



Department of  
**A**GRICULTURE  
**F**ISHERIES &  
**F**ORESTRY -  
**A**USTRALIA



**A submission to the Productivity Commission research  
study into the social and economic importance of industries  
in the Great Barrier Reef catchment and measures to  
address declining water quality**

By

**Agriculture, Fisheries, Forestry – Australia**

**September 2002**

# TABLE OF CONTENTS

<b>This Submission</b>	<b>1</b>
<b>1. Introduction</b>	<b>2</b>
<b>2. The Commonwealth's Role in Natural Resource Management</b>	<b>3</b>
<i>Agriculture, Fisheries and Forestry - Australia</i>	3
<i>Great Barrier Reef Marine Park Authority</i>	4
<b>3. Economic and Social Importance of Industries in the GBR</b>	<b>5</b>
<i>Sugar Industry</i>	5
Economic Factors	5
Environmental Issues	6
<i>Beef Industry</i>	7
<i>Fisheries and Aquaculture</i>	8
Fisheries	8
Aquaculture	8
<b>4. Policies and Measures to Address Declining Water Quality</b>	<b>12</b>
<i>Council of Australian Governments Water Reform Framework</i>	12
<i>The National Water Quality Management Strategy</i>	13
Australian and New Zealand Guidelines for Fresh and Marine Waters 2000	14
Australian Guidelines for Water Quality Monitoring and Reporting	15
Guidelines for Urban Water Management	15
Guidelines for Sewerage Systems	15
Guidelines for Effluent Management	15
Guidelines for Sewerage Systems – Use of Reclaimed Water	16
Effluent Management Guidelines	17
NWQMS Guideline Documents	18
<i>National Action Plan for Salinity and Water Quality</i>	18
<i>Natural Heritage Trust Extension</i>	20
<i>Reef Water Quality Protection Plan</i>	21
<i>The National Land and Water Resources Audit</i>	21
<b>5. Social and Economic Approaches to Managing Natural Resources</b>	<b>23</b>
<i>Social Approaches to Managing Natural Resources</i>	23
Social Impact Assessment	23
<i>Economic Approaches to Managing Natural Resources</i>	24
<b>6 Primary Industries Research by Land and Water Australia</b>	<b>26</b>
<b>7. Quantifying National and International Values</b>	<b>28</b>
<i>Projections to 2020</i>	28

## **This Submission**

This submission provides background to the Productivity Commission (PC) on Commonwealth policies and initiatives managed by Agriculture, Fisheries & Forestry - Australia (AFFA) to underpin the sustainable development of agricultural industries in regions adjacent to the GBR lagoon. This submission has a particular focus on the two main areas of research for the PC research study. They are:

- the social and economic importance of rural industries in the region, and
- the costs and benefits of various options to address declining water quality.

This submission will examine the economic and social importance of agricultural industries in the region, which include the sugar, cattle, fisheries and aquaculture industries. In addition to this assessment the submission provides information on COAG Water Reform Framework and programmes, such as the National Action Plan for Salinity and Water Quality (NAP) and the Natural Heritage Trust extension in addressing declining water quality in the region. This submission also identifies potential economic, social and environmental methodologies and research that can:

- assist in understanding the interaction between industries the environment and the community; and
- identify priorities for addressing water quality challenges in the GBR lagoon.

# 1. Introduction

Agricultural industries in Queensland, particularly the sugar and cattle industries, have provided a significant contribution to the development of the State. For example, over 90 percent of the Australian sugar industry and 49 percent of the cattle industry is located in Queensland. These industries amongst others are important to the social identity and economic viability of rural regions in Queensland.

The sugar industry, which was first established in the 1860's near Bowen, stretches 2100 km's along the Queensland coastal region from Mossman to the north to Brisbane to the south. The industry consists of over 6500 farms and has expanded from 323 000 ha in 1990 to 424 000 ha in 1999 (Australian Sugar Year Book). The sugar industry, which exports the majority of its product, provides employment directly to cane growers and millers and indirectly to other related industries such as road and rail transport and the fertiliser industry.

Of similar economic and social importance to the development of Queensland is the cattle industry, which was established in Queensland in the late 1800's. In contrast to the typical small family run sugar properties, the Queensland cattle industry is made up predominately of large properties producing 49 percent of the cattle in Australia and exporting over 60 percent of its production to overseas markets. Overall the beef industry is a major contributor to Australian rural incomes contributing 17 percent of farm production value and 14 percent of export earnings (Meat and Livestock Australia).

Together these two industries have a major influence on the environment and more specifically water quality entering the GBR. Extensive cattle grazing of native pasture in upstream catchments and the clearing of native vegetation in coastal catchments for sugar expansion has increased sediments and nutrients in major rivers entering the waters of the GBR. Based on scientific research published in the *GBR Catchment Water Quality Action Plan* there has been between a 4 to 9 percent increase in sediments entering the reef since 1850.

Recognition of these increased sediment loads and the threat this has for the ecology of the reef has led to the Commonwealth and Queensland Governments agreeing to the development of the Reef Water Quality Protection Plan, which includes joint actions to address water quality. These actions will be developed through consultation with all major stakeholders in the region. They will be a feature of the natural resource management planning process being developed through the National Action Plan for Salinity and Water Quality (NAP) and the Natural Heritage Trust extension.

## 2. The Commonwealth's Role in Natural Resource Management

Under the Australian Constitution, primary responsibility for land and water, and therefore natural resource management, rests with the Governments of the States and Territories. Therefore the Commonwealth's role is primarily one of national leadership and participation in forums such as Natural Resource Management Ministerial Council, the Primary Industries Ministerial Council and the Environment Protection and Heritage Ministerial Council (formerly the Agriculture and Resource Ministerial Council of Australia and New Zealand (ARMCANZ) and the Australian and New Zealand Environment and Conservation Council (ANZECC)) to progress natural resource management and environmental protection issues. The Commonwealth is also largely responsible for overseeing implementation of international conventions to which Australia is a party, such as those related to the World Heritage Areas of the Great Barrier Reef and the Wet Tropics of Queensland.

