

Frameworks and models for analysis and design of institutional arrangements in Outback regions

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1 Introduction

Australia’s arid and semi-arid zones, referred to in this document as “Outback”, face complex sustainability challenges. These iconic Australian landscapes, though sparsely populated have traditionally been pillars of Australia’s export economy (Spiller, Gibbins Swan, 2000). Northern Australia’s outback regions accommodate only 6% of Australia’s population, yet account for around 30% of the nation’s exports and over one third of Australia’s export growth over the past 30 years. This success is based almost entirely on primary industries such as cattle grazing, which are (a) operating in a context of declining terms of trade and volatile world markets, (b) increasingly ‘de-coupled’ from regional economies and communities through rationalisation in transport and workforce.

Recently Australia’s outback regions have become the focus of renewed development interests from industry and political spheres, which include, for example, more

intensive agricultural and irrigation development and managed population growth. There is mounting pressure for outback regions to explore options for diversifying the use of natural resources and the portfolio of products, and in particular diversifying into growing service industries such as tourism and potential new international markets for environmental services. Outback regions have a large potential to provide environmental services such as carbon sequestration and biodiversity credits to prospective international markets. These regions also face increasing demands by society for tourism, recreation and biodiversity conservation and by traditional owners for recognition of property rights.

2 Institutional Arrangements and Natural Resource Management

The complex institutional arrangements governing resource use and management in the Australian Outback, as in other parts of Australia, are facing increasing pressures to change and become more appropriate for the Australian landscape.

“Among the gravest hindrances to developing sustainable systems are our institutions...One of the biggest issues for sustainability is how to break the institutional gridlock that binds how we manage landscape, water, air biodiversity and our industries and communities,” (CSIRO, 2003)

Institutional arrangements are essentially the “rules” influencing human behaviour and include both formal and informal rules. *Formal* institutional arrangements are codified in constitutions, statutes, regulations, plans and policies. Land use, property rights, decision making and natural resource management in the outback are guided by formal institutional arrangements targeting specific resource issues (e.g. water use and management, salinity, soil erosion), specific land uses (e.g. grazing, agriculture, mining, tourism), specific environmental resources (e.g. rivers, wetlands, threatened habitats, and endangered species), and social and cultural issues (e.g. cultural heritage, and social welfare). In addition, land use, property rights, decision making and natural resource management are also governed by *informal* institutional arrangements, which are manifest in social expectations such as the rules governing relationships within a family, firm or community. They include social norms and influence the management of property resources in important ways, eg: through societal expectations of resource access and use. Other important institutional arrangements in the Outback include traditional laws and customs which are formally codified in the European System (eg: Native Title), formally codified in Aboriginal Society (eg: nation gatherings, law making, telling knowledge), and informal (e.g. informal gatherings).

The emergent questions are: are these institutional arrangements resolving resource conflicts, adequately recognising and protecting the values of nature-based systems and delivering improved socio-economic conditions for people in outback communities? Property rights and institutional arrangements have been identified as

key priorities for change to resolve sustainability, and natural resource management dilemmas in Australia.

“One of the central themes running through the debate about institutional reform is the need to make the rules of access to, and ownership of, land and the environmental goods and services it provides clearer and more equitable (Bromley 1991; Hanna et al. 1996a and b). At present, many components of nature-based systems are perceived to be owned in common by all of society, yet the rights and responsibilities for maintaining those systems are unclear and incentives for sustainable management are limited (Heal 2000).” (Cork, 2002).

“The main role for governments in natural resource management is to improve resource use through a better system of institutional arrangements and property rights. The range of instruments available to governments to achieve this objective include property right solutions, the provision of information, suasive measures, economic instruments (both price and quantity based instruments) and regulation (ABARE, 2001).

