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Are there incentives to integrate to land and water management across northern Australia?

William Nikolakis and R. Quentin Grafton

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(Photo courtesy of W. Nikolakis)

About the authors

William Nikolakis is a Postdoctoral Fellow, Environmental Management and Development Programme at the Crawford School of Economics and Government The Australian National University

Quentin Grafton is a Professor of Economics and Director of the Centre for Water Economics, Environment and Policy (CWEEP) at the Crawford School of Economics and Government

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Crawford School of Economics and Government
THE AUSTRALIAN NATIONAL UNIVERSITY

http://www.crawford.anu.edu.au

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Executive Summary

The aim of this work is to understand what incentives exist to encourage integration in land and water management across northern Australia. Integration is seen as important in improving planning and management of resources in the context of climate change and development pressure. The north Australian region is made up of three jurisdictions, the two states of Queensland and Western Australia, and the Northern Territory. It is a sparsely populated region, with over a quarter of the Australian estate and only 2% of the nation's population. However, the region makes a significant contribution to national exports and is recognized for its ecological values, and its prominent Indigenous population who have customary rights to land and water. The region produces over half the nation's annual runoff during the wet season.

Increasingly there is a focus on northern Australia as the next frontier for irrigation development. A report by the North Australian Land and Water Taskforce in 2009 suggested irrigation could expand by up to 200% in the region, though in a form that is distinct from southern Australia given soil, hydrological and biophysical characteristics of the region. Population is increasing and climate change projections point to increased temperatures and evapotranspiration, as well as more intense rainfall and cyclonic events, and in coastal areas storm surges and erosion, while in inland areas there is predicted greater incidence of drought and bushfire (CSIRO, BOM and BRS 2010a, b). The linear and non linear forces that may shape northern Australia's landscape highlight the need for integrated land and water management as a tool for adaptation. Integration can improve the coordination of government adaptation programs, as well as efforts between government and non government actors (vertical integration), and encourage coordination between sectors (horizontal integration).

Integration is both a process and an objective, to more closely align the policies and structures of institutions responsible for natural resources management (including water planning and land management). The aspiration is to provide a holistic perspective which

takes account of the inter-dependencies between resources, ecosystems and humans in natural resource management. Traditionally in the interests of specialization and transparency, different departments were responsible for managing resources independently (so for example, water, forestry and land were managed separately). However, increasingly it is realized that encouraging coordination to improve efficiency in service delivery, collaborating with stakeholders and addressing environmental problems through multi-disciplinary efforts, offers the promise of improved outcomes and dealing with greater complexity. It is argued that to encourage integration there must be a change in structural arrangements (such as legislative change, creation of a written agreement between agencies and non government actors) and the creation of processes and rules to support integration (such as whether any decisions are binding) (Margerum and Born 2000). Implementing integration is challenging, there are barriers such as departments defending their territory, short term planning, and encouraging integration in practices at the individual level (such as reducing practices that cause salinity or eutrophication, or reducing land clearing to improve biodiversity). Often the individual may bear the costs of broader land and water objectives, and this may prevent integration from taking full effect. Encouraging integration through incentives may overcome this barrier and support efforts to manage land and water holistically.

In northern Australia there are few market based incentives to encourage integration of land and water management. Most attempts at integration have been formal structural or policy efforts to encourage coordination between governments. For example, the Federal Government has sought to improve vertical integration between levels of government in program and service delivery through the creation of regional Natural Resource Management (NRM) bodies, and there have been national efforts to create consistent policies on salinity, (the National Action Plan for Salinity and Water Quality) and promote water reform (the National Water Initiative 2004). In Queensland the *Sustainable Planning Act 2009* has established a uniform process for development assessment; and in the Northern Territory there is a private agreement between indigenous land owners and ConocoPhillips to promote traditional fire management that reduces carbon emissions. The use of incentives to better align land and water use among

farmers and landholders is mostly informal across the north. The use of Payment for Ecosystem Services and Tradable Rights Allocation System may offer ways to successfully implement integration and improve natural resource management in light of increased development and climate change.

1. Introduction

1.1 Aims

Northern Australia is made up of three jurisdictions: the two states of Queensland and Western Australia (WA), and the Northern Territory (NT) (See Figure 1). As a region northern Australia comprises a quarter of the Australian estate, but makes up only 2% of the population (about 310,000 people) (Carson et al., 2009). Despite the region being sparsely populated it accounted for 30% of the nations exports and has contributed to a third of export growth in the last 30 years (Stoeckl and Stanley, 2007). Agriculture plays an important role in remote and very remote locations across the region (Stoeckl and Stanley, 2007), with pastoral activity covering almost 90% of the landscape (NALWT, 2009). It is predicted that a current trend of population growth and urbanization will continue into the future (Carson et al., 2009). About one third of the population identifies as Indigenous (Carson et al., 2009) and thirty percent of the north Australia's land base is owned by diverse Indigenous peoples (Altman et al., 2009). This land is owned under a variety of tenures, much of it communally in trust.

