The Northern Myth revisited:
A resource economics research response to renewed interest in the agricultural development of the Kimberley region

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Abstract
The proposal for a 64,000 hectare expansion of the Ord River Irrigation Area is one example of the renewed interest in agricultural development in the tropical north of the Australian continent. Thirty five years ago Bruce Davidson provided conclusive ‘evidence’ that agricultural development in this region was not financially sustainable unless supported by ongoing government subsidies. He argued that this conclusion was unlikely to change in the future. This paper outlines the controversy over past and proposed agricultural developments and explains the role of agriculture in the Kimberley economy today and in relation to other natural resource based industries. In a time when the paradigm of sustainable development recognises ‘quality of life’ and ‘equity’ as major objectives of development, positive benefit-cost ratios are reduced to being a necessary but not the only sufficient factor in development decisions. The trend towards regional governance provides regional communities with both the opportunity for and difficult task of managing their natural resources sustainably into the future. The Ord-Bonaparte Program, a 5-year interdisciplinary multi-agency R&D program, is designed to support regional governance in the East Kimberley region. Its objectives are to provide relevant data and understanding, and build capacity particularly with indigenous stakeholders. Applied economic research, within an ecological economics framework, plays a critical role within the Program. The paper suggests a range of analytical methods and applications that would make significant contributions to the Program.
1 Introduction: A history of controversy over agricultural development in tropical Australia

Recent proposals for agricultural development in the tropical north west of Australia have re-ignited the public debate on the merits of development in northern Australia. Two proposals in particular have become subject of much public debate: establishing irrigated cotton production in the Fitzroy River Valley through damming of the Fitzroy River and groundwater pumping (Anon 1995) and expansion of the Ord River Irrigation Area (ORIA). This paper looks at the latter proposal more closely and puts it in the context of sustainable regional development. Figure 1 depicts the geographical setting of the area.

![Figure 1: The Ord River Irrigation Area, East Kimberley, WA](image)

Interest in the potential of irrigated agriculture in the lower Ord River dates back even before the 1940s when Kimberley Durack started conducting irrigation experiments in the area. In 1963 the Ord River diversion dam was completed and commercial-scale irrigation commenced (Beech 1975). In 1972 the main dam was opened providing a water storage capacity in Lake Argyle of 10.76 billion m³. The reservoir can supply 2 billion m³ water annually with 98 per cent certainty (Agriculture WA 1997).

In the lead-up to and during the construction of the Ord Irrigation Scheme, a political and public debate raged over its merits. Economic arguments were presented by both supporters and opponents of the scheme. Discrepancies in the economic assessments of the scheme were largely due to the different assumptions about what constituted direct and indirect benefits of the scheme and their valuation (Walker 1973).

A benefit-cost analysis of the Ord River Irrigation Project conducted by the Bureau of Agricultural Economics (1964) concluded that cotton monoculture showed the best prospects for a benefit-cost ratio greater than 1, measured as net return from primary production for private industry in relation to public investment into the irrigation infrastructure. The study
also highlighted the sensitivity of the benefit-cost-ratio to cotton prices. At the time the Commonwealth government subsidised the cotton price through a ‘bounty’ to increase self-sufficiency.

In 1965, Bruce Davidson first published a rigorous assessment of agricultural and pastoral development in tropical Australia with specific reference to the Ord (Davidson 1972). The study concluded that most forms of agricultural development north of the tropic of Capricorn would be inefficient because any agricultural products could be produced south of it more cheaply. He painted the non-economic arguments surrounding the Ord Irrigation Scheme as based on a misguided political agenda. He specifically questioned the role of cotton as a crop given that it could be produced south of the Tropic of Capricorn more cheaply than north of it. The only crop he saw potential for was sugar cane which could be produced in the tropics more cheaply than in temperate Australia (p.126). Davidson concluded that “the future still lies with large dry-land cattle properties operated by companies or individuals with adequate capital, which remain the only economic form of development possible in tropical Australia” (p.287).

Davidson’s study received sustained criticism from supporters of the ORIA development, specifically Patterson (1965) who found cotton “a sound economic undertaking as far as the individual farmer is concerned, irrespective of whether the bounty is removed and the export price prevails” (p.39).

Cotton in the Ord boomed in the mid 1960s. The Bureau of Agricultural Economics (1971) estimated a return on capital and management of almost 20 per cent. However, by 1974 insect pests and the removal of price subsidies had caused cotton production to cease. Ex post, the limitations of some of the economic assessments of the irrigation scheme became obvious.