At the national level there is a range of broad-based Commonwealth policies and programs with implications for water resource management, including those associated with:

- the Council of Australian Government's National Water Reform Framework;
- the National Competition Policy;
- the National Action Plan for Salinity and Water Quality;
- the Natural Heritage Trust extension;
- the development of the Reef Water Quality Protection Plan; and
- the National Land and Water Resources Audit.

In recent years the Commonwealth has made a significant contribution to improved water management through:

- its contributions to the Council of Australian Government's National Water Reform Framework;
- development and implementation of the National Water Quality Management Strategy; and
- investments through the programs mentioned above and in other initiatives such as the *Environmental Management Systems Incentives Program* the *Clean Seas Program* and the *Urban Stormwater Initiative*.

### *Agriculture, Fisheries and Forestry – Australia*

Commonwealth responsibility for major aspects of natural resource management, agriculture industries and fishing industries rests with AFFA. The portfolio interests of AFFA include lead responsibility for the Commonwealth Government's water policy reforms under the Council of Australia Governments. AFFA also has joint responsibilities with Environment Australia (EA) for managing the implementation of the Natural Heritage Trust and the National Action Plan for Salinity and Water Quality. AFFA is also working with EA and the Queensland Government to develop and implement the Reef Water Quality Protection Plan.

## *The Great Barrier Reef Marine Park Authority*

The lead agency responsible for managing the GBR World Heritage Area is the Great Barrier Reef Marine Park Authority (GBRMPA). This is a statutory body established under legislation by the Commonwealth. The GBRMPA is the principal adviser to the Commonwealth and Queensland Governments on policy development and management of the GBR and its goal is to provide for the protection, wise use, understanding and enjoyment of the reef in perpetuity through the care and development of the GBR Marine Park.

### **3. Economic and Social Importance of Industries in the GBR**

#### *Sugar Industry*

##### Economic factors

Economic data reveals that the sugar industry is important industry for national wealth and export income. The annual export earnings for the sugar industry averaged over \$1.1 billion in the three years to 2001/02 and increased slightly to \$1.2 billion in 2001/02. This is considerably down from the \$1.7 billion in export sales recorded in 1997/98.

The sugar industry is also important to local economies in rural Queensland. For example, the median weekly income of sugar farmers and farm managers in Queensland's key sugar growing areas as reported by the census range from a high \$2,000 amongst a small group of farmers and farm managers in Cairns-Barron (N=29), and just over \$1,200 for a much larger number of producers in Hinchinbrook (675) and Whitsunday (220), to less than \$800 in Kolan (94).

From an employment perspective the latest available national employment by industry figures (1996 census), reveals that the Australian sugar industry employed some 15,583 people across the country. Six out of ten people were involved in the sugarcane growing side of the industry, with manufacturing accounting for 41% of people employed in the industry. Most of these activities are concentrated in Queensland, which accounts for 92% of all employees in the industry.

50 percent of employment in the Queensland sugar industry is concentrated in four main areas. They are Burdekin (N=2,328), Mackay (N=2,249), Hinchinbrook (N=1,589) and Johnstone (N=1,076). Other main areas are Mirani, Whitsunday, Burnett, Sarina and Cardwell. Together these areas account for 75% of Queensland sugar industry.

The importance of the sugar industry in a regional context is illustrated in the Hinchinbrook, Mackay and Mirani areas. More than 80 percent of people involved in agriculture in these areas work in the sugar industry. The industry also provides employment to two out of three farmers and agricultural workers in Sarina, Burdekin and Whitsunday.

Forty percent of employment in the sugar industry is related to manufacturing activities across the country's 30 raw sugar mills (26 in Queensland) and four refineries (2 in Queensland). This translates into some 6,300 jobs Australia wide, of which 5,700 are in Queensland. Burdekin (932), Mackay (871) and Hinchinbrook (642) top employment numbers in this industry (.

## Environmental Issues

The National Action Plan for Salinity and Water Quality (NAP) focuses on developing and implementing integrated Natural Resource Management (NRM) regional plans to address salinity and water quality in 21 priority regions across Australia (both the NAP and the NHT extension are to be implemented through a regional approach). This includes parts of coastal Queensland where the sugar industry is located in the Burdekin-Fitzroy and Lockyer-Burnett-Mary NAP Regions. As such, activities which promote sustainable practices and protect the environment by members of the sugar industry and thereby assist in ensuring and securing a future for the sugar industry may be eligible for assistance where these activities are included in NAP regional plans.

The National Heritage Trust (NHT) National Landcare Program has funded projects to improve resource management in a number of catchments. These projects, some of which are completed, are wide ranging, from direct on-ground activities such as developing drainage schemes in Tully to the provision of information to assist decision making for growers on sustainable soil, water and fertiliser management in the Herbert River.

The Innisfail District growers were the driving stakeholders in the development of the Johnstone River Catchment Management Plan. The Plan had involvement of all land users and interested community groups (Source: NRM submission to IA Sugar).

In 1996 the Northern Queensland (NQ) Joint Board commenced a regional revegetation planning project covering the Board's 10 member Local Governments. Plans were undertaken on a catchment-by-catchment basis linking in with previous works and the strong Integrated Catchment Management movement in the region.

To achieve a holistic approach to vegetation management, the plans cover all resource management aspects and activities needed for sustainable natural resource management. This includes weed and pest management, riverbank stabilisation utilising rockwork and other non-engineering solutions in addition to revegetation - hence the name Catchment Rehabilitation Plans.

