successful community engagement between the plantation forestry industry and local community in the Upper Clarence catchment throughout the period of this study, PAC members suggested further improvements could be made through regular updates on plantation operations in local community newsletters (list provided in Appendix II).
Best practices in pesticide usage

Whilst the total chemical footprint per hectare for perennial hardwood crops of eucalypt species was found by the PAC to be less than 10% of that used in the annual crops of maize and soybeans when adjusted for a typical 15-year production cycle, the PAC made a general recommendation that all land users choose softer (less toxic) pesticide options where possible and improve monitoring to allow spraying only pest-affected areas. Many landholders, including some plantation companies, are already taking this approach. The PAC also recommended that greater consideration be given to species and varieties with improved pest-resistance qualities, both for plantation and crop selection, as a way forward to reduce the chemical load in the catchment.

The PAC expressed particular concern about the insecticide Fastac Duo (log Kow 6.6, Table 3) used in plantations for Chrysomelid beetle control, and discussed the need for further research to examine its potential for bioaccumulation and its implications under forest certification schemes.

A self-regulatory system for monitoring potential risks to water supply contamination including stock dams and drinking water catchments and storages was recommended by Andrea Leys for further investigation. Collaboration was suggested between chemical users and the local council, which has regulatory authority and the duty of care to ensure that safe drinking water is provided to the public and that public health is safeguarded (NSW Public Health, 1994). The majority of the members of the PAC believed that improvements were necessary in environmental monitoring and assessment of pesticide safety on ecosystems and water catchments.
**Further research**

*Local plantation timber processing*

Project members have commenced research on the bioenergy potential of plantations, and on the economic footprint of potential local processing facilities. The intent of this work is to develop an understanding of the likelihood of small-scale local processing and possible distribution of benefits throughout the local community if a local processing industry were to be established.

*Fire risk of plantation forests to local communities*

PAC members suggested that further research was required to develop a greater understanding of how fire within plantation forests might impact on local communities. Consequently, it was recommended that the University explore potential for further research in this area.

*Alternative eucalypt species with improved wood properties and pest resistance*

The PAC recommended further scientific research on *Eucalyptus cloeziana* (Gympie messmate) for use in plantations in the catchment. Improvements were believed to be needed in seed collection for this species to enhance nursery propagation. The PAC recommended other species with potential for high-value timber products (such as poles), including northern grey ironbark (*E. siderophloia*), spotted gum hybrids (*Corymbia spp.*) and white mahogany (*E. acmenoides*) (shown in Figure 14). Mixed-species plantings were further recommended as a sustainable alternative for providing potentially positive impacts on biodiversity within the region.
Evaluation surveys of members of the participatory advisory committee and community

A final evaluation survey of members of the PAC showed that several participants still believed that the fiscal incentives provided by the federal government in the form of managed investment scheme (MIS) taxation legislation for retail forestry would continue to create divisions among land users. The main reasons given were continuing impacts such as

- changes in the integrity of local towns due to replacement of farming families with rental tenants on plantation properties, increasing age of local populations, and a loss of a sense of identity in small villages
- negative visual landscape appeal
- ecological impacts due to changes in water regimes, native habitat and loss of biodiversity through continued clearing of regrowth forests
- high cost of returning land to agriculture after plantation forestry cycles, loss of food-producing land, and unproven economic benefits of plantations within the local catchment.

Members of the PAC felt that the social learning study, however, was very worthwhile for increasing understanding of plantation forestry dynamics and business operations. The most useful strategies were found to be open discussion with other local participants, sharing of scientific knowledge with facilitating researchers, and expert opinion from invited speakers. Empirical evidence suggested an overall improvement in attitudes of participants towards the plantation forestry industry. This suggested that collaboration among diverse stakeholders in a facilitated, non-threatening and interesting learning environment can help reduce controversy over natural resource issues, and is recommended for more widespread use. For further information on this analysis, see Leys and Vanclay (2010).

