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final report

knowledge for managing Australian landscapes

New paradigms to find solutions to intractable NRM problems

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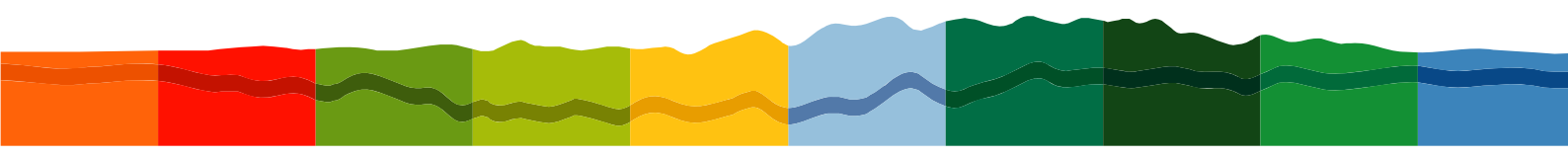


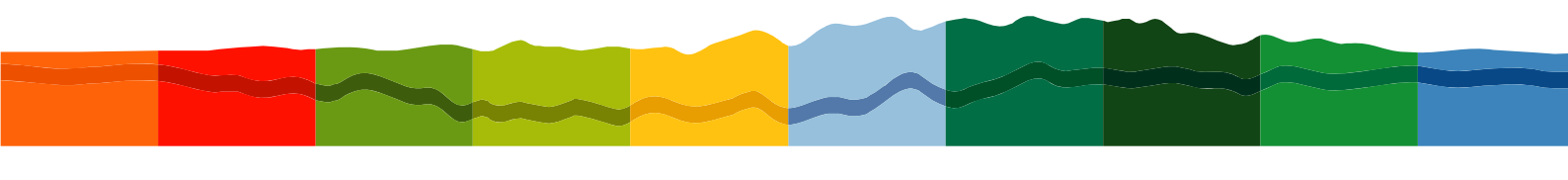
Project objectives

1. To identify the underlying mental models, beliefs, and assumptions of key scientists, policy makers, funders and the public about the dynamics of complex systems.
2. To understand stakeholder acceptance and resistance to policy options and address the root cause of problems and set forth strategies in a way that can gain acceptance.
3. To improve our understanding of the complex dynamics that result from interactions between the social, ecological and economics systems operating in agricultural systems in Australia.
4. To test the limits of the conceptual model through a rigorous quantitative modelling process.
5. To inform policy based on current understanding of critical feedback processes in complex adaptive systems and resilience building for social-ecological systems.
6. To develop adaptive institution and policy design principles that can improve natural resource outcomes.
7. To inform policy on appropriate interventions to increase the resilience of agricultural regions.

1.1 Introduction

This final report presents the results of the project conducted from 1 July 2005 to 3 July 2008. The project consisted of three phases: firstly, the investigation of personality types of people involved with natural resource management and policy across Australia with a focus on Western Australia; secondly, the development of a system dynamics model of the Western Australian wheat belt at the regional scale to demonstrate the nature of linked social-ecological systems within a resilience paradigm or framework; and thirdly, the knowledge and adoption phase of the model and concepts of resilience paradigm.

At the beginning of this project in July 2005 the concepts of complex problems and resilience were not in common usage and it was a bold step for Land & Water Australia to support this innovative project at that time. These approaches are now validated by bursts of activity over the past three years in which it has become widely acknowledged that many of our most pressing problems have the characteristics of complex problems and require quite different processes to understand and manage them. For example, the Australian Public Policy Commission acknowledges that the public service has to deal with complex problems and developing ways of dealing with them is an evolving process (Commonwealth of Australia 2007). Similarly it has been recognised that, in order for agriculture to respond to climate change, more systemic changes in resource allocation will be required (Howden, Soussana *et al.* 2007). Internationally the number of papers in the scientific literature related to complex problems and the paradigm of resilience has risen from approximately 50 per year in 2000 to about 250 per year in 2007 (Janssen 2007). The Resilience Alliance (http://www.resalliance.org/1.php) has been instrumental in promoting this approach and a new institute, the Stockholm Resilience Centre, was established in May 2007 to advance the understanding of complex social-ecological systems and to generate new insights and means for governance and management of ecosystem services for long-term sustainability.