Other crops also encountered problems due to insect and bird pests, harsh seasonal conditions with daily maximum temperatures during summer of 37°C to 43°C and lack of suitable varieties (McGhie 1987). Vast transport distances for inputs and produce lead to a significant price-cost squeeze (CSIRO 1978). A report by the Department of Natural Resources (1976) states “in view of the present hiatus in development of the Ord Irrigation Project, the [WA] State Government is taking measures to assist in the maintenance of the project, pending the next phase of development. During 1975, settlers are being paid an adequate living allowance provided they undertake to keep unused land in clean fallow, and a subsidy is also being paid in respect of land under cotton last season” (p.73).

A joint WA State and Commonwealth government review of the ORIA in 1978 found that the project had not fulfilled expectations and that the few farmers who were still cropping their lands were operating at a marginal level of profitability despite financial support from the WA government (Young 1979). The review stated that the project had faltered due to its inherent high cost structure and a poor understanding of basic Ord agronomy.

Walker (1973) provides a detailed account and interpretation of the political circumstances and processes surrounding the Ord Irrigation Scheme. He paints the era as having a ‘fetish with development’ (p.94) where it was accepted as axiomatic that northern development was a good thing (p.110) and describes a political process of “disjointed incrementalism based largely on comparisons of marginal gains” (p.112). He tells how the discussion of the scheme was narrowly focused without any debate in either the WA or Commonwealth parliaments and concludes that the case for the scheme rested on very shaky ground. This assessment is supported by Basinski (1990) who describes the decision to construct the Ord Dam politically motivated and premature.
Irrigation agriculture in the East Kimberley

‘Agricultural success’ in the ORIA did arrive in the 1980s with crop diversification, as recommended by Beech (1975) providing an important key to success. The array of crops grown today includes perennial and annual horticultural crops such as bananas, rockmelons, watermelons and mangoes. These crops promise to remain profitable land-use options into the future (Agriculture WA 1999). Other important crops include forage crops, hybrid seed production and other field crops such as chickpeas, soybeans and, more recently, sugarcane. Improved varieties and pest management strategies were other important success factors. Twenty five years after the failure of cotton, new varieties are being trialed.

Irrigation agriculture has cemented its place in the regional economy of the Kimberley. Figure 2 shows steadily increasing production values over the past 16 years with a mean annual growth rate of 21.8 per cent. In the same time period, the area cropped has increased from below 3,000 hectares to close to the capacity of Ord Stage 1 of 13,000 hectares.

Figure 2: Production value of irrigation agriculture in the ORIA (source: Agriculture WA)

Figure 3 encapsulates the diversity of agricultural production. Sugar has become the single most important crop with 3500 hectares harvested in 1998. A mill was established in the area in 1996.

The viability of Ord Stage 1 has reinvigorated the impetus for an expansion of the irrigation area (McGieh 1990). A benefit-cost analysis undertaken in 1994 (Governments of Western Australia and Northern Territory 1994:p.44) anticipated an internal rate of return for the project of 61 per cent. In 1995 the Western Australian and Northern Territory Governments agreed to cooperate in the development of approximately 64,000 hectares for additional irrigation area into the Weaber and Keep River Plains and the Carlton Plains area (Figure 1). This proposed development is called Ord Stage 2 (Kimberley Development Commission
The development of Ord Stage 2 hinges on the financial viability of sugar production. A consortium made up of Wesfarmers Ltd and the Marubeni Corporation holds sole development rights. The consortium intends to develop a further 50,000 hectares for sugar production. Some 15,000 hectares would be developed for intensive horticulture. About 5,000ha of land, all of it likely to be near Kununurra, would be made available to smaller enterprises. A sugar mill and port development would take the cost of the total project to more than $500 million. The new irrigation channel would be built by the West Australian Water Corporation for a cost of about $75 million. Additional financial support by the State would include approximately $10 million for upgrading of ‘sugar roads’ in the ORIA (Kimberley Development Commission and the Dept of Transport 1997).

The two most important factors in the profitability of sugar production are yield and price. Sugar yield is a composite of cane yield and sugar content (CCS). Table 1 shows that the ORIA compares very favourably with competing Australian growing regions in terms of cane yield but sugar content is much lower, resulting in a wide cane:sugar-ratio. Gardiner (1998), Leslie and Byth (1998) and Gardiner and Gardiner (1999) investigate the underlying factors. A cost-benefit analysis undertaken by Mahony and Wegener (1999) of two sugar cane development options in Queensland demonstrates the sensitivity of the proposals’ net present value and internal rate of return to these crucial parameters. Assuming a sugar price of $300/t, neither project provides a sound investment strategy.