A second follow-up evaluation survey is planned to assess current wider community attitudes towards the plantation forestry industry for comparison with the results from the evaluation survey of PAC members. It is anticipated that these results will be published in a scientific journal.
Acknowledgements

We would like to thank the following participants on the participatory advisory committee (PAC) who contributed their time and knowledge at meetings held regularly at the Woodenbong Golf Club throughout 2009: Rod Stanford, Jamie Ramsay, Keith Hill, John Macgregor-Skinner, Marcus McSweeney, Tony Wade, Christine Reid, Kim Robertson, Michael Smith, Dave Stace, Pam Stone and Dean Jeffery. Gratitude is expressed to all the participating local shopfront businesses in Woodenbong who gave their time to complete a business survey and to Kim Robertson for helping distribute and collect these surveys. Thank you to George Stein for use of the Woodenbong Golf Club dining room as a very pleasant venue for the regular evening meetings with the PAC.

Gratitude is expressed to Marie-Chantale Pelletier, fellow PhD candidate, for support and assistance at meetings; Dr Jacki Schirmer and Dr Kathryn Williams as CRC for Forestry ‚Communities‘ project leaders, for guidance and expertise in social research methodology, and peer review of this report; Professor Brad Potts as Program Manager of CRC for Forestry Program Four ‚Trees in the landscape‘; and members of the project steering committee, including Troy Brown of Forest Enterprises Australia, for additional peer review of this report, with amendments suggested leading to improvement. Thank you to Dr Rai Kookana and Dr Ray Correll from CSIRO South Australia for expert peer review of the section on pesticides.

Thank you to Forest Enterprises Australia (FEA) Goonellabah, particularly Rod Stanford; Kerry Moore (district agronomist at Kyogle) and Bede Clarke (district agronomist at Casino) of Industry and Investment NSW for their assistance in providing data specific to operations within the catchment.
Thank you to Mark Geyle, NSW National Parks and Wildlife Service ranger based at Kyogle, for expert advice on fire management in local national parks; and Boyd Townsend, superintendent of the NSW Rural Fire Service, for expert advice on fire management in plantation forests and across the landscape. Thank you to John Macgregor-Skinner of Northern Rivers Private Native Forestry and Industry and Investment NSW (Murwillumbah) for expert advice on timber products, processing and value-adding opportunities for the plantation estate.

This study was funded by the Cooperative Research Centre for Forestry based in Hobart, Tasmania, Australia.
References


Jenkin BM & Tomkins B (2006) „Pesticides in plantations: The use of chemical pesticides by the Australian plantation forest industry‘. (Project Number 06.4016, Forest and


Appendix I: Pesticide footprint model for the major land-uses in the Upper Clarence catchment

(Compiled by A Leys from the following sources: PAC members provided pesticide rates and frequencies used in their individual business operations, and this data was crosschecked upon recommendation by the PAC against widely used pesticide programs in the catchment with Kerry Moore, District Agronomist at Kyogle and Bede Clarke, District Agronomist at Casino for the Industry and Investment NSW, with slight amendments then made by the PAC. Data on active ingredients for forestry pesticides was provided by John MacGregor-Skinner, PAC members and employees of Industry and Investment NSW, Murwillumbah, and the remainder sourced by A Leys from Extonet, 2009; FSC, 2009; QDPI Infopest, 2009, APVMA, 2009; and MSDS, 2009.)