In Perth our work has been instrumental in increasing the number of groups and networks that are interested in the resilience paradigm and applying this thinking to complex problems such as impacts of natural resource management and planning in agriculture, tourism, construction of infrastructure and waterway management. For example, the Resilient Futures group is a way of thinking, a model, a method and a network committed to assisting communities, businesses and organisations to anticipate, transform and 'tune' themselves to the future through the thinking models and practice of resilience. Resilient Futures http://www.resilientfutures.org/) was formed in April 2008 as a result of a number of practitioners in various fields believing that the current thinking in their respective professions was inadequate in dealing with the problems of tomorrow, and that resilience thinking and the concepts underpinning it provide much needed clarity in a rapidly changing interconnected world. Resilience science offers an approach to sustainability that directly challenges our current way of doing things, particularly with a holistic perspective to natural resource management. However, past attempts to take a more holistic perspective have failed. This project investigated the potential barriers and bridges to adoption of this new approach.

Through this project we have had considerable early stage success in extending the paradigm of resilience and the use of the WA Wheat Belt Futures Model to show the interconnectedness and the dynamic tendencies between environmental, social and economic factors in the WA wheat belt. This has been done through many different entities/groups and activities, including community, government agency, academic conferences, undergraduate and graduate teaching, short courses, local groups interested in systems thinking and resilience thinking. There is a sequence of progressive stages of adoption of any method and further proposed work with regional groups will provide further evidence of the application of system dynamics modelling. We developed joint project proposals with colleagues who have the type of thinking to grasp the big picture and the interconnectedness of factors.

1.2 Research questions

1. What are the barriers to increased adoption of systems approaches?
2. Can we adequately capture the complexities and dynamics of linked social-ecological systems for policy analysis, evaluation and design?
3. Can these models substantially increase dialogue, among professional scientists, between scientists and policymakers, and with the public to improve decision making in the transition towards sustainable use of natural resources?

1.3 Summary of methods and modifications (with reasons)

Phase 1- Personality Types in Australian NRM

The well-established Myers-Briggs Type Indicator (MBTI®) was used to investigate the distribution of personality types in people involved in NRM across Australia. Our sample consisted of 457 people drawn from the institutional framework for decision making on NRM across Australia and was compared with the Australian Data Archive as the base sample. The methods were consistent with The Australian Association of Psychological Type procedures and were conducted under a Murdoch University Ethics approval (Approval

Number 2006/008). The results of this investigation have been submitted to the journal 'Environmental Management'.

Phase 2. A system dynamics model of the WA wheat belt. - wheat belt futures model.

As noted in the Annual Report dated July 2007 and discussed with Dr Stuart Pearson on 12 Oct 2007, this part of the project was delayed for the lack of an experienced system dynamics modeller. However, Dr Jean-Paul Orsini (with experience in system dynamics) was employed in June 2007 for eight months to develop the model.

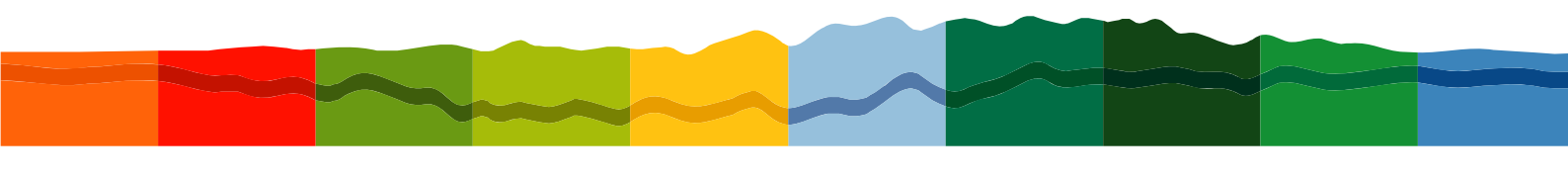
A literature review and development of a conceptual model of the WA wheat belt was published in October 2006 (Allison and Hobbs, 2006). The conceptual model was reviewed through a series of discussions and consultation meetings with key stakeholders held between July and December 2007.