1.2 Study region

Northern Australia is made up of three jurisdictions: the two states of Queensland and Western Australia (WA), and the Northern Territory (NT) (See Figure 1). As a region northern Australia comprises a quarter of the Australian estate, but makes up only 2% of the population (about 310,000 people) (Carson et al., 2009). Despite the region being sparsely populated it accounted for 30% of the nations exports and has contributed to a third of export growth in the last 30 years (Stoeckl and Stanley 2007). Agriculture plays an important role in remote and very remote locations across the region (Stoeckl and Stanley 2007), with pastoral activity covering almost 90% of the landscape (NAWLT 2009). It is predicted that a current trend of population growth and urbanization will

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Figure 1: Map of study region (TRaCK)

Northern Australia is characterized by tropical savanna in coastal areas, giving way to grasslands and deserts in the south (CSIRO, 2009). There are three main drainage divisions for northern flowing rivers (see Table 1) containing thirteen river basin regions. The aquatic ecosystems of northern Australia are of international significance, with 8 RAMSAR listed sites in the Timor Sea drainage division alone (McJannet et al., 2009). About half of Australia's total stream-flow occurs in northern Australia (200,000 gl) but often this is highly variable, with some 94% of northern Australia's rainfall occurring between November to April, making groundwater particularly important in the dry season (Creswell et al., 2009).

Table 1: Drainage divisions and river basins across the north

Drainage Division	River Basin Region
Timor Sea:	Fitzroy (WA), Kimberley, Ord-Bonaparte, Daly, Van Diemen, and Arafura.
Gulf of Carpentaria:	Roper, South-West Gulf, Flinders-Leichardt, South-East Gulf, Mitchell, Western Cape.
Northern North-East Coast:	Northern Coral.

Table 2 identifies water availability and water use across the region, as well as population and land use. The table highlights that the irrigated agriculture sector uses very little of the run off and stream flow across the region. Table 2 shows the disparity in precipitation between northern and southern part of the region- for example in the Gulf drainage division there is a mean of 1800 mm in the northern Gulf, while the south receives only 300 mm of precipitation annually.

Table 2: Drainage division profile (collated from CSIRO, 2009 and CSIRO, BOM and BRS, 2010 a, b)

	Timor Sea	**Gulf**	**Northern North East**
Jurisdictions	NT and WA	NT and QLD	QLD
Population**	164, 436	55, 788	N/A
Size (km2)	564,600	647,000	50,000*
Run off (GL)**	70, 609	75,058	N/A
Stream flow per year (GL)	90,000	90,000	17,000
Precipitation (mm) (mean)	868 *1687 in north* *383 in south*	900mm *1800 mm in north* *300 mm in south*	1338
Storage capacity (ML) **	>11,234,871	780,623	N/A
Water use (GL)**	270	250	N/A
Irrigated agriculture use (GL) **	>216	136	N/A
Irrigated land (km2) **	291	179	N/A
Pasture (km2) **	145,172	126,935	N/A

* Approximate average ** (CSIRO, BOM and BRS, 2010a,b).

The landscape is relatively intact with less than 1% of the region cleared in the Timor Sea and Gulf drainage (CSIRO, 2009). The potential to develop storages in the region is generally constrained as most rain falls near the coast (Petheram et al., 2010). There is a strong reliance on groundwater in the region (Straton et al., 2009). Yields from agriculture are relatively low because of high evapotranspiration rates (Petheram et al., 2010).

1.3 Institutional arrangements for water and land management

This section describes the institutional arrangements for land and water management in each jurisdiction to provide context to this work. Each of the three jurisdictions across northern Australia has developed institutional arrangements to manage natural resources differently. This is in response to diverse environmental, geographic, political and economic conditions. There have been efforts to encourage a convergence in water resources management culminating in the National Water Initiative (NWI) (2004). But the NWI did not require a uniform legislative framework. In land management there has been similar reforms to the NWI.

Water Management

There have been different approaches to water resources management in each jurisdiction across northern Australia (see Table 3).

In the NT, the *Water Act 1992* (amended in 2004), sets out the provisions for water management, including licensing and water trading. The Water Act (NT) identifies the Controller or Director of Water Resources as responsible for issuing licenses and setting extraction limits. The Controller reports to the Minister for Natural Resources, Environment, the Arts and Sport (NRETA). A Water Control District is declared for an area when consumptive allocations have increased to a significant level, and a water allocation has been prepared. It is acknowledged that natural and cultural values are important to NRETA and there is a general guide used in allocating water between

consumptive and non consumptive uses for 80 % to non consumptive uses (such as the environment) and 20% for consumptive uses (agriculture and town drinking supplies) (Northern Territory Government, 2009). In accessing a water license a proponent must be a land holder and apply to the Water Resources Branch in NRETA, all bores must be registered and a pump installed in relation to groundwater, as well an assessment of the water needs of the crop is made (NRETA, 2011). Consistent with Queensland and WA, the license application must be advertised in print media for public input (NRETA, 2011).

The *Water Act 2000* (Queensland) provides the legislative framework for water management, planning, licensing and trading. The Department of Environment and Resource Management (DERM) is charged with administering licensing and planning; its approach to planning is a two-tiered framework. The first tier comprises the Water Resources Plan (WRP) 10 years in duration. The WRP sets out the total volume of water available for consumptive allocation. The Resources Operations Plan (ROP) is the second tier in the water planning framework. The ROP converts existing water licenses and interim water allocations to tradable water allocations. The ROP separates land and water title, a water title is registered and transferable. A land holder may apply for a water license for consumptive use where there is no water plan (or a water allocation where there is a plan). DERM may request more information and the *Water Act 2000* requires public notice to allow for public input into the assessment. As well native title representative bodies are notified of the license application. There are conditions placed on the license such as where the water may be taken and how much water can be used in a given period, and sustainability plans may be required and ecological impacts assessed (DERM, 2009). There is an expectation the license will be fully utilized. Proponents who intend to use water for irrigation may have to develop a Land and Water Management Plan (LWMP) which details how any ecological risks are to be managed (DERM, 2011). LWMP's are mandatory under the Water Act 2000 if the area is identified in a water plan as requiring an LWMP, or where additional allocation has been purchased to apply to land (from another property). The *Sustainable Planning Act 2009* (Queensland) requires a LWMP where dams are to be developed for containing run-off.