Revegetation Plans completed by NQ Joint Board include the:

- Annan-Endeavour Rivers Catchment Rehabilitation Plan.
- Barron River Catchment Rehabilitation Plan.
- Douglas Catchments Rehabilitation Plan.
- Herbert River Catchment Rehabilitation Plan.
- Russell-Mulgrave Catchment Rehabilitation Plan.
- Tully-Murray Rivers Catchment Rehabilitation Plan.
- Upper Mitchell Rehabilitation Plan.

Other revegetation plans for the Wet Tropics include the:

- Johnstone River Catchment Revegetation Strategy.
- Trinity Inlet Revegetation Plan (Source: NQ Joint Board).

Following an independent environmental audit on the industry in 1995 the sugar industry developed its own initiatives to address natural resource issues. These initiatives include tree planting (over 1 million trees planted on sugar properties) and a Code of Practice introduced in 1998.

To support uptake of the Code of Practice amongst sugar farmers the Sugar Research Development Corporation funded the development of COMPASS a self-assessment framework for individual farmers. COMPASS is supported by the CANEGROWER organisation, which is encouraging its members to undertake environmental assessment of their properties. Farmers in the sugar industry have also changed their land management practices accepting green cane trash blanketing to minimise erosion (95% uptake north of Mackay) and over 2000 growers participating in the Queensland Rural Water Use Efficiency Initiative. The industry has committed to improving water use efficiency by 6% with 70% of irrigators using Best Management Practices by 2003.

### *Beef Industry*

The beef industry is an important resource-based industry in the GBR region and together with other industries such as tourism contributes to a diverse economic base in the region. Meat and Livestock Australia Ltd (MLA) is responsible for the R&D and promotion of the Australian beef industry. MLA has undertaken research and developed programs aimed at improving the productivity and profitability of the beef industry by ensuring it is environmentally responsible and remains sustainable. Some of MLA's programs are detailed below:

Reducing sediment and nutrient export from grazed land in the Burdekin catchment for sustainable beef production. This project focuses on providing a better process for understanding the impact of grazing on an entire catchment. The response to animal impact will be used as the basis for refining guidelines and recommendations for improved grazing management to:

- ensure the beef industry's long-term economic sustainability by retaining or improving the productive capacity of the soil resource base through reducing on-site water and nutrient loss;
- meet national and international standards of sustainable beef production by reducing detrimental off-site impacts due to sediment and nutrient delivery; and
- enhance the beef industry's capability to model grazing management impacts on the soil and water resource base across a range of scales to respond to broader community concerns.

The industry is also examining the incorporation of practical measures to assist conservation of biodiversity within sustainable beef production in northern Australia. This project takes a whole property perspective, to enable producers and other stakeholders to consider trade-offs that occur between animal production and conservation of biodiversity. Ecological research is identifying how property management influences plant diversity and ecological functioning of pastures. This new information will be used to refine management principles and indicators of ecological health and biodiversity status.

Northern Production Systems is another overarching program encompassing pasture improvements, weed control, grazing management and the environment as key aspects of northern cattle production. The North Australia Program works with the Northern Beef Industry to evaluate and fund on-property research and development that will increase productivity and profitability as well as ensuring long-term sustainability of the beef industry in northern Australia of which the GBR is a part. By increasing profitability, the beef industry can better meet the demands placed on it from the wider community as well as ensuring the industry's future.

The Commonwealth is also providing funding for other projects, matched by funds from the MLA, to address the cattle industry and natural resource management issues in northern Australia. These projects include:

- developing, implementing and evaluating fire management of woody vegetation in the Gulf region, which is a collaborative effort between landholders and woodland ecologists;
- assessment of the value of trees in sustainable grazing systems in collaboration with the Queensland Department of Natural Resources and Mines;
- Wambiana grazing trial, which is developing principles and testing options to assist producers to more effectively manage pasture utilisation in terms of animal production and resource condition; and
- Vegmachine – extending the integrated rangeland monitoring information to industry.

## *Fisheries and Aquaculture*

### Fisheries

Under Offshore Constitutional Settlement arrangements between the Commonwealth and Queensland Governments management of many of the commercial fisheries adjacent to the Queensland coast are the responsibility of the State Government. Management of the recreational and charter fisheries is also the responsibility of the State Government.

The Commonwealth Government is responsible for joint management with the Queensland Government of the GBR through the GBR Marine Park Authority. This World Heritage Area is a portfolio responsibility for the Minister for Environment and Heritage.

The management of offshore fisheries is the responsibility of the Australian Fisheries Management Authority (AFMA). In Queensland these fisheries include the:

- Coral Sea Fishery;
- Eastern Tuna and Billfish Fishery; and the
- Torres Strait Fisheries

### Aquaculture

Aquaculture is the fastest growing primary industry in Australia, increasing in value by an average of 13 per cent a year since 1990. In 2000-01, the gross value of

Australian aquaculture production was \$746 million, about 30 per cent of Australia's fisheries production. Major aquaculture products are southern bluefin tuna, pearls, Atlantic salmon, oysters, prawns, trout, mussels, silver perch and barramundi.

The industry directly employs more than 7,000 people and indirectly more than 20,000 people. During the past four years employment in aquaculture has grown by 260 per cent. It is Australia's sixth fastest growing occupation and the fastest growing occupation within primary industries.

Exports account for more than 60 per cent of the value of Australian aquaculture. Pearls and southern bluefin tuna are the main exports. Asia is Australia's major market for fisheries and aquaculture exports.

The aquaculture industry is largely based in regional Australia, and makes a significant and positive contribution to regional development. Aquaculture adds diversity to a region's economic base and creates demand for educational and training services, extension services, infrastructure and locally produced goods.

In the last seven years Queensland has experienced more than a doubling of the value of aquaculture production. The farm gate value of the aquaculture industry in Queensland for 2000/01 was \$54 million with the total number of full time equivalents directly employed in aquaculture being 592 for this same period.