The original conceptual model included feedback processes across multiple scales from the individual farmer level to the global commodity level. A model of this scope would have required a team of dedicated modellers over a long time frame to build and collect all the available information. We also debated the tension between the need to keep the model as simple as possible and the tendency to move to a data rich model. The purpose of the model is to increase understanding of the dynamic processes and is not seen as a definitive decision making tool. The regional delivery of NRM provided the framework for developing the calibrated system dynamics model which could then be validated for particular regions in Western Australia (or eastern Australia) for the broad acre agricultural regions.

Data on environmental and economic factors were available. As previous investigators have found, social data, although now recognised as being as important as the other domains, is not as readily available. In addition, how social data (social and human capital, community vitality and viability) may be linked to the environmental and economic data is not clear. Consequently only demographic data were included in this first stage of development of an operational model as a surrogate measure for social factors. This area requires further research.

Phase 3. Knowledge and Adoption

The need to change the way we think and conceptualise issues is now well documented; however, change in thinking and behaviour commonly meets resistance. During this project we have extended our knowledge through a variety of processes to introduce the terms and concepts of resilience thinking. Adoption of resilience thinking has been through the development of joint project proposals with local groups within the planning and regional development processes.



1.4 Statement of results, their interpretation, and practical significance against each objective

1.	To identify the underlying mental models, beliefs, and assumptions of key scientists, policy makers, funders and the public about the dynamics of complex systems.

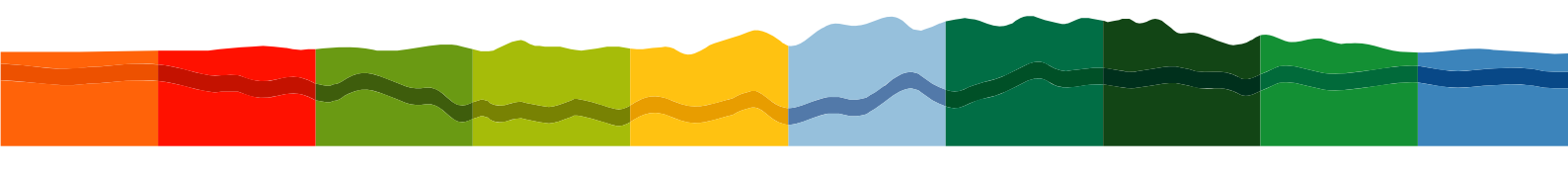
This was a very broad objective which was better clarified after the work was carried out. It is now stated as 'to understand the distribution of Myers-Briggs personality types of key scientists, policy makers and funders.'

From a review of the literature, regional resource systems can be viewed as complex adaptive systems, requiring a very different way of thinking about the behaviour and dynamics of these regions (Allison and Hobbs 2006). In particular NRM managers must attempt to view the system as a whole rather than fragmented into separate issues. Recently there has been an increased focus on social and human capital to improve NRM and their link to community vitality, viability and health (URS 2007) but at the start of this project there had been no investigation of people involved with NRM of the role that personality type may play in people's ability to conceptualise problems in a more holistic way.

We found that there was a marked preponderance of both males and females in just three of the possible 16 personality types, the ISTJ, ESTJ and ENTJ categories, and that the overall composition of the groups sampled was strongly weighted to sensate (S), thinking (T) and judgmental (J) preferences with no significant difference between the proportional distribution of types among males and females. The distribution of preference types was markedly different from that of the large base population, the Australian Data Archive, used for comparison. The results are consistent with earlier occupational preference studies that found a high proportion of introversion (I), thinking (T) and judging (J) among both Australian farmers and those in senior management positions.

From research on decision making and team dynamics it is known that teams made up of similar personality types may introduce bias into decisions and may come to decisions relatively quickly. However, these groups of similar personality types are least effective in coping with more complex problems that have shifting contingencies. The theory of psychological type which is supported by experience suggests that the best decisions include all the perspectives identified by the MBTI functions (Sensing, Intuitions, Thinking and Feeling).

Another major element of the results is a very marked difference between NRM managers (farmers etc) and those involved in NRM policy. This clearly has important implications for how these different groups perceive NRM issues and for how they communicate with each other. A recognition of the difference between the two groups could lead to the development of improved communication processes.