In Western Australia, the *Rights in Water and Irrigation Act 1914* (RIWI Act) provides the statutory framework for water management. A person is eligible to access a license if they have access to land. Licenses may be traded temporarily or permanently in part or whole (this may only occur through a land sale). Water planning occurs at a State, Regional and local area Management Plan level. The Ord River Surface Water plan is the only operational plan in the study region. A Kimberley-wide Regional Plan is being developed, which identifies broad principles of development and water use across the region. The Department of Water is responsible for administering the RIWI Act. The Act identifies that in areas proclaimed as a water management area it is illegal to take water from an aquifer or watercourse without a license- licenses are only issued by the Department to land holders where water is available for allocation and criteria for assessment include whether the activity is in the public interest or sustainable, and whether the project is consistent with other government policies (Department of Water, 2011). If any land is to be cleared the Department of Environment and Conservation must issue a permit under the *Environment Protection Act 1986.* Clearing in some catchments in southern WA requires a permit from the Department of Water to mitigate impacts on water supply; permits are also required for the construction of wells or the interference with stream beds and banks (Department of Water, 2011).

Table 3: Water management framework in northern jurisdictions

	Northern Territory	**Queensland**	**Western Australia**
Legislation	*Water Act* (1992) (amended 2004)	*Water Act* (2000)	*Rights in Water and Irrigation Act* (1914) (RIWI Act)
Regulation		Water Regulations 2002	*Rights in Water Irrigation Regulations 2000* (WA)
Institutions charged with water management	Department of Natural Resources, Environment, the Arts (NRETA)	Department of Environment and Resource Management (DERM)	Department of Water
Officials responsible for management and allocation of water	Controller of Water Resources advises and reports to the	At direction of its Minister and Chief Executive Officer	Minister for Water Resources

	responsible Minister, and issues, transfers and amends licenses		

Land Management

There is diverse legislation that applies to land management across northern Australia (see Table 4). Each jurisdiction has developed land management legislation to meet their local conditions over time. In Queensland the *Land Act 1994* and Western Australia the *Land Administration Act 1997*, their key land statutes, cover the administration of freehold, pastoral and crown lands. While separate legislation provides for this in the Northern Territory. Departments tend to be larger, with smaller divisions providing specialized service within. An important consideration in the Northern Territory is that almost half the land base is owned and managed by indigenous peoples through the *Aboriginal Land Rights Act 1976*- Commonwealth legislation. In the Northern Territory there are specific requirements placed on land holders to manage erosion and weeds. Each jurisdiction has an Environmental Protection Authority which provides independent assessment of development activities.

Table 4: Key land management and planning legislation and responsible departments

	Northern Territory	**Queensland**	**Western Australia**
Legislation	*Crown Lands Act 1992* *Pastoral Land Act 1992* *Aboriginal Land Rights Act 1976 (Cth)*	*Land Act 1994* *Sustainable Planning Act 2009* *Aboriginal Land Act 1991*	*Land Administration Act 1997* *Conservation and Land Management Act 1984*
Department/s involved	Department of Lands and Planning, Lands Group, Land Administration Division Department of Natural Resources, Environment, the Arts and Sport	Department of Local Government and Planning develops regional and state planning instruments. Department of Environment and Resource	Department of Regional Development and Lands Pastoral Land Board (a statutory authority) oversees pastoral leases and their

	Aboriginal Land Councils (Northern Land Council)	Management Local Aboriginal Land Councils	management Department of Environment and Conservation manages crown lands for a range of benefits.
Important land management legislation	*Weeds Management Act 2001* *Bushfires Act 1980* *Soil Conservation and Utilisation Act* *Environment Protection Authority Act 2007*	*Forestry Act 1959* *Nature Conservation Act 1992* *Environmental Protection Act 1994*	*Environmental Protection Act 1986*

2. Forces for change across northern Australia

There are a number of linear (development) and non linear (climate change impacts) pressures on land and water resources across northern Australia. The interaction of these forces with ecosystems is complex and will have implications for human systems, in particular for indigenous people's customary values. This section outlines the development and population pressures and climate change impacts in the region. We then identify the potential challenges for institutions from these forces.

2.1. Development and population pressure

The landscape across the north is relatively undisturbed. Around 90% of the landscape across northern Australia is used for pastoral activity (most of it unimproved native pastures) (NAWLT, 2009). Increasingly the north is being examined for its irrigation potential as land and water scarcity issues predominate in southern Australia (Hart, 2004). A recent study emphasized the potential for a 100 to 200% expansion of irrigated agriculture in the north Australian region (NAWLT, 2009). A $195 million dollar investment by the West Australian and Federal Government to the expansion of the Ord

Irrigation Project is evidence of government's commitment to 'northern development' (Department of State Development, 2009). There is a perception of an abundance of water in northern Australia. This is disputed by Creswell et al., (2009) where the authors study highlights that the region is in water deficit for much of the year (Creswell et al., 2009). The region is subject to high evapotranspiration which makes it relatively unproductive in terms of irrigated agriculture, developing water storages is constrained, and diverting flow could have implications on the regions unique ecological and customary values (Petheram et al., 2008; 2010).

Alongside the push for irrigation, there is population expansion in centres like Darwin (Carson et al., 2009) and the mining sector plays a significant role in exports which has grown substantially over the last three decades (Stoeckl and Stanley, 2007). These activities may potentially fragment the landscape and degrade tropical aquatic systems- but according to Jackson et al. (2008) there is a high value placed on free flowing rivers by the general public which runs counter to a development ideology. The pressure to strike the balance between development and conservation is ever important across the north. The non linear effects of climate change will impose further risk and complexity for policy makers and resource managers.