The prospects for the future growth in the aquaculture industry is good and based on the established record of sustained growth in the industry over the last ten years, as well as anticipated investment in research and commercial farms over the next two to three years. To achieve \$2.5 billion in annual sales by 2010, the industry's target, the current industry growth rate of 13 per cent per annum will need to be maintained.

As the aquaculture industry expands environmental and institutional issues have arisen which need to be addressed to achieve a sustainable industry. These issues include:

- Water quality – The water quality available for use in aquaculture after upstream use. The appropriate discharge levels for aquaculture farms into catchments and marine environments.
- Regulatory duplication – Duplication between State and Federal Government legislation and policies (QLD EPA regulations, EPBC Act, GBRMPA Aquaculture regulations).
- Access to Resources – Access to suitable sites and broodstock from wild fisheries.
- Lack of coastal planning that identifies approved aquaculture sites in advance of industry growth.

Aquaculture is highly regulated in Queensland through the legislative and planning process which includes the *Environmental Protection Act 1994* and *Fisheries Act 1994* and *Integrated Planning Act 1997*, *EPBC Act 1999* and the *GBRMPA*. These regulations are to some extent designed to manage declining water quality adjacent to the GBR.

The Aquaculture Industry Action Agenda and the Prime Ministers Science, Engineering and Innovation Council sustainable aquaculture paper have both addressed the ecologically sustainable development of the aquaculture industry (<http://www.affa.gov.au/aquaculture>).

The Australia New Zealand Environment and Conservation Council (ANZECC), superseded by the NRM Ministerial Council, water quality guidelines provide a framework for making local reference guidelines. These guidelines have been provided for the protection of aquaculture in Australia and New Zealand and are for influent water quality only. Effluent water quality from aquaculture is not considered in these guidelines as these questions are dealt with through State and Commonwealth Government legislation, regulations and guidelines in Australia.

The Queensland Government is also currently developing guidelines for aquaculture, which will be locally relevant and include specific catchments. It is conceivable that the implementation of these guidelines will have implications for the environment, water quality and the management of aquaculture production.

A National workshop entitled Sustainable Australian Aquaculture: Practical solutions to Achieving Ecologically Sustainable Development, was held in July 2002. The Australian Fisheries Managers Forum has endorsed the workshop and likely outcomes are:

- A National ESD Framework to be adopted as a conceptual framework for aquaculture.
- The development of the ESD Framework for aquaculture, which is included within the current FRDC ESD reporting and assessment Sub-program process.
- An Aquaculture ESD Reference Group be constituted with expertise from the existing ESD Reference Group and include increased representation from the aquaculture industry.
- That the Aquaculture ESD Reference Group identify / clarify the possible applications of the ESD Framework to industry, government and non-government organisations.
- That EA identify the possible benefits of engaging with industry on national triggers for issues of national environmental significance.

Some of the research gaps identified in the aquaculture industry include:

- potential economic and social value of this emerging industry for regional communities;
- lack of data on the actual environmental impacts of aquaculture compared with other industries;
- development of national guidelines for ESD;
- an ESD framework;
- innovative ESD/production technologies; and
- national mapping for site availability and suitability for ESD aquaculture.

Options for addressing these gaps include the Commonwealth Government's response to the recommendations made for the Aquaculture Industry Action Agenda and the

Prime Ministers Science, Engineering and Innovation Council, through the Fisheries Research and Development Corporation, CSIRO, BRS, ABARE and by collaborating with State and Territory Governments through the Primary Industries Ministerial Council and its sub-committees.

## **4.Policies and Measures to Address Declining Water Quality**

### *Council of Australian Government's National Water Reform Framework*

The Council of Australian Government's (COAG) Water Reform Framework is the key driver of national water reform. The Framework was formulated in 1994, to implement a range of reforms some of which specifically set out to achieve efficient and sustainable water industry and arrest widespread natural resource degradation.

In April 1995 all Australian Governments reached agreement on a National Competition Policy (NCP) for Australia. Under this agreement the Commonwealth undertook to fund on-going National Competition Payments to each State and Territory over the 1997-98 to 2005-06 period, on the basis of reform goals achieved by those jurisdictions. These payments are subject to each State or Territory making satisfactory progress against their NCP and related reform obligations. This agreement included reforms to the water industry and other sectors such as energy, transport and gas. Linking water reforms to the competition payments has drawn the water industry more closely into the micro economic reform process.

The COAG Framework tackles these areas by explicitly linking economic and environmental issues within a coherent and integrated reform package. Measures within the package include:

- water pricing regimes based on the principles of full cost recovery and consumption based pricing;
- separation of water property rights from land title;
- providing for permanent trading in water entitlements;
- specific provisions for water for the environment;
- water service providers to operate with a commercial focus;
- planning for conjunctive use of surface and groundwater resources (where appropriate);
- improved institutional arrangements; and
- public consultation and education.

One of the key COAG water reform achievements has been the requirement for jurisdictions to recognise and formally acknowledge the legitimate water needs of the environment.

The Queensland Water Act offers an example of legislative reform to the water resource planning process and specific recognition to the needs of the environment. The Queensland Act sets the framework for the allocation and sustainable management of water to meet Queensland's future water requirements, including the protection of natural ecosystems and security of supply to water users. The Act provides a statutory basis for Water Resource Plans which are developed by consulting with the community and stakeholders to identify water allocation and management issues within river catchments. Amongst other planning elements the

Water Resource Plans specify the establishment of water entitlements and environmental flows.

