

LINKED SOCIAL-ECOLOGICAL SYSTEMS:
A CASE STUDY OF THE RESILIENCE OF THE
WESTERN AUSTRALIAN AGRICULTURAL REGION

by

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A thesis submitted in fulfillment of the
requirements for the degree of Doctor of Philosophy
in the School of Environmental Science
Murdoch University

December 2003

The final revisions of this thesis were completed following my mother's death in March 2003 and I dedicate this thesis to the memory of my parents.

I declare that this thesis is my own account of my research, unless otherwise stated. It contains as its main content work which has not previously been submitted for a degree at any tertiary institution.

Helen Elizabeth Allison

ABSTRACT

In the Western Australian agricultural region, an area of approximately 14 million hectares (70,000 square miles), widespread areas of native vegetation have been cleared and replaced with annual cropping systems, predominantly wheat. Only 1.3 million hectares (10%) of small and scattered native vegetation remnants remain. By 2000 16% of land in the region was at risk from soil salinity and was largely unproductive for commercial agriculture. A new hydrological equilibrium affecting 33% of the Western Australian agricultural region is predicted to be reached between 2050 and 2300. The starting premise of this dissertation is that normal disciplinary science was adopted as the dominant intellectual influence on natural resource management policy and thus natural resource degradation was treated as a problem for science, extracted from its social, economic and historical contexts. The second premise of this dissertation is that natural resource problems are not isolated scientific or technical problems, and are exacerbated by human failure to predict the complex inter-relationships among the social, ecological and economic systems.

This dissertation initially provides an analytical narrative on the Western Australian agricultural region between 1889 and 2003 (114 years) with the main finding being that in the years pre-1970 a development-driven Western Australian Government was responsible for extensive land clearing for agriculture, often contrary to scientific advice. In the

1980s and 1990s the severity and extent of soil salinity and the prognosis of future negative trends in other natural resource indicators caused a rapid proliferation and evolution of Federal and State policies designed to ‘solve the problem’. Nonetheless many natural resource problems remain intractable. The second part of the dissertation investigates the epistemology of the normal science paradigm as it was applied to natural resource management problems in the 20th century as a potentially contributing cause. The evolution of an alternative epistemology, post-normal science paradigm, is then examined for explicating our current understanding of ‘reality’. A research framework was constructed which defines the post-normal science paradigm; the systemic approach; the bodies of theory—organisational, ecology, resilience and system dynamics theory; the social-ecological system perspective; and the methods—resilience analysis and system dynamics. This framework provides a novel way in which to gain a greater understanding of the fundamental or root causes of natural resource management problems. Using the case study of the Western Australian agricultural region a dynamic model was constructed based on descriptive information. An examination of the historical events and processes of the Western Australian agricultural region reveals that over a 114-year history it has evolved through two interactions of the adaptive cycle. Further investigation reveals these two cycles were synchronous with the second and third economic long-wave cycles or Kondratiev Cycles, that show the behaviour over time of the evolution of modern industrial societies. The model suggests that the reasons for the dynamic behaviour of the Western Australian agricultural region lie in the interaction of the three production growth drivers of the international commodity system, which have resulted in a pathological system, the ‘Lock-in Trap’. Increased total commodity production, reinvestment and declining

prices in real terms have tended to produce the unintended negative impacts of resource decline, environmental pollution and rural population decline. I suggest that the expansion of thresholds through the reinvestment in technology is a principle reason why there has not yet been a profound collapse of exploited renewable resources in the Western Australian agricultural region. Regional natural resource management strategies will need to take account of not only spatial cross-scale issues, in particular the linkages between the individual farmer and the international commodity system, but also the temporal variables, in particular the slowly emerging changes in ecological/physical variables, such as the hydrological cycle. This research can help to provide the information and heuristic metaphors to encourage natural resource policy makers to take long-term and whole system perspectives. It includes a powerful set of tools for communicating dynamic processes in an integrated method to inform policy and management decisions. The ideas in this interdisciplinary research are essential for making science relevant within a social and ecological context.

ACKNOWLEDGEMENTS

I wish to gratefully acknowledge the financial assistance of Murdoch University through the award of a Research Scholarship and Completion Scholarship, which enabled me to undertake this research.

Many people have provided inspiration over the course of the last four years as I have undertaken this research. Some of them will know it, and some will not as it is through their writings or through a brief conversation that I have been inspired and gained insights. Others influenced me many years ago on the journey that I have taken to the place that I now find myself, primarily my parents who instilled in me my love of nature. It gives me pleasure to acknowledge the help and cooperation that I received to undertake and complete this thesis.

Two supervisors have been gracious enough to agree to participate with my supervision. Associate Professor Frank Murray, Murdoch University supported my initial proposal and patiently followed my path of discovery of alternative ways of understanding. I will be forever grateful for his humour and flexibility. Professor Richard Hobbs, a latecomer to the role of supervisor as my path discovered new theories in ecology and linked social-ecological systems, was a source of encouragement and support in the latter half of my research.