The domestic sugar price has declined significantly over the past years as the Commonwealth government price subsidy has been reduced. In addition, the world sugar price is volatile and has been declining for a series of years, caused mainly by an expansion of world production (Figure 4) (Osman 1998, Hannah 1997). Domestic sugar prices for the 1999 harvest have not yet been finalised but growers may receive as little as $255/t (Herbert CANEGROWERS, 2000).

Table 1: Sugar production statistics for key growing regions in Australia

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<tr>
<td></td>
<td>Irrigated (Burdekin) ¹)</td>
<td>Non-irrigated (Herbert) ¹)</td>
<td>Irrigated (n.a.)</td>
</tr>
<tr>
<td>Area planted (ha)</td>
<td>59,545</td>
<td>50,458</td>
<td>66,245</td>
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<tr>
<td>Cane production (t)</td>
<td>7,230,853</td>
<td>4,638,807</td>
<td>5,643,982</td>
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<tr>
<td>Sugar produced (t)</td>
<td>1,071,612</td>
<td>628,558</td>
<td>789,593</td>
</tr>
<tr>
<td>Cane yield (t/ha)</td>
<td>121.4</td>
<td>91.9</td>
<td>85.2</td>
</tr>
<tr>
<td>CCS levels (%)</td>
<td>14.82</td>
<td>13.55</td>
<td>13.99</td>
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<tr>
<td>Sugar yield (t/ha)</td>
<td>18.00</td>
<td>12.46</td>
<td>11.92</td>
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<tr>
<td>Cane:sugar ratio</td>
<td>6.75 : 1</td>
<td>7.38 : 1</td>
<td>7.15 : 1</td>
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¹) Burdekin district is covered by four mills: Invicta, Pioneer, Kalamia, and Inkerman. Herbert district is covered by two mills: Victoria and Macknade. Southern district is covered by seven mills: Fairymead, Milliaquin, Bingera, Isis, Maryborough, Moreton and Rocky Point.

²) from Leslie and Byth (1998)

Figure 4: Development of world sugar price over period 1993-1996 (source: DowJones)
3 Agriculture within a framework of sustainable regional development

Agriculture is only one of a number of natural resource-based industries in the Kimberley. Figure 5 shows that mining (diamonds, gold, iron ore, lead/zinc, oil etc) is the highest revenue earner. Pearling along the West Kimberley contributes the lion’s share to the region’s revenue from aquaculture and commercial fishing but the Bonaparte Gulf, Ord River and Lake Argyle are important sources of fish and prawns. Pastoralism is the oldest industry in the region. It is based on cattle production across the vast Kimberley rangelands.

In 1995, tourism was the third largest natural resource-based industry. The Kimberley has become a major Australian and world tourist destination. In 1996/7 there were approximately 260,000 visitors to the region (ABS 1998). Average annual tourism growth over the previous five years was 5.6 per cent.

Together, nature-based industries account for about 43 per cent of gross domestic product generated in the Kimberley (Department of Commerce and Trade 1996). The regional economy is also highly dependent on public administration, community services and construction.

Agriculture and Fisheries employ about 7.26 per cent of the workforce. Health and community services is the region’s largest employer making up 27.3 per cent of the total Kimberley workforce. More than half of the Aboriginal workforce is employed in this sector (ABS 1998; Kimberley Land Council 1995). In all other sectors Aboriginal people make up a small proportion of the workforce.

The Kimberley population is estimated at about 28,000 of which just over 10,000 live in the two easterly local government areas (Wyndham-East Kimberley and Halls Creek) which cover most of the Ord River catchment (ABS 1998). Mean annual population growth in these shires between 1991 and 1998 was 2.6 per cent. Approximately half the population is Aboriginal.

The Kimberley Economic Development Strategy (Kimberley Development Corporation 1997) encapsulates the vision for future development of the region: “To achieve a dynamic and diverse economy characterised by sustainable and balanced economic and social growth generating an enhanced and prosperous quality of life for all its people” (p.xi). It stipulates that “Maintenance of the region’s unique lifestyle, increased Aboriginal participation in the mainstream economy and management of the sensitive environment are key challenges the
region will face in years to come” (p.ix). The strategy reflects a strong belief that the nature-based industries will be central to the achievement of this vision. Ord Stage 2 and tourism growth are mentioned as key components of the development strategy (p.xiii).

