A systems-based approach to policy making. Is there synergy between natural resource management and the Kyoto Protocol?

H. E. Allison[1] and F. Murray[2]

[1] *School of Environmental Science*
Murdoch University, Australia
E-mail: hallison@central.murdoch.edu.au

[2] *School of Environmental Science*
Murdoch University, Australia
E-mail: murrayf@essun1.murdoch.edu.au

ABSTRACT

The management of environmental issues, such as climate change and land use change, involves complex dynamics in ecology, economics and social systems. Developing integrated frameworks for these complex problems presents a challenge at all policy-making levels. Market-based policies for ecosystem services are examined with a focus on carbon sequestration, as an emerging synergy between land-use change and emissions trading of forestry-based carbon sinks, under the Kyoto Protocol. A systems-based approach offers the potential to increase our understanding of the complexity surrounding policy development for the management of multiple objectives of natural resources, within a holistic policy framework.

Key words: Global environmental problems; Systems-based approach; Natural resource management; Policy; Multiple objectives; Market-based approaches; Kyoto Protocol.

INTRODUCTION

The degree of seriousness and complexity of the impacts of human use of the environment is increasing, potentially reaching crises in the 21st century (Capra 1996, Daily 2000, De Greene 2000). Land degradation and climate change are two examples of these complex problems. Recognition of the number of interacting agents and the interrelatedness in time and space, and across hierarchies, all serve to increase the perceived complexity as knowledge increases (Figure 1). The characteristics of complex systems (non-equilibrium, non-linearity, emergence etc.) are a major challenge for policy design. It is the synergy between the mitigation strategies for climate change and natural resource degradation that is the subject of this research.

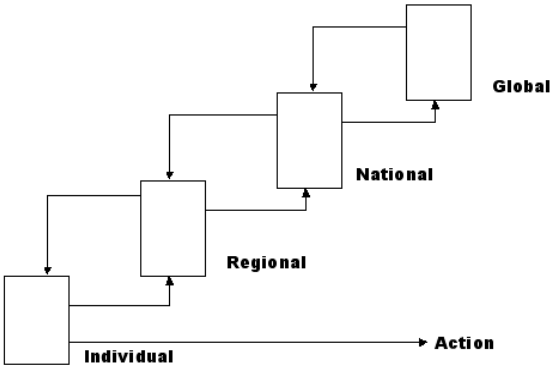

Figure 1:
Hierarchy of individual, regional, national and global relationships involved with climate change and natural resource management.

Dilemma for policy-makers

The dilemma for natural resource policy-makers is how to increase the understanding of the complexity of the interrelated ecological, social and economic systems, particularly to achieve multiple natural resources objectives across sub-systems at the individual, regional, national and global scales. De Greene (2000) proposes that new systems-based theories and concepts will provide the necessary building blocks for policy-making in these complex systems. However, a large gap exists between the theory and concepts in systems thinking, and the praxis and translation into implementable policy and actions.

CLIMATE CHANGE

Recently, the Intergovernmental Panel on Climate Change (2001) accepted, beyond doubt, that human actions are responsible for the rapidity of climate change. International policy designed to combat climate change, by reducing greenhouse gas emissions, is coordinated by the United Nations Framework Convention on Climate Change through the ad hoc Kyoto Protocol (United Nations 1997). In Australia, The National Greenhouse Strategy (Commonwealth of Australia 1998b) pursues the Kyoto Protocol objectives through four actions: (1) limiting greenhouse gas emissions, particularly from fossil fuels; (2) sequestering carbon dioxide, through carbon sinks on agricultural land; (3) increasing understanding of climate change issues; and (4) provision for adapting to potential environmental effects of global warming.

In 1996 the energy sector, utilising mainly fossil fuels, accounted for 79% of Australia's emissions; and emissions from agriculture, including land clearing, accounted for 20% (Commonwealth of Australia 1999). If the projected increases in economic growth are to be realised it will require significant changes in current practices to meet Australia's Kyoto Protocol (if ratified) emissions target of 108% of 1990 levels by 2008 - 2012. Changing land use practice and increasing carbon sequestration in woody perennial plants on agricultural lands will help to meet the Kyoto Protocol targets and may produce multiple benefits for both climate change and natural resource management.

NATURAL RESOURCE MANAGEMENT APPROACHES

Natural resource degradation is due to multiple causes in our social and economic systems and inadequate understanding of ecological systems and institutional structures (Chisholm and Dumsday 1987, Sala and Conacher 1998, Cortner et al. 1998). None-the-less, extensive land clearing of deep-rooted native vegetation is considered to be the single most important cause of land degrading processes causing flooding and dryland salinity (Commonwealth of Australia 1998a). Moreover, this activity has transformed the biotic carbon store into atmospheric carbon dioxide.