2.2 Climate change projections

Climate change is a global phenomenon which offers significant risk to social, ecological and economic systems. It is considered that there has been a rapid increase in global warming over the last century (Australian Academy of Science, 2010; IPCC, 2007). Across the north it is predicted that from 2030 and 2070 the region may experience increased temperatures, more intense rainfall events and more intense cyclonic events (CSIRO and BOM, 2007; CSIRO, 2009). The incidence of hotter temperatures in inland areas could lead to drought and bush fires, while in coastal areas sea levels rising could lead to saltwater inundation and erosion (CSIRO, 2009; Green, 2006). Some areas could receive more rainfall across the north, though it is likely overall water availability will decline, increasing the potential for ecosystem degradation (Hyder Consulting, 2008).

Regional impacts will vary and some effects may be highly localized- adapting to these impacts through adaptation represents a key challenge to society and will require the development of a supportive institutional framework (Garnaut, 2008).

It should be noted that climate models become less predictive at smaller scales and while they can indicate general trends, future regional changes are less certain. Climate change impacts are predicted to be mostly similar across the northern jurisdictions. However, according to CSIRO and BOM (2007) the Kimberley region in north Western Australia is likely to experience greater variability in rainfall, evapotranspiration and a more marked increase in hotter days above 35 degrees Celsius. The implications of climate change on the regions water resources are not well understood, though the potential for more catastrophic events and hotter temperature will increase risk. As discussed earlier the region, despite perceptions of abundance, is water limited throughout the year because of high rates of evaporation and evapotranspiration for most of the year (CSIRO, 2009). This climate risk combined with increasing population growth in centres like Darwin could enhance water stress. Alongside water security concerns, the increase in irrigation activity could lead to eutrophication during the dry season (particularly were systems are seasonal) (Brodie and Mitchell, 2005). Declining water security and water quality will have consequences for human, ecological and economic systems.

The implications of climate change for ecological systems will vary. Northern Australia comprises some 19 distinct bioregions, ranging from the largest intact tropical savannah, and aquatic ecosystems of high value in Australia (ATRG, 2004). There are also coral reefs, mangrove systems, rainforests and heathlands (Hyder Consulting, 2008). Low lying coastal areas are at risk from saltwater inundation, as well as the combined pressure of industrial, agricultural and urban development (Hyder Consulting, 2008). Climate change may have implications for biodiversity in icons such as the Great Barrier Reef and Kakadu wetlands- without effect planning the physical impacts of climate change will be more pronounced (Hyder Consulting, 2008). Climate change is likely to affect key industries across the north, such as agriculture, tourism and mining. Growing conditions will be negatively impacted by increased temperatures, enhancing risk for agriculture and

pastoral activities (McKeon et al., 2009; Gunaskera et al., 2007; Department of Climate Change and Energy Efficiency, 2010). More extreme weather will have implications that can be managed more effectively through proactive planning efforts.

2.3 Potential implications for institutions

Managing land and water in light of climate and development pressures will represent challenges to existing institutional arrangements. First, the effects of climate change are non linear, this creates challenges for departments to prioritize actions and to coordinate programs to address complex inter-dependencies at a landscape level, and adapt to impacts that are both temporal and spatial in nature. Managing across the region will be constrained by different jurisdictions, infrastructure, knowledge gaps and ecosystems. Although Vorosmarty et al. (2010) state that northern Australia's water security and biodiversity is at 'least threat' on a global scale, the region has been earmarked for it's for irrigation potential (NAWLT, 2009). Policy makers will be constrained in making effective decisions by information gaps, including little understanding of: ground and surface water connectivity, or the link between groundwater and groundwater dependent ecosystems (which are of high cultural importance).

The work of McJannet et al. (2009) suggests that even minor changes in flow regimes in northern Australia could have significant affects on water quality, including increased nutrient loads, which will degrade ecological assets. Increased nutrient loads leading to eutrophication has occurred already in some tropical rivers in Australia (Brodie and Mitchell, 2005). This highlights the importance for implementing management arrangements that coordinate land and water management in addressing environmental problems. As well, policy makers should rigorously test climate and development scenarios to understand thresholds and connectivity at a landscape level (Hamilton and Gehrke, 2005). If water stress becomes more acute, tension may increase between consumptive and non consumptive users, heightening the importance for adaptive planning. Water plans across the north tend to view rainfall as being relatively stable into

the future, presupposing no change in water availability. However, this neglects the effect of increased population, development and hotter temperatures on water availability (Nikolakis et al., 2011). Tradeoffs may need to be made between development and conservation that reflect complex interdependencies in an uncertain environment- this highlights the need for an integrated approach to natural resources management (NRM).

An integrated approach to NRM is considered to be effective in that it seeks to improve coordination between government and non government actors, encourage community involvement in management and take an inter-disciplinary perspective in problem solving (Bellamy et al., 1999). Traditional approaches to NRM tend to have a singular focus to managing resources (like land and water) which has served to create fragmented decision making, while integration can help address non linear impacts from climate change through the recognition of the inter-connectedness between natural resources, and between human and ecological systems (Margerun and Born, 2000; Morrison et al., 2004; Patwardhan et al., 2009). However, there remain significant barriers to implementing an integration approach, which may include political and social factors that work against a more coordinated and collaborative approach between government and non government actors in NRM (Margerum and Born, 2000). One example across Australia is the exclusion of mining from water management regimes, which serves to fragment decision making at a landscape level (Nikolakis and Grafton, 2009).