The regional strategy sees economic growth as the key to development. It does acknowledge, however, that development is not solely about increased GDP but also about social and environmental improvements. This thinking is in line with the concept of ‘sustainable development’ (World Commission on Environment and Development 1987: p.43) which acknowledges that increasing quality of life equally embodies satisfaction of non-material human needs and fulfilment of desires and aspirations many of which are directly related to environmental quality.

In his discourse on sustainable development, Gallopín (1996) stresses that more emphasis should be placed on services and technologies rather than resource-dependent industries as carriers of economic growth. He employs a Venn diagram to conceptualise that development, measured as increased quality of life, can occur in the absence of material economic growth and that economic growth does not guarantee ‘development’ as quality of life can be declining specifically if growth is material dependent (Figure 6).

![Figure 6: Venn diagram representing quality of life, material economic growth and non-material economic growth (source: Gallopin 1996)](image)

Sustainable regional development is increasingly becoming synonymous with community governance as there is a trend of transferring responsibilities from federal and state governments to the regional level (Gates 1999).

Under a new ‘partnership framework’ envisaged for Australia, local government holds the key legislative obligation to adopt policies and engage in activities that are consistent with State and national policies and regional plans for natural resource management (National Natural Resource Management Task Force 1999). The thinking is that “the devolution of decision making will enable regional communities to determine the mixture of mechanisms [...] that is most appropriate in their region” (p.39). This reflects the idea that regional
communities have a ‘duty of care’ whereby community and industry groups, landholders, philanthropists and government are stakeholders in the design and implementation of regional strategies (p.45).

Focussing on sustainability at the local and regional level makes sense for a number of reasons. It is the level where changes are seen and felt in an immediate manner. It is the level where consequences of environmental degradation are most acutely felt and where successful intervention is most noticeable (Bridger and Luloff 1999).

A series of federal and State policies and legislation in Australia already encourage regional involvement and governance. Examples are the initiation of catchment management bodies by the States to pursue and implement integrated catchment management in the early 1990s (Johnson et al. 1996) and more recently, an ecosystem-based and consultative process of implementing the federal Oceans Policy. At the local level, new forms of citizen participation in planning are emerging, not only in Australia (Plein et al. 1998).

Regional governance requires a high level of community participation in planning and decision-making processes. The success of regional governance therefore hinges critically on the capacity of stakeholders to engage meaningfully in these processes. Capacity development and social mobilisation are critical steps in empowering regional communities to play the significant role that they have been assigned in regional sustainable development. Research is critical in supporting regional governance.

A shift in the concept and understanding of research and development activities is required to support the paradigm shift at the policy level. The traditional linear research-extension-adoption model whereby people and decision makers were supposed to act rationally - in the sense that they implemented what researchers told them was ‘best’ for them – has been abandoned. In its place a philosophy has emerged of facilitating change and sustainable development by engaging stakeholders, embracing their knowledge and ways of thinking and empowering participants in decision making through a processes of co-learning, negotiation and co-management.

4 Research supporting sustainable regional development in the East Kimberley

The first part of this section (4.1) introduces the Ord-Bonaparte Program (OBP). The program represents a multi-agency interdisciplinary R&D program whose objective it is to support regional governance in the East Kimberley. Section 4.2 outlines the role of ecological economics analysis for sustainable development and highlights some key aspects of theoretical thinking. On this background, section 4.3 details the main ideas for an economics research contribution to the OBP.

4.1 The Ord Bonaparte Research Program

The framework for a large research program has been established for the East Kimberley region. The recently completed business plan outlines the scope of research to be undertaken in the East Kimberley over a 5-year project commencing in July 2000 (CSIRO 1999). The objective of Ord-Bonaparte Program is to empower the people and institutions in this large, sparsely populated, natural resource rich region to manage their natural resources into the
future in a manner that generates economic wealth, addresses issues of inter- and intra-
generational equity and guarantees ecological sustainability.

The concept of the OBP is grounded in a scoping study into sustainable development of
tropical Australia (Johnson et al. 1999). This study highlights the need for research to
integrate technical, institutional and capacity development aspects to address the full range of
current limitations to sustainable development. The ultimate aim is the removal of those
impediments and support the implementation of regional governance.

The OBP seizes the opportunity to “assist the community to plan and achieve sustainable
futures” (CSIRO 1999:p.1). It does so by bringing together existing and new research
activities into natural resource management by a series of local, State and national
organisations and agencies. The program pursues two avenues. The more traditional avenue
is to generate ecological, bio-physical, economic and social data and knowledge and to
provide a scientific understanding of regional development as a complex adaptive system.
The second avenue is to implement processes of learning and participatory action research
that can underpin engagement, negotiation, planning processes and sustainable development
in the region in the long term.