Apart from these formal advisers, I owe much to colleagues past and present for their

generous contributions of information and time: Dr Jennifer Robinson, Murdoch University, for her eclectic intellect, robust arguments, forthright approach and discussions on system dynamics; Charlie Nicholson, CALM, a former manager, original thinker and always a systems thinker; Dr Neil Pettit for encouragement and incisive comments on the final draft; Dr Julia Hobson who provided positive feedback on drafts of my papers; Dr Bryan Jenkins, Murdoch University, for his participation, energy and interest in conceptualising models; the members of the Task Force for the Review of Natural Resource Management and Viability of Agriculture in Western Australia (Dr Paul McLeod, Dr Libby Mattiske, Dr George Gardiner, Norman Flugge and Margaret Agnew) for whom I was Executive Officer, for sharing their progressive views on the future of natural resource management and policy; Will Fey for choosing to coach me in system dynamics ‘his way’; Dr Tim Haslett, Monash University, and his students who took me under their wing at my first system dynamics conference and who very kindly provided me with his system dynamics modelling course notes ‘Mastering itthink’; Professor Nimal Jayaratna, Curtin University Business School, who encouraged the extension of my enquiring mind in the genre of systemic analysis; others include Dr Richard Bell, Dr Michael Booth, Dr Frank Harman, and Dr David Annandale of Murdoch University; Dr David Egan, Curtin University Business School; Dr Sarah Lumley, University of Western Australia; Dr William Hutchinson, Edith Cowan University; Aldo Zagonel, University of Albany, SUNY; Dr Andrea Hinwood, Edith Cowan University; Dr Brian Walker, CSIRO; Dr Alistair Fletcher, Dr Will Shenton, Dr Robert Johnson, Risk and Uncertainty Group CSIRO Petroleum; Kristen Blann, University of Minnesota; Annie MacBeth, Futurist; Peter Curry and Dr Denis Saunders.

I am grateful to Island Press for granting permission to use elements of Figure 3-12 from Holling, C. S., L. H. Gunderson and G. D. Peterson. Chapter 3, Sustainability and Panarchies from *Panarchy: Understanding Transformations in Human and Natural Systems*, L. H. Gunderson and C. S. Holling, eds. Copyright, 2001 by Island Press. Reprinted by permission of Island Press, Washington, D. C., and Covelo, California and to CSIRO for granting permission to use Figures 1.1 and 1.2, reproduced by permission of CSIRO Australia CSIRO 2003.

There are also innumerable friends and colleagues who have encouraged me (with or without realising it) in my endeavour, including Dr Sue Moore, Murdoch University, who gave me the final push in this direction and suggested I talk to Associate Professor Frank Murray (now one of my supervisors), and Dr Viki Cramer, who always made herself available for academic, diverse and interesting discussions; friends who reminded me that there was a world outside of my research and provided support in their own ways: Agriculture Breakfast Group (Ross George Agriculture WA, Dr Donald Burnside URS, Martin Wells, John Duff, Nic Watson, Dr David Bennett and others mentioned individually elsewhere); Wednesday morning beach swimming group, a constant source on inspiration on summer and winter mornings; Envirodrinks colleagues; my dear friends Lindy Brookes and Joe Tonga who on numerous occasions provided me with dinner, bed and breakfast; Peter Krawec; Kellie and Peter Pendoley; Dr Sue Swift; Helen Fordham; Amy Lomas; Helen Grzyb; and Dr Ann Hamblin; and to all those not named individually.

Thanks for support and friendship goes to fellow students in the wind tunnel, that we postgraduates called home for the duration of our candidature. I am grateful for the support of the staff in Division of Science and Engineering: Jeanne Clarke, Frank Salleo,

Colin Ferguson, Sarah Xu, Susan Flay, Heather Gordon and Lindsay Lincoln, and in the Division of Research and Development Ann Randell and Karen Olkowski. Thanks go to Alan Rossow and Kevin Hardman for drafting some of the more difficult figures and to Ted Lamont and Richard Krumins (Vet Science) for advice on the tricks to making acrylic moulds when I struggled with a three dimensional acrylic model of the adaptive cycle.

Finally, special thanks to Jay Whitely, a fellow Ph.D. colleague and friend who gave so willingly of his time, provided much humour, and guided me in the art of \LaTeX for the final document preparation, and Dr Iain Allison, Senior Science Adviser, Glasgow University, who supplied me from an early age with his brotherly advice, introduced me to *The Hobbit* (Tolkien, 1961), ‘*Zen and the Art of Motorcycle Maintenance: An Inquiry into Values*’ (Pirsig, 1976) and *Sophie’s World: A Novel About the History of Philosophy* (Gaarder, 1994) and who holds no responsibility for the consequences of those actions and the content of this work. All errors and interpretation are my sole responsibility.

The text was proof-read by Jan Knight of Flying Edits.

LIST OF PUBLICATIONS

Aspects of this thesis have been accepted for publication.

Allison, H. E. and Hobbs R. J. (in press). Resilience and adaptive capacity of the Western Australian agricultural region: a social-ecological system. *Conservation Ecology*.

(Chapters 2, 6, and 7)

Under review

Allison, H. E. and Hobbs, R. J. The historical and policy context of natural resource management in Western Australia. *Environmental Management*.

(Chapter 2)

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