<table>
<thead>
<tr>
<th>Pesticide rate applied (L or kg/ha)</th>
<th>Rate of active ingredients (L or kg/ha)</th>
<th>Frequency of applications (applications/year)</th>
<th>Pesticide load by a.i. per annum (rate a.i./ha/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Herbicides</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simazine 900 @ 5.5 kg/ha</td>
<td>simazine 4.5 kg/ha</td>
<td>1.5 per 15 years&lt;sup&gt;1&lt;/sup&gt;</td>
<td>simazine 0.45 kg/ha/yr</td>
</tr>
<tr>
<td>Glyphosate CT @ 2 L/ha</td>
<td>glyphosate isopropylamine @ 0.9kg/ha</td>
<td>5 per 15 years&lt;sup&gt;2&lt;/sup&gt;</td>
<td>glyphosate isopropylamine 0.3kg/ha/yr</td>
</tr>
<tr>
<td>Verdict @ 0.15 L/ha</td>
<td>haloxy fop-R-methyl ester 86 g/ha</td>
<td>0.5 per 15 years&lt;sup&gt;3&lt;/sup&gt;</td>
<td>haloxy fop-R-methyl ester 3 g/ha/yr</td>
</tr>
<tr>
<td></td>
<td>diethylene glycol mono ethyl ether 77g/ha</td>
<td></td>
<td>diethylene glycol mono ethyl ether 3 g/ha</td>
</tr>
<tr>
<td>Lontrel @ 0.1 L/ha</td>
<td>clopyralid TIPA salt 51 g/ha</td>
<td>0.5 per 15 years</td>
<td>clopyralid TIPA salt 2 g/ha/yr</td>
</tr>
<tr>
<td><strong>Insecticides</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rogor @ 0.8 L/ha</td>
<td>dimethoate 240 g/ha</td>
<td>4 per 3 years on 5%&lt;sup&gt;4&lt;/sup&gt;</td>
<td>dimethoate 16 g/ha/yr</td>
</tr>
<tr>
<td></td>
<td>cyclohexanone 450 g/ha</td>
<td></td>
<td>cyclohexanone 30 g/ha/yr</td>
</tr>
<tr>
<td>Product</td>
<td>Concentration</td>
<td>Application Details</td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>------------------------</td>
<td>----------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Fastac Duo 0.5 L/ha</td>
<td>alpha-cypermethrin 50 g/ha xylene 375 g/ha</td>
<td>2 per 3 years on 3% alpha-cypermethrin 1 g/ha xylene 8 g/ha</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**

i) Simazine is only applied for pre-emergent weed control on 50% of the plantation estate for a second application over a 15-year production cycle.

ii) Glyphosate is used prior to planting and then for inter-row weed control, particularly early in plantation establishment and prior to reintroduction of grazing to reduce weed pressure.

iii) Verdict and Lontrel only applied with Simazine overspray post-planting in plantations on 50% of estate.

iv) Rogor was only applied to areas of *Eucalyptus dunnii* plantation where there were outbreaks of the psyllid insects at a frequency of two sprays in 18 months, and accounted for 5% of FEA's plantation estate over recent years 2008/09. Younger plantations tend to be most affected. Fastac Duo was applied in *E. dunnii* plantations for control of the Chrysomelid beetle, which accounted for 3% of FEA's plantation estate within the Upper Clarence catchment. Other common species *E. saligna* (Sydney blue gum) and *Corymbia maculata* (spotted gum) are not commonly attacked.

v) Approximately 27,400 hectares were under hardwood plantation forestry in early 2009 (M-C Pelletier, Hurfords Hardwood, 2009, pers. comm.)
### B. PESTICIDE FOOTPRINT  
**BEEF CATTLE (IMPROVED PASTURE)**

<table>
<thead>
<tr>
<th>Herbicides</th>
<th>Pesticide rate applied (L or kg/ha)</th>
<th>Rate of active ingredients (L or kg/ha)</th>
<th>Frequency of applications (applications/year)</th>
<th>Pesticide load by a.i. per annum (rate a.i./ha/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glyphosate CT @ 400 mL/ha(^1)</td>
<td>glyphosate isopropylamine @ 180 g/ha /ha</td>
<td>1 per year</td>
<td>glyphosate isopropylamine 180 g/ha/yr</td>
<td></td>
</tr>
<tr>
<td>2,4-D Amine 625 @ 0.9 L/ha(^1)</td>
<td>dimethylamine salt of 2,4-dichloro-phenoxy acetic acid 563 g/ha</td>
<td>1 per 2 years</td>
<td>dimethylamine salt of 2,4-dichloro-phenoxy acetic acid 282 g/ha/yr</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**

i) Herbicides mainly used for spray grazing or pasture topping techniques in weed control.