Key issues in the East Kimberley region include irrigation, aquaculture, tourism development
and the integration of Aboriginal stakeholders and the community at large in planning
processes and adjustments of institutional structures to facilitate regional governance
(Johnson et al. 1999). The diversity and importance of these issues highlight the complexity
and difficulty of tasks surrounding sustainable regional development.

Sustainable regional development can be conceptualised as a complex system. A ‘systems
approach’ is needed to track the web real-world problems and issues involved. Systems
analysis is a way of conceptualising and analysing the complexity of sustainable regional
development by looking at the entirety of a problem in its specific context with all its ‘hard’
scientific and ‘soft’ social dimensions. The major analytical objective of systems analysis is
to enable the comparison of alternative options in the light of their possible outcomes
(Checkland 1981).

The systems approach is reflected in the OBP structure (CSIRO 1999). The program is made
up of five ‘objectives’ which reflect areas of research centred around key natural resources
and their management. They are ‘sustainable rangeland systems’, ‘integrated water resource
planning and management’ and ‘sustainable coastal and marine systems’. ‘Aboriginal natural
resource planning and management’ deals specifically with indigenous issues of natural
resource management. ‘Regional resource futures’ develops methods and tools for integrated
regional analysis and program evaluation in an effort to pull the research together in an
interpretive and participatory manner. Each objective is further disaggregated into ‘strategies’
which outline the specific research needs.

Cutting across the five objectives are nine research ‘themes’ which provide methodological
foci and channel stakeholder interest. The themes are ‘biophysical resource inventory’,
‘process understanding’, ‘socio-economic data and understanding’, ‘synthesis and
integration’, ‘participation’, ‘institutions’, ‘capacity’, ‘indigenous social and cultural issues’
and ‘monitoring and evaluation’.

As the OBP approaches sustainable natural resource management as a systems issue, the
natural basic reference area is the catchment. The Ord River catchment area is approximately
100 times greater than the anticipated total ORIA of approximately 80,000 hectares or 800
square kilometres.
The hydrological catchment boundaries, however, are not congruent with what can be called the limits of the ‘social catchment’ relevant to the study, characterised by administrative boundaries and the social, cultural and economic activities and linkages of the people living in this region. The area of the social catchment is about three times the size of the actual Ord River catchment, extending approximately 300 kilometres east-west and 750 kilometres north-south, and covering some 250,000 square kilometres of land.

A large proportion of land is now under Aboriginal control or ownership and more is subject to Native Title claims, future lease take-overs and land acquisitions. This alone makes Aboriginal people a key stakeholder in natural resource management. When Ord Stage 1 was developed, Aboriginal values and interests were completely ignored (Coombs 1989). Head (1999) argues that three conceptualisations were responsible for this. The landscape was deemed ‘empty’ and uninhabited wilderness. Aboriginal people were ‘invisible’. Agricultural land use was idealised and the thought of water running down a river without being unutilised was perceived as ‘waste’. Consultation and negotiations with Aboriginal groups are happening for Ord Stage 2 but proceedings and details are confidential.

Aboriginal people represent about half the population in the Kimberley region and represent a major economic force in the regional economy. A study by Crough and Christopherson (1993) showed that if the value of production of the Argyle diamond mine was excluded from estimates of the regional economy, then spending attributable to Aboriginal people in the Kimberley region represented approximately 40 per cent of the income of the Kimberley regional economy in 1991/92 (p.265).

The OBP acknowledges that increasing communication and information exchange between Aboriginal and non-Aboriginal segments of the community are paramount for long-term planning and management. The program places specific emphasis on Aboriginal involvement in an effort to provide a much better understanding of Aboriginal land-use systems, values and aspirations. Aboriginal people have had a close association with the country for at least 18,000 years (Dortch 1977). Indigenous land-use systems all over the world have attempted to achieve an ecological balance with their environment (Gonzalez 1978). Traditionally, Aboriginal people apply multiple uses to enhance their chances of providing a livelihood and to increase sustainability of the land as a whole. The OBP seeks to specifically build capacity among Aboriginal people so that they can participate more actively in regional natural resource planning and management.

Subsequently, the paper outlines the opportunities that resource, environmental and ecological economic approaches provide to address not only individual natural resource management matters but also the issue of sustainable regional development at large.