A series of changes to water management associated with national water reforms have and will continue to assist in improving water quality. Implementation of the National Water Quality Management Strategy (NWQMS), the requirement under State/Territory legislation to provide environmental flows in planning arrangements, reforms to water pricing (which is substantially completed in urban but not rural areas) coupled with the expansion of water trading have positive implications for national water quality including water quality entering the GBR. For example, environmental flows should improve dilution effects in water systems that have high levels of salinity, acidity and other contaminants such as phosphorous and nitrogen. The rising value of water resources, which are partly due to implementation of these reforms, is also encouraging greater water use efficiencies including re-use schemes on farms. This reform measure should assist in improving water quality entering catchments by minimising off-farm drainage and water wastage.

While progress in implementing reforms has varied between jurisdictions, the achievements in implementing the National Water Reform Framework to date should not be underestimated. Policy and institutional settings are now significantly different to those in prior to 1994. Furthermore, there has been substantial progress in the commercialisation of water authorities and the establishment of water entitlements and trading arrangements.

### *National Water Quality Management Strategy (NWQMS)*

Australian Water Resources Council and ANZECC jointly launched the NWQMS in 1992 to provide a nationally consistent approach to water quality management. In 1995 the NWQMS was linked to the COAG Water Reform Framework. The National Competition Council assesses the NWQMS implementation by the States and Territories.

The NWQMS is one of the key tools to be used by the NAP and the NHT extension to develop catchment management plans and address water quality entering the GBR. The national guidelines consist of 21 technical papers providing guidance on many aspects of the water cycle including ambient and drinking water quality, monitoring, groundwater, rural land and water, urban stormwater, sewerage systems and effluent management for specific industries.

The guidelines have been developed by involving all major stakeholders including Commonwealth and State agencies, industries and the general community. The adoption of nationally consistent guidelines provides a shared national objective while local implementation allows for flexibility to respond to differences at regional and local levels, such as differing political, social and natural conditions. The following guidelines documents are relevant to the PC research study because they relate directly to the development of catchment management plans and the assessment of options to address water quality entering the GBR lagoon.

**Australian and New Zealand Water Quality Guidelines for Fresh and Marine Water 2000**

The revised version uses new data and research to outline objectives, principles and a management framework for fresh and marine water quality. The key focus of these guidelines is on:

- outlining the principles, objectives and philosophical basis underpinning the development and application of the guidelines;
- outlining the management framework recommended for applying these guidelines to the natural and semi-natural marine and freshwater resources;
- providing detailed default numerical water quality guidelines and approaches to developing and using numerical guidelines in different water bodies; and
- providing advice on designing and implementing water quality monitoring and assessment programs (note that this is discussed in much greater detail in the *Australian Guidelines for Water Quality Monitoring and Reporting* below).

These guidelines do not set up mandatory national standards for jurisdictions, they do, however, provide a framework for recognising and protecting water quality for the full range of environmental values including:

- aquatic ecosystems;
- primary industries (eg irrigation, stock drinking and aquaculture);
- recreation and aesthetics; and
- drinking water.

The guidelines document cover the development of water quality guidelines for different water bodies and associated water quality objectives. The guidelines document has additional reference volumes covering more detailed discussion on aquatic ecosystems and primary industry issues. They also come with databases and software to assist users.

## Guidelines for Water Quality Monitoring and Reporting

This document provides a benchmark comprehensive framework for the monitoring and reporting on the quality of fresh and marine waters and groundwater. The framework covers all aspects of monitoring programs, including:

- setting monitoring program objectives;
- designing monitoring programs;
- field sampling;
- laboratory analysis;
- data analyses and interpretation and
- reporting and information dissemination for monitoring programs.

These guidelines use four case studies to illustrate the whole monitoring process for river, groundwater estuarine and marine environments.

It is envisaged that these national guidelines will inform and guide the development of the local area water quality action plan, which is one of the proposed actions under the Reef Water Quality Protection Plan. They will also be useful in providing a uniform system for gathering water quality data and analysis and in identifying specific regions where water quality may be impacting on the GBR.

## Guidelines for Urban Stormwater Management 2000

These guidelines are designed to assist managers to identify objectives for stormwater management and to integrate management activities at the catchment, waterway and local development level. These guidelines also outline:

- why we need to manage our stormwater;
- what are the challenges;
- how to involve the community;
- the management tools available; and
- preparing, implementing and monitoring Stormwater Management Plans.

These guidelines encourage improvements to stormwater management in Australian cities, which can provide a much needed water resource for agriculture and industry. The increasing utilisation of this resource can minimise the volume of polluted stormwater being released to rivers, estuaries and coastal waters in Queensland. Stormwater is known to contain elevated levels of suspended solids, nutrients, micro-organisms, heavy metals and organic materials all of which could have a detrimental effect on the ecology of the GBR lagoon.

Utilisation of stormwater in Queensland cities involves not just new infrastructure to manage and divert flows but also a change in attitude, from viewing stormwater as a nuisance to be disposed of quickly to seeing stormwater as a resource. The storage and use of stormwater is being tried in other States, which have water shortages such as South Australian, however, the main incentive for cities in coastal Queensland, to utilise stormwater is related to stormwater impacts on the environment. Stormwater is one of the contributors to poor water quality entering the reef and options to manage this resource sustainably are worthwhile pursuing (the main coastal cities adjacent to the GBR are Cairns, Thuringowa/Townsville, Mackay, Rockhampton, and Gladstone ranging from a population of 26000 to 140,000).

## Guidelines for Sewerage Systems

The five part series of the NWQMS *Guidelines for Sewerage Systems* covers the whole cycle of the sewerage system. Amongst the principle aims of these guidelines is the desire to return greater volumes of treated wastewater and biosolids to the environment in an acceptable way to the community after considering environmental and human health and cost factors. These five guidelines also provide national principles for managing trade waste within the sewerage system and principles for minimising and managing sewerage system overflows.