There are two major implications for these results. Firstly, regional NRM groups are being faced with increasingly more complex problems. If the personality types of all the people in the group are similar, they will introduce bias into their decision making. In many of the groups dealing with NRM decision making there is a dominance of Sensing and Thinking perspectives and a lack of Feeling and Intuition perspectives. Consequently when people do not include the feeling perspective they may be limited--by failing to get information from the people who are involved, ignoring the impact on people's lives and work, forgetting to evaluate the decision by organisational or group values and developing solutions that are logical but impossible to actually achieve. When people do not include the Intuitive perspective in decision making they may be limited by what has been tried before, ignore information about options being tried by other organisations or groups, forget to see the interactions that will occur when the plan is implemented and find short-term solutions. We propose that a wider range of personality types within the composition of NRM decision-making groups would increase their flexibility and adaptability in responding to the rapidly changing complex problems they must deal with.

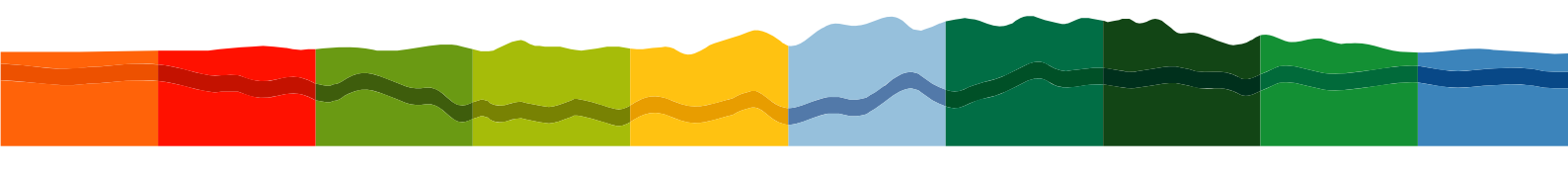
2. To understand stakeholder acceptance and resistance to policy options and address the root cause of problems and set forth strategies in a way that can gain acceptance.

Consultation meetings with stakeholders were held during the development phase and the knowledge and adoption phase of the project.

One of the objectives in the use of the model was to increase people's awareness and understanding of the holistic nature of regional systems within nested hierarchies or panarchies. Part of this approach was to introduce a number of the key concepts of resilience thinking, such as setting the issue within the broader context, thinking across multiples scales, thresholds and non-linear processes. Because this requires a major shift in how people think, we tried presenting the theory first prior to the model and vice versa. There were issues in both sequences which were dependent on the cognitive processes and interests of the individuals. For some, the conceptual model engaged them thoroughly so that the concepts could be interwoven through the discussion of the model and the development of the scenarios. Those that work with models and are familiar with them were very interested in technicalities of the model. Both approaches were useful to engage the stakeholders with the resilience paradigm concepts. Stakeholders were able to appreciate that there are multiple factors influencing the dynamics of the WA wheat belt across multiple scales. As well as the proximal direct factors there are also the underlying fundamental forces.

Some of the resistance is related to traditional approaches to policy making and program implementation. This was evident from stakeholder statements which pigeon-holed issues as natural resource problems with specific funding, without either the policy or the people situating the problem within the bigger picture.

Strategies are developing that aim to change the way we deal with problems from 'silo' to more integrated approaches. Resilience thinking and the Resilient Futures framework and process are a proven alternative to 'business as usual'. These methods are being initiated in



Perth in August 2008 in a unique strategy forum as a collaborative project with the Resilience Futures Group and us. To improve our understanding of the complex dynamics that result from interactions between the social, ecological and economics systems operating in agricultural systems in Australia