4.2 Theoretical considerations for ecological economics research for sustainable development

In the past, much of the debate about (agricultural) development – not only in the East Kimberley - was dominated by efficiency arguments. Benefit-cost analysis was employed to quantify returns on public and private investment and gross-margin analysis determined annual selection of crops. This thinking, of course, is much too narrow to support arguments about ecologically sustainable development including human welfare and equity.

Sustainable regional development, as mentioned above, can be conceptualised as a complex system. Systems are groups of interacting, interdependent parts linked together by exchanges of energy, matter and information. Complex systems are characterised by strong interactions
between the parts, complex feedback loops that make it difficult to distinguish cause from effect, and significant time and space lags, discontinuities, thresholds, and limits (Costanza et al. 1993). Analytical frameworks tend to become more complex as their scope is increased (i.e., more issues are included into the analysis). Increasing scale, (i.e., the geographical and temporal boundaries) can have the same effect. Scale and scope are key criteria in modelling complex systems along with generality, realism, precision and resolution. Importantly, these features are interrelated.

Ecological economics provides a suitable conceptual and analytical framework for investigating the issue of sustainable regional development as it explicitly attempts the integration of multiple disciplines. Ecological economics can be seen as the “study of compatibility between human economy and the environment in the long-run” (Martinez-Alier and O’Conner 1996:p.154). This acknowledgment of interdependence between economic and natural systems is the core defining feature of ecological economics Common (1996).

The OBP can be seen as an ecological economic research approach as it pursues, in an applied sense, the goal of ecological economics to “enhance the capacity of the community to develop a ‘shared vision’ as the prerequisite to generating momentum, supported by policies, to move toward ecologically sustainable development” (Meadows 1996:p.117). Ecological economics can contribute not only to the conceptualisation and analytical stages of the OBP. It also needs to play a critical role in the implementation of the research by assisting the regional stakeholders to translate the outputs of scientific inquiry into political action (Leff 1996:p.78).

The inquiry into sustainable development requires a ‘trans-disciplinary framework’ According to Costanza et al. (1996:p.1) this framework must integrate three core elements:

- A practical and shared ‘weltanschauung’ and vision of sustainable society;
- Methods of analysis and modelling which address the questions and problems relevant to achieving the vision; and
- Institutions and instruments to implement the vision.

Four notions are seen as fundamental to an ecological economics approach (p.2):

- The economy is a sub-system of the ecosystem. Consequently there are ecological and social limits to economic growth.
- The vision of sustainable development is one of high quality of life and fair distribution of resources.
- A precautionary approach to development is required as the earth is a complex system and outcomes of activities are largely uncertain and may be irreversible.
- Institutions should be pro-active and device simple, adaptive and implementable policies based on sound systems understanding.

Quantitative analysis plays a key role in generating the knowledge and understanding required to underpinning this process. The models applied need to fulfil three core conditions (Constanza et al. 1996:p.7). They must:

- Acknowledge biophysical constraints on economic systems;
- Analyse interactions between ecological and economic systems; and
- Account for inherent uncertainties in behaviour of complex adaptive systems.

O’Conner et al. (1996) are concerned with the ‘plurality of legitimate perspectives’. “Any natural system that is of interest to use has properties that affect our welfare. Our scientific
priorities as well as our descriptions of these systems and their relation will reflect our interest, our ethical preoccupations, and our passions” (p.228).

Institutional and cultural variety and alternative assumptions about social preferences and environmental dangers must be accounted for in an analysis. This can be achieved, for example, by comparative scenario simulations and sensitivity testing. Even so, there are limitations to the validity of the analysis. O’Conner et al. stress that “in the view of emergent complexity the spectrum of future environmental effects unfolding over space and time is not specifiable in advance, and a probability distribution cannot meaningfully be identified” (p.229). They design a typology of uncertainty according to two criteria (Figure 7). The first relates to the supposed probability distribution of events and the second to the reliability or confidence placed in probabilistic knowledge propositions.

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<th>reliability</th>
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<td>imprecise</td>
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Figure 7: Classification of (un)certainty (adapted from O’Conner et al 1996)

Martinez-Alier and O’Conner (1996) regard questions on ‘ecological distribution’ as a key aspect of ecological economics (p.161). What is the distribution of benefits of present patterns of natural resource use and environmental management? Which social groups carry the principal burdens of unwanted side-effects, for example from the loss of environmental amenities resulting from environmental degradation? How are they distributed across societies, space, and time? How are these asymmetries valued?