## Guidelines for Sewerage Systems - Effluent Management

These guidelines outline the options available for managing effluent, including methods to minimise waste by re-using effluent in particular land applications and discharges to coastal and inland waters. There is also a section on public health and the environment examining the various potential health risks associated with re-use options. The main objectives for effluent management are:

- to avoid risks to health;
- to maximise the reuse of effluent (for both the value of the water and the nutrients);

- to minimise both adverse impacts to land and the contamination of surface and ground waters when used in land applications; and
- to maintain agreed water quality objectives for receiving waters when discharging to surface waters.

The water quality objectives will usually be decided after considering:

- existing ecosystems;
- the environmental values or uses of the receiving water; and
- environmental flows.

The majority of treated sewage effluent in Queensland coastal settlements is discharged to waterways adjacent to the GBR. Several coastal sewerage treatment plants use secondary treated effluent for land irrigation, and the Queensland Government will require discharges to coastal waters to achieve appropriate nutrient removal by 2010.

### Guidelines for Sewerage Systems - Use of Reclaimed Water

This document proposes guidelines for a national approach to foster the use of reclaimed water in a way that safeguards public health and provides community and environmental benefits. The guidelines can be used by water resource managers and sewerage authorities to develop reclaimed water schemes and as a reference for the community, industry and environmental groups. The focus of this document is on:

- the type of re-use;
- the level of treatment;
- reclaimed water quality;
- reclaimed water monitoring; and
- controls.

Given the growing pressure on water resources it is surprising that the overall proportion of wastewater reclaimed in Australia is small (171GL or 11% of sewage plant effluent in 2000 – Dillon, P. in *Water*, April 2001, p18). However, the 171GL figure is growing at 28 GL/y and there are many examples of small scale reclaimed water use in operation, in golf courses, race tracks, sports ovals, turf farms, nurseries, wetlands and for agricultural production. The overseas trend is for a much greater use of water from this source particularly in the relatively dry States of Florida and California in the United States. The trend for re-using reclaimed water is also expanding in those areas of Australia with few water resources and subject to low or unreliable rainfall. Coastal regions in Queensland are not in this category, however, similar incentives for using stormwater also apply to wastewater, i.e., minimise nutrients and contaminants entering the GBR lagoon.

Although not featured here the draft NWQMS Guidelines for Sewerage Systems – Biosolids Management advocates the use of treated sewage effluent (biosolids). Biosolids are increasingly being acknowledged as an important resource, which could be diverted to agricultural and recreational use to address elevated marine nutrient levels from both point and non-point sources. Biosolids are being successfully used on golf courses in Port Douglas and in other Queensland coastal regions.

## Effluent Management Guidelines

There are six effluent management guidelines within the NWQMS covering the dairy, piggery, wool treatment, tanning and wineries and distilleries. The majority of these industries are located in rural areas with a few in the GBR region.

One of the key aims of the effluent guidelines is to ensure a nationally consistent approach to effluent management throughout Australia. These guidelines are sufficiently flexible to serve as a framework for developing codes of practice and general industry agreements as well as a range of legislative controls that apply in Australia.

Another aim of the effluent guidelines is to help eliminate or minimise the impact of effluent on the quality of our water and land environments and encourage sustainable effluent reuse. Therefore the effluent management guidelines have been designed to assist industries, regulators and planning authorities in undertaking site assessments, designing effluent management and treatment systems, monitoring and reporting, and developing contingency measures.

Collectively the water quality and environmental objectives of the effluent guidelines are to:

- maintain the environmental values of surface and groundwater, including their ecology, by minimising the discharges of effluent containing organic matter, nutrients, salts or chemical constituents;
- minimise any adverse effect of effluent addition to land, which may lead to a degradation of soil structure, salinisation, waterlogging, chemical contamination or erosion; and
- avoid off-site nuisance or interference with amenity, such as odours associated with inappropriate or poorly operated waste treatment process.

The main emphasis of these national guidelines is water quality protection. In general the national guidelines are less relevant for particular locations than regional and local government guidelines, which take account of specific environmental and social circumstances.

It is also apparent that where agricultural based industries exist they can have a high-localised impact on water systems. These guidelines are therefore important for managing specific industries and when developing regional plans, and for processes which set out to achieve integrated regional catchment management.

## NWQMS: Guidelines and documents

<b>Policies and Process for Water Quality Management</b>	
1	Water Quality Management - An Outline of the Policies
2	Policies and Principles - A Reference Document
3	Implementation Guidelines
<b>Water Quality Benchmarks</b>	
4	Australian and New Zealand Guidelines for Fresh and Marine Water Quality
5	Australian Drinking Water Guidelines - Summary
6	Australian Drinking Water Guidelines
7	Australian Guidelines for Water Quality Monitoring & Reporting
<b>Groundwater Management</b>	
8	Guidelines for Groundwater Protection
<b>Guidelines for Diffuse and Point Sources</b>	
9	Rural Land Uses and Water Quality
10	Australian Guidelines for Urban Stormwater Management
11	Guidelines for Sewerage Systems - Effluent Management
12	Guidelines for Sewerage Systems - Acceptance of Trade Waste (Industrial Waste)
13	Guidelines for Sewerage Systems - Sludge (Biosolids) Management
14	Guidelines for Sewerage Systems - Reclaimed Water
15	Guidelines for Sewerage Systems - Sewerage System Overflows
16a	Effluent Management Guidelines for Dairy Sheds
16b	Effluent Management Guidelines for Dairy Processing Plants
17	Effluent Management Guidelines for Intensive Piggeries
18	Effluent Management Guidelines for Aqueous Wool Scouring and Carbonising
19	Effluent Management Guidelines for Tanning and Related Industries in Australia
20	Effluent Management Guidelines for Australian Wineries and Distilleries

### *The National Action Plan for Salinity and Water Quality*

In response to the growing appreciation of the significance of dryland salinity and water quality issues, the Prime Minister released the National Action Plan for Salinity and Water Quality in October 2000. The Action Plan takes a targeted approach to tackling these critical issues across Australia, in partnership with States and Territories and the community.