“Overcoming existing institutional impediments such as property rights etc will require the development of new organisational forms that enable collaborative decision making allowing cohesion at social and ecological levels, flexibility to cope with a variety of forms and dynamic variables, while bridging conventional impediments and issues of scale.” (Coop and Brunckhorst, 2000, p2),

Challenges of implementing concepts of sustainable development have called into question the efficacy of many existing institutional arrangements, the appropriateness of current distributions of power and equity, and the adequacy of decision-making processes. Pursuing sustainable development poses particular challenges for governance. Uncertainty, cumulative impacts, long-time scales, biophysical and jurisdictional boundaries, and the difficulty of measuring human impacts on the environment are examples of such challenges. Other issues for natural resource management and sustainability are that the institutional landscape is highly complex, highly regulated by legislation, and generally governed by institutional arrangements that reflect Colonial development strategies rather than Australian landscapes and conditions. Existing land use regimes have complex structures involving rights, roles, and responsibilities for sustainability, rapidly increasing arrangements to plan and manage resource use, and trans-boundary issues stemming from uncoordinated and disintegrated approaches to management and there is no doubt that ecological problems have provided new challenges to the rationality of bureaucratic organization and decision-making. Furthermore customary land management provides added institutional complexity because Aboriginal law is extremely different, diverse and dynamic, limiting its compatibility with legislation.

In response to sustainability problems, the emerging paradigm for governance emphasizes systems approaches, flexible and adaptive institutions, decentralization and empowerment, collaborative governance, communicative planning, conflict resolution and new approaches, such as incentives, for encouraging environmental

compliance. The contemporary challenge for natural resource management in Australia is to operationalise these concepts within resource management contexts. This requires an understanding of the impact of institutional arrangements on natural resource management and of the conditions required to facilitate sustainability given local conditions.

3 Institutional arrangements in the Outback

Property rights define the rights that people have to access, use and commercialise market and non-market services from natural resources as well as the obligations and responsibilities associated with those rights. They therefore encapsulate the incentives that influence investment and development in regions.

The concept of multiple use is fundamental to land use in Outback Australia because physical resource development and resource management occurs on common pool resources (e.g.: leasehold land) by multiple stakeholders with different development and use rights. There has been much inconsistency and confusion over the definitions and usage of the terms ‘common pool resource’ and ‘common-property resource’, as noted by Ostrom (2003a). ‘Common-property resources’ are economic goods with high exclusion costs and where one person’s consumption subtracts from the total – or a ‘common pool resource’. Common-pool resources may be owned by national, regional or local governments, by communal groups or by private individuals or corporations. When they are owned by no one or paradoxically by ‘everyone’, they are used as open access resources by whomever can gain access. Ostrom and Schlager have defined five types of property rights (in Ostrom, 2003a) (table 1) most relevant to the use of common-pool resources.

Table 1 Property Rights Most Relevant for the Use of Common-Pool Resources (Schlager and Ostrom, 1992)

<i>Property Right</i>	<i>Definition</i>
Access	The right to enter a defined physical area and enjoy non-subtractive benefits (e.g. hike, canoe, sit in the sun)
Withdrawal	The right to obtain resource units or products of a resource system (e.g. catch fish, divert water)
Management	The right to regulate internal use patterns and transform the resource by making improvements
Exclusion	The right to determine who will have an access right, and how that right may be transferred
Alienation	The right to sell or lease exclusion, management or withdrawal rights

Property rights are the principal instrument for achieving and reconciling multiple aspirations, reducing uncertainty for investors and maximising benefits to the community. By defining use and access rights of sectors and user groups, and by

stipulating responsibilities, property rights essentially determine (a) the welfare that can be generated from landscapes, (b) how benefits and costs are distributed between sectors and user/interest groups, and (c) the security of rights in the face of economic and ecological uncertainty.

The multiple use of outback landscapes raises a diverse array of sustainability issues related to property rights, property access, and roles and responsibilities associated with land use. Property rights are a specific type of institutional arrangement; they are institutions of use and ownership, and like other institutional arrangements, property rights are affected by the operation of formal and informal structures and processes at multiple scales. There are strong criticisms that the existing property rights regime hinders a diversification of uses of Outback landscapes and of products, while the industries that it entrenches provide declining services for regional communities. Changes to tenure of rural leasehold land are currently underway in some states (Qld, WA) in order to re-define stewardship for grazing lessees and safeguard natural resource condition (DNRM, 2003). The National Farmers Federation has declared property rights their number one issue (Acton, 2003).

These approaches are embedded within a multiple-year research project, which the Commonwealth Scientific and Industrial Research Organisation (CSIRO) has recently commenced. The fundamental components of this research are more fully described in Greiner (2003).