Ekins (1996) sees economists’ tasks shifting away from a normative role of defining goals to a role of advising “on ways of minimising the costs of achieving [sustainability] within an institutional framework that recognises the pervasive and profound, if uncertain, links between ecosystems and the socio-economy, and the dangers of attempts at partial maximisation or optimisation in such a context” (p.147).

Tainter (1996) stresses the importance of embracing historical knowledge. “Historical knowledge is essential to sustainability. […] Rarely will the experience of a lifetime disclose fully the origin of an event or a process. […] No program to enhance sustainability can be considered practical if it does not incorporate such fundamental knowledge” (p.61). Gupta (1996) points out the specific importance of indigenous and local ecological knowledge systems. “Indigenous visions of how the world works will be essential in generating the technological and institutional innovations for sustainability” (p.92).
4.3 Applied economics research within the Ord-Bonaparte Program

There are a wide variety of qualitative and quantitative economic methods that can meaningfully contribute to a better vision for sustainable regional development, improved understanding of the underlying regional processes, a sound grasp of the options for development and their consequences, and a comprehension of the policies that can be employed to achieve the vision.

Traditional resource and environmental economics approaches have been criticised for being narrow and focussed. Ekins (1996) argues that commonly applied modelling and econometric techniques are limited in their usefulness by strict assumptions, including perfect knowledge and competitive market and by non-inclusion of unpriced environmental effects and socio-cultural matters. He argues that optimal resource allocation and extraction trajectories derived from such analysis therefore run the risk of defining ecological un-sustainability.

This criticism is certainly valid in the broader sense, but traditional methods such as input-output analysis, benefit-cost and gross margin analysis, and mathematical programming models at farm and regional scale will always contribute valuable insights into aspects of what is a complex regional system (Van Kooten 1993). The challenge is bring various techniques together and provide an interpretation of the results within a consistent ecological economics framework. With this in mind, the paper goes on to suggest different methods of economic analysis – without claiming to be inclusive – towards an integrated economics research framework for the OBP.

Input-output analysis is an important tool in assessing an industry’s contribution to a region. It can trace the resources and products within the regional economy and show, for example, the interdependence between various sectors of the economy or the effects of government spending (Midmore 1991). It can identify monetary and employment multipliers as well as leakage out of the regional economy (Robinson 1997, Hubbard and Brown 1979). Mining, for example, is the single largest industry in the East Kimberley in terms of revenue generated. However, its contribution to the region through employment and monetary multiplier would be rather small due to the structure of the industry. Mining operations tend to fly in/out staff from capital cities and house them in purpose-built settlements. As far as the region is concerned, they ‘import’ inputs and ‘export’ outputs. Input-output analysis can quantify the true monetary and employment multiplier effects of different (natural resource based) industries and thereby assist the process of prioritising alternative directions of development for the regional community.

Modified forms of input-output analysis and combinations with dynamic systems models and scenario analysis have been applied to make explicit the link between the level of economic activity and corresponding ‘ecological footprint’ or impact on the environment (Bicknell et al. 1998; Schembri 1999).

The question of whether Ord Stage 2 will go ahead - assuming approval of the development proposal by WA and NT environment protection agencies and successful negotiations with indigenous stakeholder - is a commercial decision and will not be influenced by the OBP. Most likely, a decision will be taken before the OBP commences in July 2000. However, the development will have significant environmental implications, which the OBP has a role in evaluating.

Ord Stage 2 would be the largest consumer of irrigation water, which, as a consequence, is poised to become a scarce resource. Mathematical programming techniques can be employed to show optimal spatial and temporal water allocations, quantify water-use efficiency and
quantify trade-offs between different users of water, different irrigation areas, different crops and different irrigation techniques. By introducing stochastic elements into the analysis, the implications of climatic risk can be examined. These results can inform the process of allocating water entitlements between different user groups and users. Scarcity of water will force the introduction of a consumption-based price for water that can be determined through marginal cost analysis. In combination with farm-scale modelling ‘best practice’ can be supported beyond current understanding (Kimberley Development Commission 1998).

More trade-offs at the catchment level warrant investigation. Issues of efficient and ‘optimal’ use of land and water resources and treatment of externalities are best investigated at this scale and numerous economic studies have taken a catchment approach (eg. Greiner 1997). Irrigation occurs on a relatively small area within the Ord River valley but it affects the entire catchment. Water supply is reliant on the runoff generated in the upper catchment which is predominantly grazed. The impact of irrigation, through changed river flow, nutrient and sediment export, etc. is felt further downstream in the coastal and marine areas where recreational and commercial fishing are important industries. A catchment-scale understanding of the hydrologic system and its economic dimension is essential. An dynamic environmental-economic model covering the entire catchment area is required to provide an economic interpretation of the hydrologic system, the relationship between various natural-resource dependent industries and potential trade-offs between them.