Traditional natural resource management policies in agriculture have been based on obsolete ecological theory, assumptions of social behaviour (Brown and MacLeod 1996) and in isolation from social and economic policy frameworks (Bellamy and Johnson 2000). In comparison, recent rhetoric in the literature in natural resources management recognises the interrelatedness of social, environmental and economic systems. One major outcome has been the development of integrated, process-driven, community-based approaches (Holling 1978, Carpenter et al. 1999, Bellamy and Johnson 2000). However, such community-based integrated approaches have proven to be difficult to implement (Bellamy and Johnson 2000). The difficulties correspond with the identified inherent systems characteristic of complex problems.

Natural resource management issues have been identified and described in the literature, in such terms as 'wicked' problems in integrated resource management (Bellamy and Johnson 2000) and planning (Rittel and Webber 1973, Karacapilidis 2000), and 'messy' problems (Checkland 1984) in soft systems thinking. The 'wicked' and 'messy' nature of these problems relates largely to the complex sets of attitudes, beliefs, values, opinions and perceptions that humans introduce into a system (Waring 1996). Similarly complex problems in economics are described as 'flighty' (Goldstein 2001). Other causes for the complexity in natural resource management has been stated to arise from the variability of the resource-base and their continually evolving nature (Lynam 1999); through interactions with ecological and economic sub-systems (Rosser 2001); from cause and effect not being closely linked in time or space, and that the services they provide are intangible (Bellamy et al. 1999); and from market failure, property-right failure, institutional inefficiency, political deficiency and lack of information (Young et al. 1996).

Future directions of natural resource policy in Australia

Two future policy directions in natural resource management in Australia have been identified as critical: (1) adopting a regional approach; and (2) achieving fundamental change through a wider mix of policy instruments, including enhancing the role of economic and market-based mechanisms. For example, creating market-based mechanisms to realise the intangible benefits of ecosystem services is proposed as one of a mix of policy instruments

Market-based mechanisms for ecosystem services

Although ecosystem services are essential for human existence they are typically undervalued, especially when the value to future generations is taken into account (Daily 2000). Ecosystem services have usually been considered to be 'free' goods. They are subject to open access, and assuming economic rational behaviour, they are ultimately degraded (Hardin 1968). Methods to value ecosystem services are emerging, for example, avoidance costs of building and maintaining water treatment plants by maintaining a healthy catchment that purifies the water (Daily 2000). As another example, emissions trading of carbon sinks is being developed under the Kyoto Protocol.

Daily (2000) describes an ecosystem services framework that attempts to integrate biophysical, economic and social systems of natural resource protection. However, Rosser (2001) cautions that the coupling of ecological and economic systems may produce non-linear dynamic outcomes at multiple levels and in multiple ways. A supporting proposition is that complications will arise from the coupling of equilibrium economic market-based approaches within a non-equilibrium ecological system (De Greene, pers. comm.).

POTENTIAL POLICY SYNERGY

On the one hand concern over the impact of human induced climate change through increased atmospheric carbon dioxide has driven international policy to search for flexible mechanisms to reduce carbon dioxide concentrations in the atmosphere. One of these mechanisms, emissions trading using forestry-based carbon sinks, has emerged as one of the market-based initiatives to mitigate the increased atmospheric carbon dioxide concentrations. On the other hand concern over the continuing trend in the declining condition of natural resources and biodiversity in agro-ecosystems, partly due to the loss of deep-rooted vegetation, poses a dilemma for rural land management in Australia.

Agriculture and forestry are reliant upon natural resources for the production of food, fibre and timber. However, they also provide ecosystem services, such as the removal of carbon dioxide from the atmosphere thorough photosynthesis, biodiversity maintenance and flood mitigation etc. These two rural enterprises are being considered as suppliers of increased ecosystem services through the potential to sequester carbon from atmospheric carbon dioxide. Carbon, biodiversity, and salinity are being proposed as ecosystem services that could be traded. Some investigators believe that it will be

necessary to package a number of ecosystems services together to drive the necessary landuse change required in many agricultural areas in southern Australia (Thompson and Heffer 2000). Consequently, synergy arises from the need in Australia for reforestation of degraded agricultural land and the potential to offset carbon emissions to meet our potential international commitments under the Kyoto Protocol.

The current policy framework for natural resources is developed within individual portfolio areas and is neither integrated across all natural resources nor across social and economic government portfolios. The integration of policies for sustainable land management and climate change policies is one prescription to achieve multiple objectives in environmental, social and economic systems. Increasing carbon sequestration through plantation development can be coupled with the Kyoto Protocol flexibility mechanisms of emissions trading.

Systems thinking provides the conceptual understanding and principles that are necessary (De Greene 2000) to understand the interrelatedness of issues in natural resource policy making.

If this market-based approach is adopted within the current institutional arrangements this raises a number of questions. How can systems thinking aid decision-making to achieve multiple objectives in natural resource management and climate change? What complications will arise from the coupling of equilibrium economic market-based approaches within a non-equilibrium ecological system?

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