ii) Pasture grasses include the naturalised Rhodes and Kikuyu grasses, and common paspalum carpet grass. White clover, and in wetter areas Maku lotus were other common species used.

iii) Cattle drenches and arachncides were used for worm and tick control. In this case it was assumed that these chemicals are degraded on and within the animal and do not reach the ground in their active form.
## C. PESTICIDE FOOTPRINT  🌱 SOYBEAN CROPPING

<table>
<thead>
<tr>
<th>Pesticide rate applied (L or kg/ha)</th>
<th>Rate of active ingredients (L or kg/ha)</th>
<th>Frequency of applications (applications/year)</th>
<th>Pesticide load by a.i. per annum (rate a.i./ha/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Glyphosate CT @ 2 L/ha</strong></td>
<td>glyphosate isopropylamine @ 900 g/ha</td>
<td>2 per year¹</td>
<td>glyphosate isopropylamine 1.8 kg/ha/yr</td>
</tr>
<tr>
<td><strong>Verdict @ 0.15 L/ha</strong></td>
<td>haloxy fop-R-methyl ester 86 g/ha</td>
<td>1 per year</td>
<td>haloxy fop-R-methyl ester 86 g/ha/yr</td>
</tr>
<tr>
<td></td>
<td>diethylene glycol mono ethyl ether 77g/ha</td>
<td></td>
<td>diethylene glycol mono ethyl ether 77g/ha</td>
</tr>
<tr>
<td><strong>Spinnaker @ 0.14 L/ha</strong></td>
<td>imazethapyr 34 g/ha</td>
<td>1 per year²</td>
<td>imazethapyr 34 g/ha</td>
</tr>
<tr>
<td></td>
<td>urea 31 g/ha</td>
<td></td>
<td>urea 31 g/ha</td>
</tr>
<tr>
<td></td>
<td>polydimethyl siloxane 1.5 g/ha</td>
<td></td>
<td>polydimethyl siloxane 1.5 g/ha</td>
</tr>
<tr>
<td><strong>Deltamethrin @ 2.5 L/ha</strong></td>
<td>deltamethrin 63 g/ha</td>
<td>2 per year³</td>
<td>deltamethrin 126 g/ha</td>
</tr>
<tr>
<td></td>
<td>1,2-propanediol 160 g/ha</td>
<td></td>
<td>1,2-propanediol 320 g/ha</td>
</tr>
</tbody>
</table>

### Notes:

i) This pesticide program is for a minimum tillage system.

ii) Spinnaker is used in soybeans as a pre-emergent or early post-emergent herbicide. Verdict is a post-emergent herbicide for control of grass weeds.

iii) Deltamethrin is an insecticide used against *Heliothis spp* and other caterpillars during the growing season. Towards the end of the growing cycle it is commonly reapplied for control of green vegetable bug and other pod sucking pests.

iv) Approximately 1,280 hectares were planted to soybeans within the Upper Clarence catchment in the 2008/9 cropping season (B Clarke, Industry and Investment NSW, 2009, pers. comm.)
# D. PESTICIDE FOOTPRINT MAIZE CROPPING