There will need to be tradeoffs made in setting priorities for land and water management as development increases and climate impacts take effect. Integration is an important step in developing more structured decisions for adaptation in land and water management by making assessments and policies which consider stakeholder preferences and account for the cumulative effect of resource decisions. While policy efforts may be integrated, there are challenges with operationalising integration and managing land more holistically for conservation and development outcomes. Market based instruments may encourage farmers to engage in land management practices that reduce nutrient runoff- thereby improving integration. But getting the right incentives structure has proved challenging. Perhaps such efforts to promote integration may need to be augmented by governance

structures that include users and stakeholders in resource governance. In northern Australia, social norms are seen to have the effect of encouraging compliance by irrigators through social sanctions (Straton et al., 2009).

3. Integration

3.1 What is integration?

Environmental problems are considered to be 'wicked problems' in that they are complex, rooted in dynamic ecological and social systems of which policy makers may have little information and knowledge (Rittel and Webber, 1973). Integration may be one way to improve the management of the environment and natural resources- it is both a process and an objective (Margerum and Born, 2000). Integration is an approach to environmental planning and NRM that seeks to: encourage coordination between government agencies in program delivery to reduce duplication, inconsistencies and inefficiencies (Cairns and Crawford, 1991); improve collaboration between government and stakeholders in policy design and implementation (Morrison et al., 2004); and increase the use of multi-disciplinary approaches in addressing environmental problems (Patwardhan et al., 2009).
Effective integration can overcome gaps in knowledge to improve policy formulation and implementation, build capacity among policy makers and stakeholders through collaboration, and improve accountability by re-centering authority (Margerum and Born, 2000; Morrison et al., 2004; Bellamy et al., 1999). But while integration is emerging as an important goal, it is in danger of becoming a vague buzzword (Lane and Robinson, 2009).

Integration may be called a variety of things, including collaboration, cooperation and coordination- but they are in practice an element of integration. Coordination is according to Margerun and Born (2000) "at the core of an integrated approach because complex environmental problems are rarely the responsibility of any one agency, organizational

unit or individual; the problems usually require a collaborative effort among numerous entities to achieve collective goals" (p.6). This coordination can take the form of coordinated decision making, inter-organisational coordination structures, establishing new coordination entities or information exchange. But the effectiveness of the coordination is dependent on a shared understanding and a common set of goals which must be strategic and long term to be effective. In short the coordination must be regularized (Margerun and Born, 2000). Morrison et al. (2004) describe that integration in the context of NRM has four defining characteristics: (i) it is spatial or place based; (ii) coordinative in that it involves government, NGO's and civil stakeholders; (iii) collaborative in that actors are involved in decision making and planning; and (iv) rational: decisions are implemented once consensus is reached.

The concept of integration has been applied to different fields. Integrated Water Resources Management (IWRM) has been described as a process that encourages greater coordination in management of land and water to optimize economic, social and ecological outcomes (Jonch-Clausen, 2004). IWRM is considered a holistic approach which draws on the integration concept, and aims to enhance collective action and institutional formation. IWRM generates greatest benefits when it is linked to land based activities- but this is not always possible, as often this linkage is not enshrined in statute (Mitchell, 2005). IWRM takes a basin perspective, and is performance based with indicators to encourage adaptation- in northern Australia water plans have not taken a basin perspective, but rather focused on groundwater or surface water, often in a discrete area of a catchment. Another approach is termed Integrated Resource Management (IRM). Bellamy et al., (1999) argue that IRM emerged because of community tension over resource degradation and declining biodiversity. The approach according to the authors combines community participation, technical knowledge and institutional and policy coordination between government and non government actors to improve management of natural resources. An example of where IRM has encouraged a strategic approach to NRM is in New South Wales, where Margerun and Born (2000) describe that historically decision making was fragmented and included a diverse range of stakeholders from government, to farmers to environmentalists. There were a variety of conflicting policies

and programs, little data sharing and collaboration. While each stakeholder was concerned with managing land and water impacts there was a lack of coordination which led to poor environmental outcomes.

Integration is seen to be important in addressing the goal of sustainable development, however, as Morrison et al. (2004) outline there may be a range of motivations for integration including cost savings, institutional innovation, a moral compulsion to improve accountability, or part of reforms to improve organizational efficiency or knowledge sharing. These descriptions of integration are at the institutional level. Integration is holistic and seeks to manage the cumulative effect of development across the landscape, and such an objective requires collaboration between government and stakeholders to improve outcomes. Lockwood et al. (2010) argue that informed by 'new governance,' there is an emerging approach in NRM which views environmental problems as best solved by more interaction and collaboration between government and non government actors.

Problems in the governance of natural resources are often deeply rooted in social dynamics. For example, conservation and employment are often positioned as competing aspirations in resource management. Integration may help reconcile these sectoral objectives by bringing decision makers, experts and stakeholders together to balance these objectives (Morrison et al., 2004). The authors describe that under a conventional NRM paradigm: "water planning…is mainly about environmental flows and water use efficiency, and not related economic or social issues[and] water and vegetation programs are all too rarely integrated" (p.245). Recent initiatives in Australia to encourage integration between land and water management include the National Water Initiative (2004) and the section 20 (c) of the *Water Act 2007* (Commonwealth), the latter which seeks to integrate social, economic and ecological factors, and integrate the management of resources and planning in the Murray Darling Basin in south eastern Australia. Programs such as the National Action Plan for Salinity and Water Quality sought to encourage integration in agricultural management practices across the nation in particularly soil management practices to mitigate salinity; and the creation of 56 regional

NRM bodies across Australia sought aimed to support vertical coordination in government service delivery to regional areas (what Ross and Dovers, 2008 call ‘administrative mechanisms’ for integration).