The key objectives of the Action Plan are to:

- prevent, stabilise and reverse trends in dryland salinity affecting agricultural production, the conservation of biological diversity and community assets and infrastructure (such as houses, roads etc); and
- improve water quality and secure reliable water supplies for human, agricultural and industrial uses and for the environment.

The centrepiece of the Action Plan is support for communities and landholders to undertake action directed towards meeting targets on salinity and water quality in twenty key catchments or regions which are most affected by salinity and water quality problems. The Plan builds on the successes of the Decade of Landcare program and the Natural Heritage Trust and supplements the Murray Darling Basin Salinity Strategy and other State strategies.

To achieve its objectives, the Action Plan calls for:

- setting targets and standards for natural resource management;
- development and implementation of integrated catchment plans by regional communities, with support from governments;
- technical and scientific support, skills training, information, and market incentives; and
- changes to land, water and vegetation policies in the States and Territories to complement the integrated catchment plans.

The National Action Plan (NAP) supports targeted action to improve land and water management in targeted catchments/regions. The NAP relies heavily on partnerships between governments and communities to lay the foundations for effective integrated natural resource management.

Central to the NAP is the provision of funding to community based regional bodies for the development and implementation of integrated NRM Plans within the identified NAP Priority Investment Regions. These integrated NRM plans are the basis for funding under the NAP. They will build on existing work already done in these regions, include targets and standards for integrated natural resource management, have strong accountability arrangements, and be developed by the regional bodies based on best available information and science. The Plans require accreditation by the Commonwealth and respective State governments prior to joint Commonwealth/State funding being provided to the regional bodies.

Under the NAP, Queensland is developing a series of projects intended to provide strategic support to the Regional Bodies responsible for developing NRM plans in the NAP priority investment regions/catchments. These include four Reef catchments – the Mary, Burnett, Fitzroy and Burdekin catchments. Projects include the provision of environmental (particularly for salinity, water quality) and socio economic data.

The Water Quality projects are intended to ensure community based water quality planning through the NAP is linked to State water quality and management projects. A key project is the development of frameworks and processes for setting and monitoring targets. These projects also include a range of activities intended to incorporate social and economic assessments into NAP planning and implementation.

Dr Allan Dale of the Department of Natural Resources and Mines is leading the socio-economic program.

The NAP priority investment regions for which NRM plans are being developed are predominantly catchment based. As the regional bodies established for NAP purposes are also responsible under the Reef MoU for developing the Reef water quality targets and for developing actions to meet these targets, an analysis which takes a whole of catchment approach for any nor all of these four catchments would be of great value.

The data aggregations suggested by the PC research study appear to be inconsistent with those used for natural resource management issues, particularly NRM planning. NRM planning generally adopts a catchment approach as reflecting the more realistic environmental (if not the social, economic or administrative) “compartmentalisation”. The relative incompatibility of data sets/data aggregations across disciplines will continue to create difficulties as we move towards integrated approaches to regional planning. Given, as stated above, the role of the NAP regional bodies in achieving the outcomes sought through the Reef Water Quality Plan, it would be useful if a real effort were made to undertake data analysis in a form consistent with regional planning approaches.

The information being sought through this question will be of great benefit to the NAP regional bodies in developing NRM plans and investment strategies.

### *The National Heritage Trust Extension*

The Natural Heritage Trust is a major Commonwealth natural resource management initiative, with \$2.5 billion committed since its inception in 1996-97. The Trust was extended in the May 2001 Budget for a further five years, from 2002-03 to 2006-07.

Funding under the Trust will be through four programs. These are Landcare, Bushcare, Rivercare and Coastcare:

- The Landcare Program will invest in activities that contribute to reversing land degradation and promoting sustainable agriculture.
- The Bushcare Program will invest in activities that contribute to conserving and restoring habitat for the native flora and fauna, which underpin the health of the landscape.
- The Rivercare Program will invest in activities that contribute to improved water quality and environmental flows in river systems and wetlands.
- The Coastcare Program will invest in activities that contribute to protecting coastal catchments, ecosystems and the marine environment.

Trust funds will be delivered at three levels: national investments, regional investments, and a local component, the Australian Government Envirofund.

Regional investments will become the principal delivery mechanism for the Trust and will follow, where appropriate, the model developed for the NAP. Under this model, investment is made on the basis of an accredited, integrated natural resource

management plan developed by the region, including those adjoining the Great Barrier Reef lagoon.

The plans that are accredited for Trust investment will identify all of the natural resource management issues in a region, develop actions to address these issues and then select the most important issues for action. They will also set resource condition and management action targets based on agreed national standards.

In the NAP priority regions the delivery of Trust and NAP funding will be integrated as far as possible. The plans being developed in the 21 priority regions under the NAP will also be used for the purposes of Trust investment in those regions

National investment at this level will cover priorities addressing activities that have a national or broad-scale, rather than a regional or local, outcome. This will include activities at a sub-national level, such as State-wide activities as well as those that cross over State and regional boundaries. It will also address matters of direct Commonwealth jurisdiction, such as those relating to Commonwealth waters.

The Commonwealth Government is committed to spend at least \$350 million of Trust funds directly on measures to improve water quality over the five years to 2006-07.

### *The Reef Water Quality Protection Plan*

The Commonwealth and Queensland Government signed a memorandum of understanding (MOU) on August 13 2002, agreeing to a joint approach to protecting the GBR from land-based sources of pollution. A feature of the MOU is the draft Reef Water Quality Protection Plan (the Plan), which identifies proposed actions to improve water quality and protect the GBR from land-based sources of pollution. These proposed actions, of which the PC research study is one include:

- Productivity Commission research study.
- Chemical Review of Diuron.
- Identifying the major sediment sources within GBR catchments.
- Negotiating an Eco-efficiency agreement with the fertiliser industry.
- Promoting development and adoption of Codes of Practice for agricultural industries.
- To promote and implement with local cane boards guidelines on granting new or increased cane production areas.
- Develop a local area water quality action plan.