4 Analysing institutional arrangements

Numerous frameworks have been developed in the fields of political science, planning and public administration to analyse institutional arrangements. These frameworks often combine mixes of normative and substantive elements, programmatic elements, and criteria and indicators, however the appropriateness of any particular framework depends on the reasons for evaluating an institutional system in the first place.

In the case of outback resource management, rising externalities, it is our hypothesis that conflicts between stakeholder groups, and negative socio-economic, cultural and ecological impacts in the Outback are the result of institutional dilemmas. In order to understand whether observed problems in the Ourback are in fact the result of ineffective institutional arrangements, a framework is required to analyse the impacts of different institutional arrangements (constitutional, collective and operational) on externalities associated with multiple use, conflicts between stakeholders over resource use, and minimising environmental impact. In addition, the framework will facilitate the application of models to evaluate different institutional arrangements quantitatively to be able to compare existing settings with possible alternative scenarios.

We are therefore interested in understanding the institutional arrangements that shape stakeholder behaviour in outback landscapes. This includes (1) identifying key

institutional arrangements at a range of levels (individual, industry, community and local, state/territory and federal governments), (2) understanding how they interact and influence human behaviour, and (3) estimating what impact individual actions in aggregate have on outcomes for resource use and management. We are also interested in identifying the instances where institutions are failing to deliver the outcomes that are desired by multiple stakeholders in Outback landscapes. Towards this end, we wish to use the qualitative analysis to diagnose the reasons why institutions are not delivering desired outcomes and use this knowledge to propose arrangements that are likely to be more effective in meeting stakeholder needs. In section 4.2 we discuss existing qualitative frameworks and develop a project-specific one. In section 4.3 we develop a structure for a quantitative model, which will provide predictive capacity using the results from the qualitative framework a different case studies.

4.1 Level of analysis

Institutional arrangements operate within governance systems. Governance systems are the sum of the many ways that individuals and institutions (public and private) manage their common affairs. It is a continual process through which conflicting or diverse interests may be accommodated and cooperative may be action taken. It includes formal institutions and regulations as well as regimes empowered to enforce compliance, and informal arrangements that people and institutions have agreed to be in their interest (Commission of Global Governance, 1995). Governance systems are a ‘tiered’ aggregation of formal institutions of governments, markets, the justice system, and organizations, as well as informal institutions of traditions, values and norms.

The level or scale of analysis is a particularly important consideration because while the analysis of a single policy or institutional arrangement may conclude that it is efficiently achieving its objectives and that those objectives are desirable, this arrangement will not be the only one affecting a particular environmental issue (eg: biodiversity conservation) and it may disregard important negative and/or unintended side-effects arising from the operation of institutional arrangements at different spatial scales (eg: local, regional, state, and national).

Ostrom has identified three levels of rules that cumulatively affect the actions taken and outcomes obtained in using common property resources: operational rules, collective choice rules, and constitutional choice rules. Operational rules directly affect the day-to-day decisions made by appropriators concerning resource use (eg: resource withdrawal, monitoring, information exchange, sanctions etc). Collective choice rules indirectly affect operational choices. These are the rules that are used by appropriators, their officials, or external authorities in making policies about how resources should be managed. Constitutional choice rules affect operational activities and results through their effects in determining who is eligible and determining the specific rules to be used in crafting the set of collective-choice rules that in turn affect the set of operational rules (Ostrom, 1990 p52).

4.2 Qualitative frameworks

4.2.1 Relevant frameworks

Three qualitative frameworks are particularly relevant to the analysis of institutional arrangements(at multiple levels) governing property rights and natural resource management in Outback Australia, namely: the Institutional Analysis and Design (IAD) framework developed by Ostrom and others (Ostrom 2003b), the Multiple Use Commons (MUC) framework developed by Edwards and Steins (Edwards and Steins, 1998), and the ISO 14001 Framework for Environmental Management Systems (Joint Technical Committee QR/11 Environmental Management, 1996) which has become a global exemplar for environmental management in the private and public sector.