A significant challenge is implementing integration at the individual level. Often the costs of landscape level objectives will be born by individuals such as farmers. This may inhibit the achievement of these goals as the farmer may be dissuaded from engaging in such activity. Incentives may encourage landholders (like farmers) to implement practices that improve soil and water quality (such as through re-vegetation which can also improve conservation outcomes). These incentives are discussed in section 4.2 in the context of northern Australia.

3.2 What supports integration?

Integration is experimental and it may not always be the most efficient or effective approach to addressing environmental problems. There are particular conditions documented in the literature which are seen to support integration. Lane and Robinson (2009) state that integration should enhance the: “capacity of governance arrangements and institutions to respond intelligently to management and environmental uncertainties” (p.22). The authors suggest a fluid (and only partial) approach to integration where efforts are aligned between networks and stakeholders to achieve a uniform set of goals. The authors in examining integration efforts to improve water quality for the Great Barrier Reef in northern Queensland view collaboration between stakeholders and government as key to improving integration.

For integration to be successful it must recognize the interdependencies between the environment (so clearly identify the problems and connectivity between land and water) and people and industry; improve coordination across government and spatial scales; reduce inefficiencies and duplication in policy and programs; and address knowledge gaps (Lockwood et al., 2010). While Morrison et al.(2004) identify 6 key factors to

support integration: (i) there must be a strategic commitment; (ii) a structural reorganization at regional level that is consistent with expectations (iii) sufficient resources must be available to facilitate integration efforts (iv) participatory procedures are available to encourage collaborative planning; (v) a methodological or information exchange between actors (vi) and a functional delivery: implementation and evaluation of practices and standards at a regional level. Implementation of integration remains difficult at the individual landholder level, but Lockwood et al.(2010) argue that encourage stakeholder 'buy in' to natural resource governance efforts, that the institutions responsible for NRM must be legitimate, accountable, transparent, inclusive, fair, integrated, capable and adaptable.

Information on what supports integration is still developing. Though it is acknowledged the barriers are significant. These range from vertical barriers created by federalism, where the federal government and state governments may pursue conflicting land and water management policies in the same catchment. As well there are competing stakeholder values that can be polarized in a development versus conservation position. However, integration offers the potential to improve land and water management by eliminating fragmentation. But a vital link must be made at the individual landholder level for integration to take effect. Market based incentives to support integration may offer opportunities to encourage this.

4. Integration in northern Australia

4.1 Efforts to encourage integration in northern Australia

There have been efforts to encourage integration in northern Australia. With increasing pressure for development from the irrigation and the booming commodities sectors, the potential for fragmentation is acute. Integrating NRM could also have the added benefit in north Australia for providing a uniform structure for indigenous Australians to assess

project proposals on their traditional lands and territories. Most of these initiatives have taken the form of administrative structures and strategies (like those identified by Ross and Dovers, 2008). The objective of these efforts has been to encourage vertical integration for government programs and policy (i.e. NRM bodies are an example of administrative structures, and the National Water Initiative an example of a national strategy to take a more holistic perspective in water resources management). In northern Queensland a 'fluid' approach to integration was deemed to be quite a success in improving land and water management to address water quality in the Great Barrier Reef Catchment (Lane and Robinson, 2009).

In 2001, the Great Barrier Reef Marine Park Authority released a report detailing water quality issues for the Reef. Agricultural activity was seen to have a significant impact on reef health (Great Barrier Reef Marine Park Authority, 2011). In response the Queensland and Federal Government prepared a Reef Water Quality Protection Plan in 2003, which identified an integrated approach between land and water management to address water quality, the aim is for a reduction in run-off of harmful nutrients and pesticides by 80% for agricultural businesses and 50% for grazing operations (Great Barrier Reef Marine Park Authority, 2011). To achieve this, farmers are required to develop Water Quality Improvement Plans. These set water quality targets, and monitoring and reporting requirement to meet the Reef Water Quality Protection Plan. A joint rural industry group and a scientific advisory panel were developed to combine expertise with stakeholder input, to inform policy. According to Lane and Robinson (2009) a major challenge to this integration initiative has been to identify the appropriate scale of response and to integrate the regulatory and legislative framework to create consistent provisions and policies. The authors suggest that regional plans have been quite effective particularly as they engage across sectors and government through NRM bodies in a network approach.

More broadly the efforts to encourage integration have been ad hoc in nature. In Queensland the *Integrated Planning Act 1997*, aimed to provide a framework to balance the assessment of development applications. The *Integrated Planning Act* provided a planning framework at a state and regional level, and implemented a system for

development assessment: the Integrated Development Assessment System (IDAS). IDAS set out a template and checklist for development applications, and identifies the potential environmental impacts of development- it provides a structural effort for integration. The *Integrated Planning Act* was replaced by the *Sustainable Planning Act 2009* (QLD), which incorporates IDAS, and seeks to encourage a uniform approach to development assessment across the state.

In the Northern Territory a strategic level, integrated natural resources management plan was developed which views knowledge sharing between indigenous and non indigenous peoples as important. It recommends an adaptive management approach to environmental problems and resource use, to encourage indigenous land management activities, and a philosophy of ecological sustainable development (Northern Territory Government, 2005). There has been little analysis to determine the efficacy of the approach. There are no explicit incentives identified in the plan to encourage integrated management. The approach to encouraging improved land management is penalty based, for example land owners are responsible through statute for rectifying any environmental damage or hazards (reflected in s. 20 *Soil Conservation and Land Utilization Act*- failure to do so shall lead to a $100 fine).