<table>
<thead>
<tr>
<th>Pesticide rate applied (L or kg/ha)</th>
<th>Rate of active ingredients (L or kg/ha)</th>
<th>Frequency of applications (applications/year)</th>
<th>Pesticide load by a.i. per annum (rate a.i./ha/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Herbicides</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atrazine WG @ 2.5 L/ha</td>
<td>atrazine 2.25 kg/ha</td>
<td>2 per year&lt;sup&gt;1&lt;/sup&gt;</td>
<td>atrazine 4.5 kg/ha/yr</td>
</tr>
<tr>
<td>Dual Gold @ 1.5L/ha</td>
<td>S-metolachlor 150 g/ha</td>
<td>1 per year</td>
<td>S-metolachlor 150 g/ha/yr</td>
</tr>
<tr>
<td>Glyphosate CT @ 2 L/ha</td>
<td>glyphosate isopropylamine @ 0.9kg/ha</td>
<td>2 per year&lt;sup&gt;2&lt;/sup&gt;</td>
<td>glyphosate isopropylamine 1.8 kg/ha/yr</td>
</tr>
<tr>
<td><strong>Insecticides</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorpyrifos 500 @ 1L/ha</td>
<td>chlorpyrifos 500 g/ha naptha 470 g/ha</td>
<td>1 per year&lt;sup&gt;3&lt;/sup&gt; on 10%</td>
<td>chlorpyrifos 50 g/ha/yr naptha 47 g/ha/yr</td>
</tr>
<tr>
<td>Semevin 500 @ 0.2 L/ha</td>
<td>thiodicarbamate 80 g/ha fibronil 140 g/ha</td>
<td>1 per year</td>
<td>thiodicarbamate 80 g/ha/yr fibronil 140 g/ha/yr</td>
</tr>
</tbody>
</table>

**Notes:**

i) Atrazine is a herbicide used at planting for residual weed control and again post-planting.

ii) Glyphosate CT is applied twice in pre-planting operations for weed control in a minimum tillage system.

iii) Chlorpyrifos 500 is an insecticide applied at seed planting for situations only where black beetle and wire worms are present, with an average area of 10% used for this catchment.

iv) Urea is a fertiliser commonly applied at planting, however can also be applied post-planting as a side dressing when crop is around 25–40 cm of height only if weed burden is high for an inter-row cultivation for weed control. In this case the post-planting Atrazine WG treatment would be forgone.

v) Approximately 770 hectares were planted to maize within the Upper Clarence catchment in the 2008/9 cropping season (B Clarke, Industry and Investment NSW, 2009, pers. comm.)
## Appendix II: List of local community newsletters and associated contacts for media correspondence

<table>
<thead>
<tr>
<th></th>
<th>Newsletter/Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Bonalbo/Old Bonalbo Newsletter</em>, Jill Gorry, Phone: (02) 66 653248, Email: <a href="mailto:froghollow11@westnet.com.au">froghollow11@westnet.com.au</a></td>
</tr>
<tr>
<td>2</td>
<td><em>Drake Village Voice</em>, Janis Owen, Phone: (02) 67 376790, Email: <a href="mailto:dvrc@dvrc.com.au">dvrc@dvrc.com.au</a></td>
</tr>
<tr>
<td>3</td>
<td><em>The Bridge (Tabulam)</em>, Sharon White, Email only: <a href="mailto:smwhite@austranet.com.au">smwhite@austranet.com.au</a></td>
</tr>
<tr>
<td>4</td>
<td><em>Bonalbo Central School Newsletter</em>, Phone: (02) 66 651205, Fax: (02) 66 651251, Email: <a href="mailto:bonalbo-c.school@det.nsw.edu.au">bonalbo-c.school@det.nsw.edu.au</a></td>
</tr>
<tr>
<td>5</td>
<td><em>Woodenbong Central School Newsletter</em>, Phone: (02) 66 351281, Fax: (02) 66 351488, Email: <a href="mailto:woodenbong-c.school@det.nsw.edu.au">woodenbong-c.school@det.nsw.edu.au</a></td>
</tr>
</tbody>
</table>

**Source**: Anne Gibbs, Natural Resources Officer, Upper Clarence Landcare group.
ESTABLISHED AND SUPPORTED UNDER THE AUSTRALIAN GOVERNMENT'S COOPERATIVE RESEARCH CENTRES PROGRAMME
Appendix 7: Notifications of acceptance for publication of journal papers