The IAD Framework is a broad framework for assessing institutions to determine how they affect the incentives confronting individuals, and their resultant behaviour. The IAD framework has been applied to empirical settings to systematically analyse the structure of the situations individuals face when making decisions, and how the rules, the nature of the events involved, and community affected these situations over time (refer figure 1). Examples of applications include the study of land Boards in Botswana, the incentives of operators and state government with regards to coal roads in Kentucky, the evolution of Coffee Cooperatives in the Cameroon, and the effect of rules on the outcomes of common-pool resource settings throughout the world (Ostrom 2003b, p9)

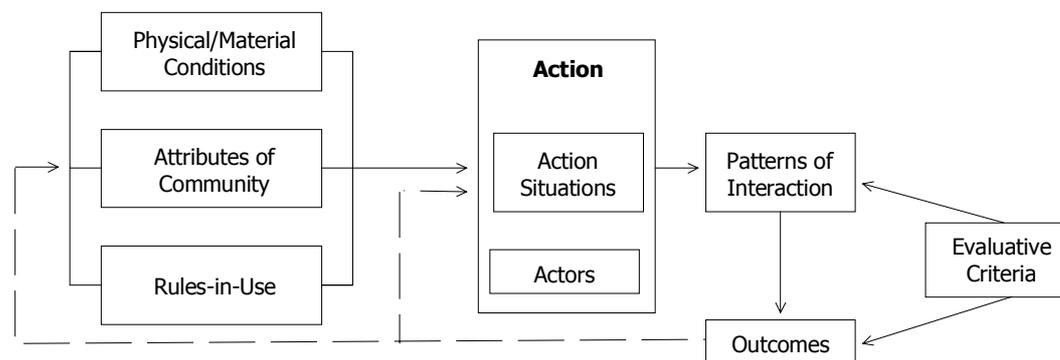


Figure 1: Framework for Institutional Analysis (Source: Ostrom, 2003, p46)

The Multiple Use Commons (MUC) framework developed and applied by Edwards and Stein (1998), based on an “analytical framework designed by Oakerson (1986, 1992) and adapted thereafter, with contributions by, amongst others, Ostrom (1990, 1992 & 1994), Feeny (1994) and Tang (1992).” (Edwards and Steins, 1998). This analytical framework is built specifically to assess institutional arrangements in multiple use commons, particularly the influence of different contextual factors on outcomes. The framework is capable of facilitating analysis of resource systems which support multiple *types* of uses by multiple *types* of communities/groups

(Edward and Steins, 1998). The framework considers the physical characteristics of the resource and technological solutions to reduce constraints, the decision-making arrangements governing the use of the resource, the patterns of interaction and the direct and indirect impact of these factors on outcomes (Edwards and Steins, 1998) (refer figure 2).