The regulatory framework across the north for land and water management varies, but can be prescriptive for development (see Table 5). Parts of northern Queensland are subject to the *Wild Rivers Act 2005* (Queensland). The *Wild Rivers Act* prohibits economic development in catchments declared as high preservation zones. While in other parts water quality is monitored by respective departments and projects may be assessed by an Environmental Protection Authority (WA and QLD have in place *Environmental Protection Acts* that set and enforce standards for project assessment, while the NT has in place legislation to create an Environmental Protection Authority which acts in an ombudsman role). Generally various treaties such as RAMSAR seek to protect wetlands and could be supported by the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* which can impose processes to protect threatened species.

Table 5: Integration efforts of relevance across northern Australia

	Northern Territory	**Queensland**	**Western Australia**
Policies and Plans .	The NT has a Living Rivers Policy which provides some broad principles on economic development around rivers that are relatively undisturbed. A land clearing moratorium in place in the Daly since 2003 and this was in effect until March 2010 (Northern Territory Government, 2008) Natural Resource Management Strategies seek to link water quality with land management.	In conservation areas in QLD there are various initiatives aimed at improving water quality such as that for the Reef Water Quality Protection Plan which seeks to manage discharge to the Great Barrier Reef. Natural Resource Management Strategies seek to link water quality with land management.	The State Waterways Initiative 2011 which offers general principles on maintaining or repairing the health of rivers, and maintaining their ecological values Natural Resource Management Strategies seek to link water quality with land management.
Legislation	*Environmental Protection Authority Act 2007* established the Environmental Protection Authority which aims to develop standards in monitoring and provide independent advice to government.	*Sustainable Planning Act 2009* encourages a uniform approach to planning and development assessment in the state. It adopts a risk management approach to development and provides an opportunity for community input in planning (Queensland	*Environmental Protection Act 1986* established the Environmental Protection Authority which is an independent statutory that seeks to reduce pollution and improve environmental management. It can issue licenses which prescribe conditions to operate to reduce

		Government 2010). The *Wild Rivers Act 2005* precludes or limits development in areas declared Wild Rivers for their preservation value (because they are pristine or near pristine). Within these areas are high preservation zones which limit the form of land use and development of water infrastructure (such as weirs and dams). *Environmental Protection Act 1994* is focused on pollution and contamination, DERM can issue licenses and approvals for polluting activities, as well as impose penalties for activity that causes serious environmental harm.	pollution and discharge.
Bills	There are guidelines for clearing of native vegetation earmarked to become legislation in the near future. *Native Vegetation Management Bill.*		

While efforts to improve coordination in land and water policy may encourage better informed decision making and collaboration between government and stakeholders, the largest challenge for integration remains in effecting behavioral change among landholders. This is particularly true for re-vegetation for conservation and downstream water quality issues, because the costs are borne by individuals and the benefits shared by broader users. The next section explores existing and potential incentive mechanisms to effect behavioral change among landholders in jurisdictions across northern Australia.

4.2 Potential market based approaches to encourage integration

The use of economic incentives and related instruments to support, or replace regulatory or voluntary approaches to environmental and natural resources management is increasing in importance for public policy. Such incentives include environmental taxes, tax incentives and tax shifting; and, non tax measures such as tradable permits, subsidies, user charges and resource pricing. The benefits of using incentives include increased flexibility, investment in technological innovation and reduced costs in control, monitoring and enforcement (Jack et al., 2008). The agricultural sector has been the focus of many pilot programs to encourage payment for ecosystem services given the potential for landholders to improve conservation and the desire for new economic opportunities among farmers in the developed and developing world (Vatn, 2010; Wunder et al., 2008).

Currently in Australia there are various government sponsored tax incentives to encourage conservation practices, and improved land and water management. For example, under the *Income Tax Assessment Act 1936* (Cth) and *Income Tax Assessment Act 1997* (Cth), primary producers can access ‘landcare operations tax concessions’, for development water infrastructure or mitigating degradation, planting trees, controlling pests and weeds. In Queensland, there is the potential to access non tax incentives ; for sustainable management, such as grants through local NRM or state government bodies (such as from the Vegetation Incentives Program or the Envirofund), grants through the

NatureAssist program, and there are also low interest loans available through the statutory QRAA for landholders.

In terms of voluntary incentive mechanisms, there are private arrangements to improve environmental outcomes in the region. A well documented example is the voluntary contract for a carbon abatement project entitled the 'West Arnhem Land Fire Abatement' (WALFA) project. This arrangement provides that indigenous groups in the area use fire management practices that reduce carbon emissions. The amount of carbon abated is purchased by ConocoPhillips to offset carbon emissions from a local LNG gas plant. This arrangement is seen to be consistent with indigenous values and provides income to a disadvantaged group (Whitehead et al., 2009).

Australia has been at the forefront of developing markets for water and biodiversity, as well as developing a successful salinity offset system for water markets (NWC, 2010b). The pursuit of demand side strategies to overcome environmental problems or to deal with over-allocation of water resources has been a focus of governments. In creating a specified property right that is tradable and valuable, theory presupposes that it becomes economical to protect and enforce this property right (Demsetz, 1967). For example, the development of water markets in southern Australia has led to improved water use efficiency, productivity gains, and has optimized social, economic and ecological objectives (NWC, 2010 a). The use of markets to purchase water for the environment has proven to quite effective in supporting ecological outcomes in times of drought (NWC, 2010 b).