7.1 Acceptance of scientific paper No.1 in International Forestry Review

From: CFA [cfa@cfa-international.org]  
Sent: Sunday, 5 September 2010 8:04 PM  
To: Andrea Leys  
Cc: VANCLAY Jerry  
Subject: Leys and Vanclay - proof  
Attachments: Leys and Vanclay.pdf; IFR Guidelines for authors.doc  
Importance: High

Dear Andrea

I have attached the proofs for your paper which will be published in the September 2010 issue of the International Forestry Review. Please check them thoroughly for content and layout (please make sure to refer to the Guidelines for Authors attached) and return them to me by the end of Monday 6th September.

I would also be grateful if you would submit one high resolution photograph related to your research that could be considered for the cover of the IFR.

With best wishes

Alan

______________________________
Alan Pottinger  
Editor, International Forestry Review  
Tel. 00 44 (0)1588 672868  
Fax. 00 44 (0)870 01 16645  
www.cfa-international.org/IFR.html

______________________________
26 August 2010

Ms Andrea Leys,
School of Environmental Science and Management
Southern Cross University
PO Box 157 Lismore
NSW 2480

Dear Ms Leys,

Re: “Evaluation framework for participatory modelling in Australian plantation forestry communities.” (357/AIJ)

Your ms with Vanclay and Schirmer has been read by two referees and a Panel Editor and their comments are attached. The Panel Editor recommends that we accept your ms for publication in Australian Forestry after minor amendment and I am happy to accept this recommendation.

The Panel Editor adds that Ref 1 provided some comments on wording and a little detail on the use of participatory modelling. The first comment (AN1) should be addressed as with general comments on wording. The second referee provided substantive comments but also suggested publication with minor modification. This referee made some exceptionally helpful sociological comments with respect to this manuscript, I would advise careful consideration of these comments. This will considerably strengthen the paper.

We look forward to receiving a revised ms. In preparing your revision, please pay particular attention to the referees’ comments and those of the Panel Editor above.

Please submit the revised ms electronically as a Word document to admin@forestry.org.au using the template provided on the Australian Forestry part of the IFA website (www.forestry.org.au/ifa/c/c1-ifa.asp) and include a commentary on changes you have made at the same time.

Yours sincerely,

(Dr) A.C. Matheson
Managing Editor
7.3 Acceptance of scientific paper No.3 in Regional Environmental Change

Ref.: Ms. No. REC-D-10-00002R2
Stakeholder engagement in social learning to resolve controversies over land use change to plantation forestry
Regional Environmental Change

Dear Ms Leys,

The reviewers and the subject-matter editor have completed their evaluation of your paper and recommend acceptance of it for publication. I have reviewed the materials and agree with the recommendation. I am therefore pleased to accept your paper for publication in Regional Environmental Change as written.

You will be contacted by a representative of our publisher concerning copyright transfer agreements and page proofs later in the production process. Please contact the editorial office if you have questions or need more information in the interim.

Thank you for submitting your work to Regional Environmental Change.

With kind regards,

Wolfgang Cramer
Editor-in-Chief
Regional Environmental Change
Important Announcement

Dear Author,

Thank you for publishing with Springer. This message is to let you know that your article

- Article title: Stakeholder engagement in social learning to resolve controversies over land-use change to plantation forestry
- DOI: 10.1007/s10113-010-0132-6

has gone into production. Before we can send you your proofs, we have to ask you to provide some additional information. Please go to the following website (you may need to copy and paste the URL into your browser): http://www.springer.com/home?SGWID=0-0-1003-0-0&aqId=1278537&checkval=de58f4381a886a88e26403452a255f5b
**7.4 Acceptance of scientific paper No.4 in conference proceedings of 18th Commonwealth Forestry Conference, Edinburgh, Scotland**

From: Montserrat Capón Regal [montserrat@in-conference.org.uk]
Sent: Saturday, 17 April 2010 6:16 AM
To: aleys10@scu.edu.au
Subject: IMPORTANT! 18th Commonwealth Forestry Conference-Voluntary Paper feedback

Importance: High

Dear Ms Leys,

Thank you very much for submitting your full paper for the Commonwealth Forestry Conference taking place in Edinburgh in just under 3 months time.