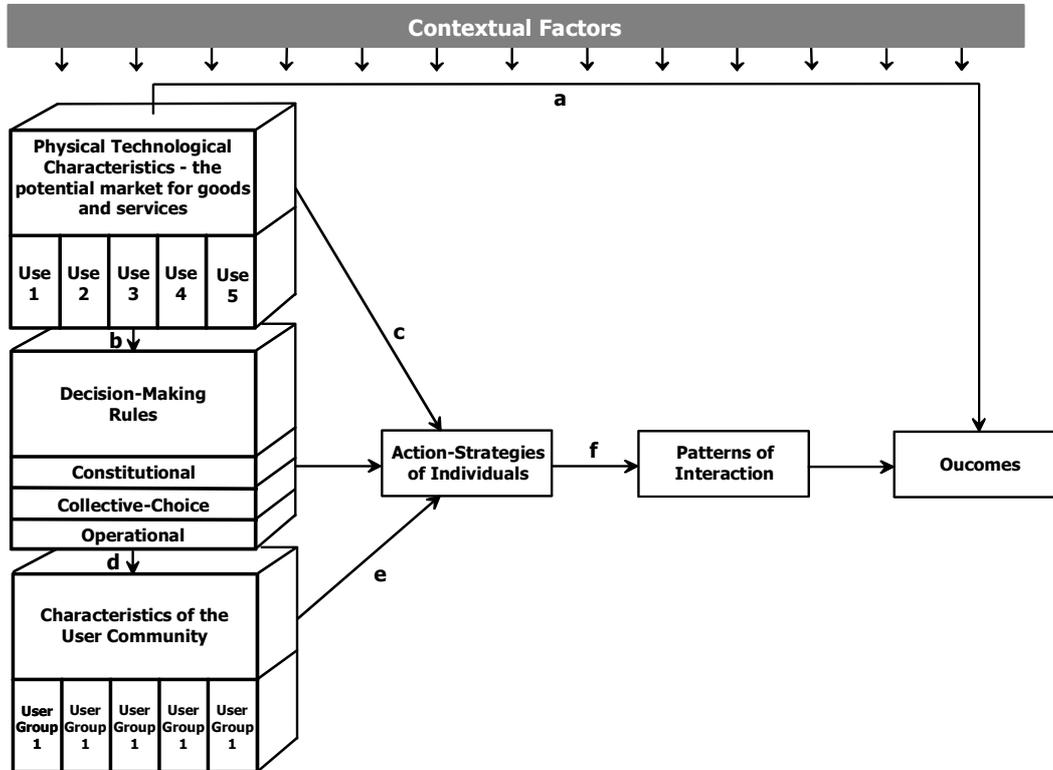


Figure 2: Multiple Use Framework by Edwards and Steins
(Source: Edwards and Steins, 1998, p368)

The ISO14001 standard for environmental management systems (EMS), is a global environmental management exemplar. It advocates a “plan, act, monitor and review” cycle of adaptive environmental management to assess environmental performance and improve measures for controlling and minimising environmental impact (table 2).

The guidelines in the ISO 14001 standard can be applied to individuals, businesses, organisations, agencies, industries, individual institutional arrangements, and entire governance systems to assess the efficacy of systems and processes for environmental management, regardless of size, type, or level of maturity. The standard has also been applied to evaluate the effectiveness of institutional arrangements for forestry management, and environmental management in the sugar industry in Australia.

ISO 14001 can be tailored to any management system to: define environmental risks; evaluate the effectiveness of the systems dealing with it; develop strategies to improve

performance; and establish the framework for ongoing assessment and improvement (Joint Technical Committee QR/11 Environmental Management 1996). The framework purports that environmental management must be central to decision making, governance arrangements, organisational structure, organisational roles, responsibilities and processes, and resource apportionment (Joint Technical Committee QR/11 Environmental Management, 1996).

Table 2: ISO 14001 Environmental Management Systems: Components

Description of ISO 14001 Components	
Commitment and Policy Framework	<p>Commitment to ecologically sustainable development.</p> <p>Assessed in terms of the development and application of appropriate legislation, policies, conventions and agreements which contribute to achieving ecologically sustainable development.</p> <p>Also considers the process for coordination of Commonwealth and state forest related policies and legislative requirements.</p>
Planning	<p>Management practices supported by principles of environmental care, guidelines and minimum standards, and the basis (quantitative, qualitative, expert opinion) for application of guidelines and minimum standards within codes for specific management practices, and transparency of the planning process.</p> <p>Legal requirements, environmental aspects of management practices, allocation of values to particular planning zones, planning processes for minimising environmental impacts of management practices and appropriateness of plans and their scale and scope in relation to environmental objectives and targets</p>
Implementation	<p>Capacity and capabilities of governments and agencies to deliver ecologically sustainable development through adequate accountability and responsibility, resourcing, operational controls, documentation, records keeping and reporting, communication, education and knowledge, and skills and training.</p>
Measurement and evaluation	<p>Systems for monitoring and evaluating environmental performance and the condition of management plans and the condition of the environment in relation to requirements for ecologically sustainable development.</p> <p>Also includes the process for auditing components of the management system and corrective actions.</p>
Review and Improvement	<p>Processes for review which lead to continuous improvement of the management system</p>

(Source: Adapted from Commonwealth and Victoria Regional Forest Agreement Steering Committee, 1998).

4.2.2 Suitability Analysis of Different Frameworks

The framework for the proposed research needs to meet six principal conditions. The framework needs to facilitate and understanding of the impact of (1) contextual factors, (2) the impacts of individual institutional arrangements. The framework must (3) also facilitate the analysis of multiple-scales relevant to governance systems, (4) be relevant for assessing resource management problems in multiple use scenarios, and (5) enable the diagnosis of institutional ‘problems’ and allow recommendations for ‘solutions’. Finally the framework must allow the comparative analysis of different empirical cases.