There are a wide variety of modelling techniques available to deal with dynamic systems. Among them are simulation modelling, neural networks and agent-based modelling. Depending on the purpose of the individual modelling exercise, specific techniques might be favourable (Costanza et al. 1996/2).

Non-market valuation will play a critical role for the economic research within the OBP. Non-market values are an important part of the total economic value of an ecosystem, specifically to indigenous people. Gatzweiler (1999) applied contingent valuation to elicit the value of ecosystem services attributed by indigenous people. He used the willingness-to-accept-compensation approach in the context of local indigenous ecological knowledge by embedding it into the specific institutional and value environment.

Other applications of non-market valuation methods can be envisaged in the field of tourism. Visitors may receive a substantial consumer rent from visiting the East Kimberley region. Tapping into the consumer surplus may provide opportunities for the region to better manage some areas and facilities. Also, new insights into visitor demands and expectations may generate the impetus for new tourist-related enterprises, specifically in the field of indigenous tourism.

Valuation techniques can be further employed to explore the relationships between different industries and resource users. To which degree are nature-based industries complementary? Are there resource conflicts? What is their nature and how large do people perceive them to be? Examples of questions are: Is there a complementary relationship between irrigation agriculture and tourism? What are the various aspects of that relationship? Is there a potential conflict between aquaculture development in Lake Argyle and residential water use in Kununurra?

All of the presented methods make a contribution to the community’s ability to establish a vision for their region and define the regional objectives for sustainable development.

The second important aspect is examining how the vision might best be achieved with the help of policies and institutions (Lockwood 1999). Scenario analysis combined with dynamic
modelling plays an essential role to that end. The effects of an exhaustive range of different policy instruments, in isolation and combination, need to be calculated and carefully assessed and interpreted. Combined with institutional analysis and design, this leads to a definition necessary structures and adaptive process. On this foundation, existing institutions and policies can be re-aligned and new ones developed to support long-term sustainable natural resource management.

In terms of providing the stakeholders with tools so that they can assess for themselves the relative merits and problems with alternative development scenarios and the potential array of outcomes, the focus must be on (1) transparency of input data and assumptions, (2) ease of use and (3) assistance in result interpretation and presentation. Within the second criterion it is important that the stakeholders are able to look at the system from their perspective. Perspectives differ between individuals and groups depending on their experience, purpose and weltanschauung. Different perceptions represent ‘mental models’ or systems views which are relevant to the stakeholders concerned (Senge 1992; Ison et al. 1997). After all, the research will only be long-term relevant if the tools are appreciated as an essential means of learning about sustainable development and continuously used by stakeholders. Learning is the key towards successfully dealing with a rapidly changing human and natural environment and advancing from a re-active stance to one of developing pro-active natural resource management strategies within a framework of sustainable regional development.

Conclusions

The agricultural development of Tropical Australia has been a contentious issue and economic arguments have been at the centre of the political debate. This is exemplified in the case of the Ord River Irrigation Scheme in the East Kimberley. With the proposed expansion under Ord Stage 2 expected to go ahead shortly, it is shown that the proposal is isolated from a broader view of sustainable regional development. While agriculture plays an important role within the regional economy, it is but one natural-resource-based industry. Ongoing devolution of federal and State responsibilities for natural resource management to regional communities on the one hand and a global shift in thinking towards sustainable regional development on the other hand create a unique opportunity for regional governance. This brings with it the onus on communities to develop the capacity to plan into the future and manage their resources in a manner that supports sustainable development. It is argued that research and development play a crucial role in building capacity within the community and stakeholder groups so that they can substantially participate in the learning, visioning and policy setting processes that underpin regional governance. The Ord Bonaparte Program is an interdisciplinary multi-agency R&D initiative which will take place in the East Kimberley over the next 5-6 years. The OBP is, in itself, an experiment in applied research and development for implementation of ecologically sustainable development at the regional level. It is shown that the philosophy behind the OBP is grounded in systems thinking and congruent with concepts emerging from the field of ecological economics. Socio-economic research will be a core component of the research program. The paper suggests a series of economic analytical techniques and methods that, in combination, will provide an essential contribution to developing strategies towards sustainable regional development.

References