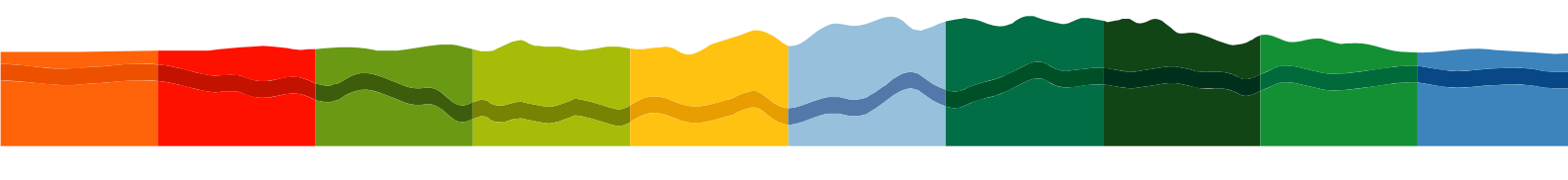
During our meetings with key stakeholders in the early development of the quantitative model it was clear that there was a range in understanding about the interconnection of factors in the social, ecological and economic domains and across spatial scales. In some cases it was apparent that there was a lack of appreciation of the interconnectedness and the linkages of factors between scales above and below the scale of interest that is the regional scale. Systems thinking and system dynamic modelling were useful methods to address regional sustainability by bringing rigour and quantitative analyses to bear on these issues. While we believe modelling is essential to understanding scenarios for complex regional systems, the purpose of the model, how the model is developed and used, and the type of model developed need to be appropriate for the characteristics of the region and the capacity of its constituents. The model can help stakeholders to see the past patterns of change that have occurred in the region and to identify with them. From this point it is easier to discuss possible future scenarios.

When modelling 'hard' variables only, such as production and input costs in the economic variables, there are few difficulties in quantification. However, 'soft' social variables, such as social capacity, introduce a number of difficulties in modelling. This includes data gathering techniques and protocols to incorporate this information into the models. For this reason the quantitative demographic information was the only social variable used in this early stage of model development.

The development of social variables requires further study and collaboration with social scientists. Further development would require a multidisciplinary team approach.

3. To test the limits of the conceptual model through a rigorous quantitative modelling process

Our interest in using quantitative models for the analysis of regional resilience stems from several potential benefits. First, modelling provides a way to help systematically catalogue and articulate the knowledge that is currently available about how a region works. That is, it provides the methodology to attempt a comprehensive and logical analysis of regional systems. Second, modelling provides a method to attempt an integrated analysis of different, but frequently interacting, issues. Integration across these different issues is usually difficult because stakeholder groups' issues concentrate often on different aspects or perspectives within the same system, as opposed to separate but loosely linked alternate or separate systems. Integration therefore requires reconciling a variety of interpretations about the same social-ecological system and usually requires a broader theoretical framework in which to nest different world views together with careful analysis of the meaning of common terms and relationships.



The original qualitative conceptual model that we developed (Allison and Hobbs 2006) depicted the global commodity system, identified key driving variables and how that commodity system might be linked to the ecological factors and the social factors through the ecological and social capacity of the whole system. We later found that a model at this scale for even one commodity (wheat) would have required a team of modellers and a longer time frame. A new conceptual model was therefore developed at the regional scale. This model was tested and changed through discussion with key stakeholders. We have joint project proposals with regional council groups to use the WA Wheat Belt Futures Model to investigate how farming systems can respond to changing climate conditions by embracing innovation in their farming mix.

4. To inform policy based on current understanding of critical feedback processes in complex adaptive systems and resilience building for social-ecological systems

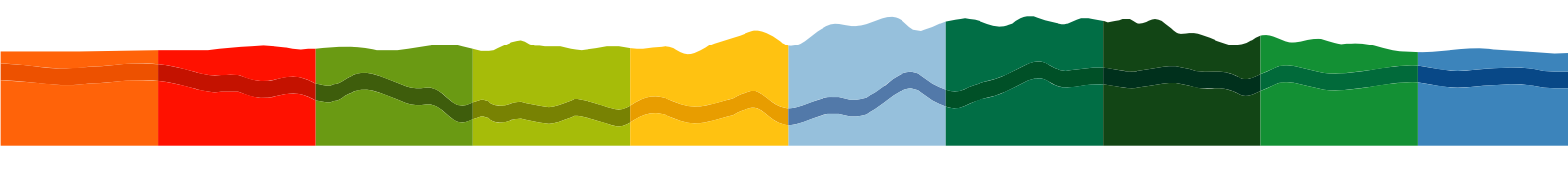
Given the complexity of the effects of exogenous (external) and endogenous (internal) factors on the system, the WA Futures Model has been developed to assist in evaluating possible future trends at the environmental, economic and social levels and in anticipating thresholds that can tip the system into alternative operating modes, sometimes irreversibly. Using the WA Wheat Belt Futures Model shows that the current trend in these factors will continue, for example the need for productivity and efficiency to continuously increase and for institutional change to absorb these changes. This is a complex adaptive system at work; however, it comes at a cost to the ecological and social systems. If used appropriately these models allow us to ask better questions. For example, this raises the questions of how resilient is the region, how long can this trend continue? Some might argue that this is a sustainable change if only agriculture is considered, but we argue that agriculture is set within a social-ecological system, in which many other factors must be considered in response to these changes. These include, for example, social factors such as skill shortages and migration from agricultural coastal areas, increased competition in the labour market from the resources sector outside the wheat belt, alternative lifestyle choices becoming increasingly available to people, increased farmer age, and implications for planning on infrastructure.