Please pass this information onto the presenting author if you have submitted the paper on their behalf.

The Programme Committee has now reviewed your paper and we are pleased to advise that it does not need any further work to it.

**IMPORTANT: Further details on the session date/time of your presentation will be sent to you sometime next week.**

Registration and Financial Support

Please note that all presenters must register as delegates for the Conference by 4 June 2010.
If you have not yet registered, you may wish to do so before the Early Registration deadline which has been extended until **22 April 2010**.

Yours sincerely,

Montse

Montserrat Capón Regal
Assistant Event Planner
In Conference Limited
4-6 Oak Lane
Edinburgh, EH12 6XH
Scotland, UK
Tel: +44 (0)131 339 9235
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**think of the environment before you print**

From: Montserrat Capón Regal [montserrat@in-conference.org.uk]
Sent: Saturday, 24 April 2010 12:29 AM
To: aleys10@scu.edu.au
Subject: 18th Commonwealth Forestry Conference (CFC 2010) - Voluntary Papers presentation details
24th April 2010

Dear Ms. Leys,

18th Commonwealth Forestry Conference
28 June – 2 July 2010
Edinburgh International Conference Centre, Scotland, UK

Paper Reference Number: O-37

Title: Role of participatory modelling in reducing community controversy surrounding the expansion of plantation forestry

Further to my previous correspondence, I have pleasure in advising you of the date of your presentation of the above paper.

Date of Presentation: Wednesday 30 June

The full conference programme with the provisional timings can be viewed on the conference website www.cfc2010.org. Please check this closer to the date of the conference in case some changes have been made to the programme.

Notes for Presenters of Papers

Presentation Timing
The Conference papers will be presented in a series of parallel sessions based on the themes and sub-themes of the conference with papers grouped accordingly.

Each speaker will have a maximum of 15 minutes for presentation, followed by 5 minutes for questions. The Chairperson will be instructed to enforce this without exception. At the end of each session, there will be further time for questions, answers and discussion.

Data Projection
You do not need to bring your own computer. We advise that you bring two copies of your presentation with you to on a memory stick. If you wish to show a video clip, please remember to also save a separate copy of this on your memory stick.

Please ensure that you have handed over your memory stick to the Technician in the Speakers’ Preparation Room at least 4 hours prior to your presentation.

Registration and Financial Support

Please note that all presenters must register as delegates by 4 June 2010 otherwise your paper will be withdrawn.

We look forward to seeing you in Edinburgh and if you have any queries, please do not hesitate to contact me.

Yours sincerely,

Montserrat Capón Regal
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CFC 2010 Secretariat
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Web: www.in-conference.org.uk
7.5  Acceptance of scientific paper No.5 in Land Use Policy

Your Submission LUP-D-10-00116R2
ees.lup.0.d55c7.d18bbde9@eesmail.elsevier.com on behalf of; Land Use Policy [g.robinson@kingston.ac.uk]

Sent: Mon 22/11/2010 10:12 PM
To: a.leys.10@scu.edu.au

Ms. Ref. No.: LUP-D-10-00116R2
Title: Social learning: A knowledge and capacity building approach for adaptive co-management of contested landscapes Land Use Policy

Dear Andrea,

I am pleased to confirm that your paper "Social learning: A knowledge and capacity building approach for adaptive co-management of contested landscapes" has been accepted for publication in Land Use Policy. I am grateful that you have persisted with the various changes requested by the referees.

Thank you for submitting your work to this journal.

With kind regards,

Guy Robinson

Prof. Guy M Robinson
Editor
Land Use Policy

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