(1) Contextual factors are constituted in the user groups' social, cultural, economic, political, technological and institutional environment and can have an important influence over people's behaviour, such as their decision to comply with institutional arrangements and contribute to arrangements such as collective actions (Ewards and Steins, 1998). The ecological and socio-political characteristics of Northern Australia's Outback landscapes, including low landscape productivity, high climatic variability, sparse population and vast distances between individuals and a large indigenous population with differing cultures and aspirations (Stafford-Smith et al, 2003), influence human behaviour, patterns of resource use and the management of resources. All three frameworks presented in this paper deal with contextual and political influences. The IAD framework considers context through the investigation of political and other variables in the analysis of communities, the reasons underling the rules in use in empirical settings, and by identifying the other specific factors influencing behaviour (e.g. factors affecting collective action). Similarly the MUC framework incorporates contextual and political information from case studies through its analysis of operational rules governing day-to-day decisions made by individuals. For example the success of operational rules can be measured by their ability to ensure that resource stocks are maintained at a particular level over time.

The EMS framework incorporates contextual and political information at the framework application stage and during the assessment of the efficacy of the management system. In the first instance, local contextual information is inherent in the application of the framework in a management systems context (eg: by defining the parameters of each EMS to reflect the specific needs of the case study). In the second instance, information on local context and other political variables influencing governance is central to the assessment of the efficacy of the management system (eg: criteria and indicators to assess governance context, bureaucratic relationships etc).

(2) The framework must facilitate the understanding of the impacts and effects of existing institutional arrangements, including the impact of change over time. In other words, the framework must help us to understand the socio-political structures and processes that govern the decision-making environment by enabling us to define the arrangements for institutional development (eg: institution building and reform), individual behaviour and collective action. The IAD and MUC frameworks are particularly good in this regard. The EMS framework is more limited in this regard because it does not establish its own parameters for defining institutional context.

(3) The framework must be appropriate to assess complex governance systems, and facilitate the analysis of various institutions at multiple scales. All three frameworks provide the scope to consider governance systems in this way. The IAD framework and MUC frameworks are specifically intended for organising information about operational, collective, and constitutional choice rules. Designed to assess "management systems", the EMS framework be applied to assess complex institutional arrangements operating at single spatial scales or across entire governance systems.

(4) The framework must facilitate the analysis of multiple use scenarios. All three frameworks provide the scope to consider governance systems in this way. The MUC framework is particularly useful because it was designed especially for the analysis of multiple use commons. It explicitly assesses the capacity of the resource system to accommodate different uses and it also considers physical attributes of natural resources in multiple-use scenarios.

(5) One of the key objectives of this project is to determine the effectiveness of institutional arrangements in achieving desired outcomes for stakeholders in multiple-use contexts. Therefore the evaluation framework must enable the diagnosis of institutional ‘problems’ and ‘solutions’. The EMS framework has the greatest potential to facilitate this type of policy relevant diagnostic. This is achieved by integrating substantive criteria for sustainability, and criteria to assess institutional performance (eg: trust and reciprocity, coordination, collaboration, collective action) into the framework.

(6) Finally the framework must structure the analysis so as to enable capable of *comparative evaluation* of different institutional systems, in different contexts including those across state borders. All three frameworks meet this requirement.

Conceptually, these three different types of frameworks offer different advantages for the analysis of institutions in outback environments. The Multiple Use Commons framework emphasizes on contextual factors, particularly multiple layers of institutions and action and the multiple-use of resources. The Institutional Analysis and Design framework offers a very comprehensive approach to defining the way different variables interact to affect behaviour in empirical settings. Finally the Environmental Management Systems framework provides an excellent tool to evaluate the institutional variables and characteristics operating in specific resource management contexts to diagnose policy problems and make recommendations for policy reform. We propose to combine elements from the three approaches into a modified framework (Figure 3).