An implication of this research is that policy makers will have to become more strategic by creating a mindset, a behaviour for strategic planning, and action where continuous and discontinuous change are embraced.

5. To develop adaptive institution and policy design principles that can improve natural resource outcomes

We did not achieve Objective 6 within the current project in the absence of considerably more financial and human resources.

Further comments related to this objective are summarised under Objective 7.



6.	To inform policy on appropriate interventions to increase the resilience of agricultural regions

Agricultural regions are complex adaptive systems. Issues are linked from the individual farmer level to the global level. Consequently policy will have to recognise these linkages and have policy processes that recognise these linkages. In addition, climate change will impact on the resilience of agricultural regions. Climate change policies must be integrated into broad agricultural policy to keep it relevant (Howden, Soussana *et al.* 2007).

At this stage in the project the identification of appropriate interventions are of a generic nature identified from the theoretical level as we have yet to engage a group in the agricultural region for this purpose. We do have two joint project proposals in which further policy interventions may be identified.

The first stage in policy development will require teaching and extension of identification and understanding of complex problems, and teaching people the skills to deal with them.

1.5 An outline of how these outputs can be adopted

There are a number of areas in which these outputs can be adopted.

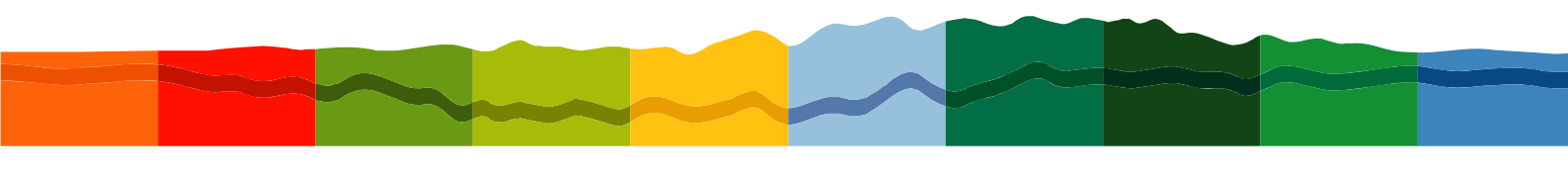
In Western Australia we have seeded the foundations of the resilience thinking approach and developed project proposals for ongoing work in this area. Further funding is required to keep the momentum going to work to develop case studies on the resilience of urban and regional communities.

Ongoing funding is required to foster and support these innovative approaches which encourage broad systems thinking that cover a range of scales and have multidisciplinary approaches. Sufficient time and support will be required to achieve a critical mass of people with the skills and understanding for these innovative methods to gain currency.

The inclusion and explanation of resilience language can be encouraged in all policy documents so that there is a common language that can be used across all sectors.

These approaches will be more readily accepted by people with a particular way of thinking and seeing the world as a whole. The Myers Briggs Indicator is one useful way that people can identify their potential for understanding these approaches.

Further research is required in our education system. Research is required into how system thinking and multidisciplinary approaches are taught and how they can best be applied at undergraduate and post graduate levels. In many ways, building on the research conducted in this project to develop undergraduate teaching programs which adopt this approach may be the most useful way to lead to long-term adoption.



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1.6 Direction on where the reader can obtain additional information

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