Using market based approaches to integrate land and water management is not well documented in literature. However, integration occurs on different levels that must be coordinated to manage the landscape holistically (Morrison et al., 2004). The use of government-funded incentives, such as the Natural Heritage Trust or the National Salinity Action Plan, have sought to improve coordination in land and water management to enhance conservation outcomes. The non linear impacts of climate change may foster a need for integrated management, also, for climate change response measures the need for

integration may be equally significant. For example, if a carbon regime encourages afforestation to generate sequestration credits, the creation of these monocultures will have implications for water resources and biodiversity. Policy makers should coordinate these activities to prevent perverse outcomes. Market based approaches may augment policy efforts to encourage integration by linking incentives to broader landscape objectives. As Bell and Quiggin (2008) highlight, markets may not always lead to constructive outcomes, and may need to be supported by an effective regulatory framework.

Payment for Ecosystem Services (PES)

PES schemes are increasingly viewed as an efficient way to address environmental problems. PES seeks to price the non market values 'created' by ecosystems (such as clean water and biodiversity) (Costanza et al., 1997). In designing PES schemes there is a need to determine whether the marginal benefit of providing a service (such as water quality for downstream users) is constant. If it is constant a trading regime or tax may be effective- if not, a more complex scheme is required which may impose higher transaction costs (Jack et al., 2008). User pays approaches to PES are seen to be the most effective as they reflect local conditions and are better monitored (Wunder et al., 2008).

Managing tropical savannas across northern Australia for multiple ecosystem services is emerging as an important opportunity in rural Australia and reflects the transition to multi-functionality (Greiner et al., 2009). There are particular conditions required for success in PES schemes. Jack et al. (2008) argue that PES schemes function best when there is greater heterogeneity in costs to the producer of PES, as incentive structures are likely to be optimized (particularly when compared to command and control based approaches). The authors posit that PES may be effective in alleviating poverty where the poorest landholders have lower opportunity costs, but at the same time if there are a high number of small landholders, transaction costs are likely to be higher (Jack et al., 2008). To be effective there must be a willingness to pay by users of the ecosystem service provided (instead of free riding) and political factors may distort PES schemes; the

effectiveness of a scheme is dependent on the political power of those subject to the costs and benefits of PES (Wunder et al., 2008). Incentive structures should encourage innovation through investment in technology, and may facilitate PES providers going beyond that required in legislation, making the PES system most cost efficient over time (Jack et al., 2008).

In northern Australia the potential for PES may be constrained by the fact that there is little scarcity in 'natural capital', meaning there may be little monetary value for much of the ecosystem services provided (Greiner et al., 2008). But there is the potential for landholders (particularly traditional owners) to support weed and feral animal management (Greiner et al., 2008). These services could expand to include payments for soil and water management over the long term (where climate change and development may impose constraints on the landscape).

Tradable Rights Allocation System

A "Tradable Rights Allocation System" is where a threshold is set for environmental impacts at a landscape level (prepared through scientific and community input) and developers are provided an allocation for any impacts in a specific management area (Weber & Adamowicz 2002; Weber 2006). Once this threshold has been met, developers must purchase an allocation from other users in the area (Weber & Adamowicz 2002). This incentive structure is seen as important in encouraging companies to adopt best practice environmental standards, as well as to promote higher levels of coordination between resource developers for their landscape impacts (Kennett, 2005). Such an approach could be applied to northern Australia and include water quality measures and biodiversity outcomes. Importantly, the threshold should be reviewed as the level of knowledge improves on land and water resources across the north, and understanding increases on impacts from climate change.

5. Conclusion

Efforts at integration seek to manage land and water holistically to meet collective landscape level objectives. Integration occurs at many levels, including improving vertical integration in government, coordinating policies, programs and research- to horizontal integration, which provides for greater collaboration across sectors and stakeholders at a regional scale. Integration may be important to address non linear impacts from climate change and the linear impacts from development. Traditional singular focused departments may fall short in addressing the complexities and interdependencies across resources, ecological and human systems, particularly in light of the uncertainties from climate change in the region. A major challenge to integration is encouraging individual landholders to implement practices that reflect the holistic agenda of integration. Incentives for landholders to adopt practices that improve conservation and water quality outcomes are available privately and through government funded initiatives, these may offer one way to improve integration between land and water management across northern Australia.

Across northern Australia there have been initiatives to encourage integration in planning and development assessment, as well as strategies to support consistent policies in resource management. There are examples of incentive mechanisms to encourage improved environmental management- the federal government offers tax incentives for landholders engaged in conservation measures, and there are private carbon abatement agreements such as the WALFA between ConocoPhillips and indigenous landholders in the Northern Territory. Apart from these examples the use of incentives to better align landholder activity with broader landscape objectives is at an early stage across the north. However, the use of PES is anticipated as one way to encourage resilience in rural communities in the tropical savannas (Greiner et al., 2008). Already the use of PES has been earmarked for weed and feral animal management. At present there may be limited demand for ecosystem services across the north, but into the future there may be opportunities to expand PES to include water quality and biodiversity credits if development and climate change fragment the landscape. PES may also provide an

opportunity for indigenous groups to engage in environmental management on their estate. Another approach which may encourage integration of land and water management among landholders is a Tradable Rights Allocation System, which can set a threshold on environmental impacts, and developers can buy or sell an impact allocation according to their needs.

Given the complexity of environmental problems in light of climate change, integration offers a multi-disciplinary approach to natural resource management which is able to respond to changing conditions in an adaptive way. While government may develop structures and strategies to support integration, it is identified as important to offer incentives to landholders that align their land and water use activities with broader landscape objectives to improve outcomes.

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