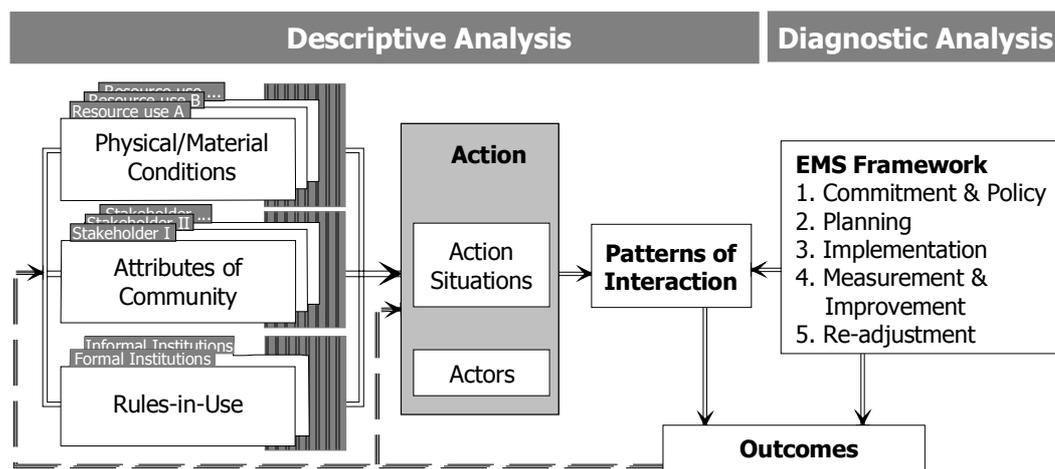


Figure 3: Modified Framework for Institutional Analysis

The aim of the modified evaluation framework is to assess the physical and material conditions of empirical environments (eg: resources, ecological conditions and problems, other landscape conditions), the attributes of local communities (eg: heterogeneity, networks), and the rules in use (the formal and informal institutional arrangements influencing behaviour) and the impact of these variables on patterns of resource use, externalities, resource conflicts and other outcomes. In order to provide information to support institutional change, a multi-criteria analysis using the EMS framework will evaluate relative progress towards implementing collaborative planning and collaborative governance. This will be achieved by integrating criteria for collaborative governance (eg: measures for improving trust and reciprocity, coordination, integration, collaboration, collective action) into the analysis.

4.3 Quantitative model

Capturing the defining elements and relationships within a quantitative model will be achieved through Aoki's (2001) game-theoretical method for analysing institutions. Two considerations are critical;

- (1) Quantifying property rights outcomes requires simultaneous analysis of economic, ecological and social aspects; and
- (2) Dynamic aspects of institutional change are essential. Change itself has to be analysed.

Game-theoretical modelling techniques are able to provide this focus

Game-theoretical models can be defined either as explicit optimisation models, which implement a utility function, or they can be categorised as networks, which define decision rules about how agents deliberate over different possibilities during each

stage of a game. We will use a game-theoretical network model, also called a belief network, for this analysis.

The key to Aoki's approach is to interpret institutions as the result of market behaviour. Technically, those results constitute observable equilibria from various action choices by the agents which take part in the 'game'. Agents would be the different stakeholders that are connected to property rights issues in the Outback, stratified by their knowledge, attitudes and expectations. These three elements allow the differentiation of n different (groups of) agents.

Figure 4 visualises the setting of a game: Every agent can choose a strategy/action from a range of m existing options. This step leads to specific behaviour of each agent. The agent is confronted with the behaviour of the other $n-1$ agents as well as interference by environmental/contextual factors. A drought can be such a perturbation but also changed market conditions. These perturbations are modelled as stochastic impulses. The sum of n strategies (actions) and k interferences define the game (play) of each stage.

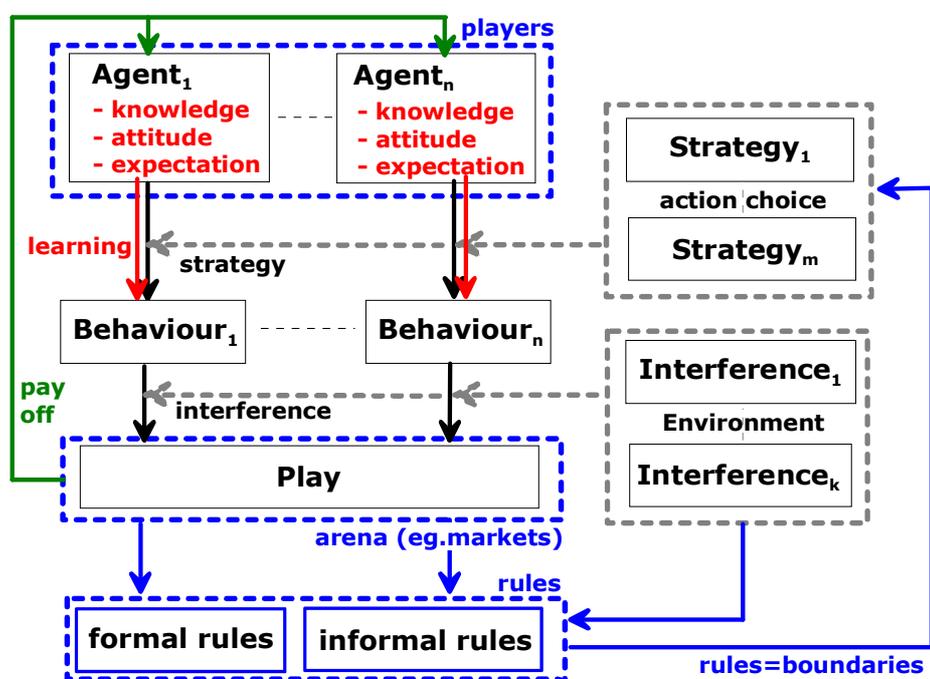


Figure 4: Game-theoretical network model for the quantitative analysis

For each stage of this repeated game the outcome of the game determines a specific payoff for each of the n agents. This payoff forms the learning process of the agents in a way that knowledge, attitude or expectations will change. This learning process is the core element of a Bayesian model, or a belief network. As a consequence of the learning process the agents might change their behaviour by choosing another strategy of the (up to this point unchanged) action choice.

The institutional aspect enters this game-theoretical model by interpreting the outcome of a game as an equilibrium. Equilibria define formal and informal rules. At the same time the context can affect the system in a way that formal rules will be modified directly. For instance, policy directed at protecting the environment (often) restricts the scope of future behaviour options of agents. Such restrictions can be modelled by a feedback effect of the formal rules on the action choice. This means that, henceforth, the n agents cannot choose the same strategies but have to face new boundaries for their behaviour.

This model approach will allow us to analyse institutions represented by the three boxes *players*, *arena*, and *rules*. Scenario analysis can be employed to assume structured sets of specified changes in property rights arrangements. For these scenarios, the model will show whether and when the change leads to an equilibrium and what the economic, ecological and social consequences will be.

As investment decisions play a key role in this discussion about sustainable land-use three central ideas of New Institutional Economics can be taken:

Williamson (1985) emphasises the importance of asset-specificity, uncertainty and frequency of transactions for investments. This will be an essential link of this analysis between institutional issues and growth issues.

Following North (1993) we will use the size of transaction costs to serve as an indicator for the efficiency of institutions.

Demsetz (1967) states that property rights have the tendency to change over time to minimise transaction costs.

The result of such an approach will be a game-theoretical model that will take the general structure derived from the IAD, MUC and EMS frameworks. The framework will therefore provide qualitative information about institutional arrangements, such as identifying agents, their knowledge, attitudes and expectations, and the formal and informal rules affecting behaviour. The results of the framework will be qualitative information about the institutional arrangement in a structured way so that it can be used in the model to simulate quantitative scenarios. Aspects like uncertainty of agents will be considered by Bayesian mechanisms like a belief network, described above. These scenarios will evaluate policy options for changes in the institutional arrangement. Evaluation criteria are, for instance, wealth indicators and distributional issues. The three key ideas of New Institutional Economics, summarised above, will be taken as fundamentals in the model definition.

5 Conclusions

The multiple use of outback landscapes raises a diverse array of sustainability issues related to property rights, property access, and roles and responsibilities associated

with land use. This paper proposes a qualitative and a quantitative approach for investigating the impacts of property rights on landscape use and management, welfare changes and distributional implications that changes to property rights might generate.

The qualitative approach integrates a series of existing analysis frameworks to provide an in-depth understanding of how property rights influence management and use of landscapes. Property rights are fundamental to the sustainable development of Outback Australia's regions. They define the incentives that influence investment and development in regions.

The quantitative approach is based on game theory and agent-based modelling and will provide a predictive capacity for forecasting potential changes to management and use of landscapes based on institutional arrangements. The quantitative approach implements a game theoretical approach, which specifies institutions as equilibria.

The analysis of potential alternative changes to property rights regimes will be conducted using both approaches. The approaches will be embedded within an empirical research structure, whereby multiple case studies, which will be conducted across Northern Australia over the coming years, will provide the data and real-life context for the analysis.

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