It is probable that funding for most of these proposals will come from the NAP and NHT extension. It is also probable that new proposals will arise from the current consultation process on the draft Plan being undertaken with stakeholders and the community. It is expected that community consultation will be completed in December 2002 and the Plan to address water quality finalised soon afterwards.

### *The National Land and Water Resources Audit (NLWRA)*

The NLWRA is a Natural Heritage Trust funded program providing assessments of land, vegetation and water resources in Australia. Of these assessments *The*

*Australian Water Resources Assessment 2000* provides a comprehensive review of the state of surface and groundwater resources in Australia. Some of the key results of this assessment, which have some significance in the Queensland context, are:

- 26% of Australia's surface water management areas are either close to or overused when compared to sustainable flow regime requirements;
- Australia's surface water quality data are limited with 28% able to be assessed for any of the key variables-turbidity, salinity or nutrients;
- 241 of 325 surface management water units and 265 out of 538 groundwater management units are at low to medium levels of development; and
- overall water use in Australia increased to 23 300 GL in 1996/97 up from 14 600 GL in 1983/84 (*Australian Water Resources Assessment 2000*).

The 2000 assessment identifies approximately 75% of the water used in Australia is for irrigated agriculture with around 20% for urban and industrial purposes. The Audit illustrates the growth in water use has mostly been in the irrigated agriculture sector, however, in the urban/industrial sector water use has risen from 3060 GL in 1983/84 to 4673 GL in 1996/96, a 53 percent increase in use.

## 5. Social and Economic Approaches to Managing Natural Resources

### *Social Approaches to Managing Natural Resources*

Over the last 150 years the sugar and cattle industries have played a significant part in the social and economic development of regions adjacent to the GBR. These industries have to a significant degree influenced local community attitudes to managing natural resources. In more recent times new industries have been established and become important to the region, such as tourism, fishing and aquaculture. These new industries, which are largely dependent on healthy ecosystems, combined with a greater scientific understanding of the threats to the environment from unsustainable land use practices have led to changed local attitudes towards the environment.

With these changed attitudes and an improved understanding of the ecology of the reef it is probable that adjustments to how natural resources are managed for agricultural production will be necessary to protect the environmental values of the GBR. There are various social research methodologies for examining the impact on communities from changes to access and condition of natural resources.

### Social Impact Assessment (SIA)

Social Impact Assessment (SIA) is a multi-disciplinary field that draws on sociology, psychology, geography, political science and the humanities. SIA differs from more typical approaches because it is anticipatory, enabling the consequences of an action, such as measures to address water quality on the farm, to be measured or assessed before that action has taken place.

SIA is an important assessment methodology/tool providing communities with a role in decision-making and the development of particular policies that will affect them. SIA could have a particular relevance in regions adjacent to the GBR as proposals and actions to change land management practices through the NAP, the NHT extension and the Reef Water Quality Action Plan are currently being developed through a community consultation process.

There are 10 key steps in the SIA process. They include:

1. Public involvement
2. Identification of alternatives
3. Baseline conditions
4. Scoping
5. Projection of estimated effects
6. Predicting responses to impacts
7. Indirect and cumulative impacts
8. Changes in alternatives
9. Mitigation
10. Monitoring

Bronstein and Vanclay (*Environment and SIA*, 1995) summarise these steps into three main tasks; assessment and prediction; mitigation and monitoring; and audit and

analysis. The steps and the principles of SIA place an emphasis on the social dimension and how particular policies or programs will impact on people's way of life, their culture and their community. SIA differs from economic assessments because it emphasises the non-monetary effects of an action, assessing the costs and benefits in societal terms.

In Australia SIA has been used in the national context for the Australian Regional Forest Agreement. Queensland has also used SIA to examine the social impacts of potential changes in commercial access to and use of fishery resources. NSW has also used SIA to examine the social and economic impacts in water management decision-making.

SIA is about to be used by the Murray-Darling Basin Commission, which is seeking interest in designing and implementing an SIA that engages stakeholders on the proposal for providing environmental flows to the Murray. This SIA will focus on the impacts of the proposed policy interventions (based on three environmental flow levels) compared to a no-change scenario upon stakeholder's way of life, culture and community. For more information on this SIA see D., Coakes, *SIA: A policy makers guide to developing SIA programs* Bureau of Rural Sciences, June 1999.

SIA is one of a number of measures that can be used to assess the values and priorities society place on natural resources. The PC should recognise that non-financial world heritage values, particularly in multi-use areas in the GBR region are not readily amenable to numerical quantification. These include existence values, values to science and ascetic values. However, it should be noted that notwithstanding a comprehensive approach, such as SIA, methodologies to attempt to calculate such values are highly contentious.

### *Economic Approaches to Managing GBR Water Quality Issues*

Developing a strategy to manage water quality in the Great Barrier Reef (GBR) lagoon will require consideration of a multitude of tradeoffs that characterise many natural resource management problems. For example, there are tradeoffs between:

- upstream and downstream uses;
- production and conservation;
- who pays and who benefits; and
- different generations because we may accept costs today for benefits that will only be realised in the distant future.

Debate about these tradeoffs has intensified following the release of end of catchment water quality targets by the Great Barrier Reef Marine Park Authority. In particular, the implications of achieving these targets for different groups of resource users, and society as a whole, are poorly understood.

Effective intervention to manage water quality in the GBR lagoon will have three key prerequisites (adapted from Bell, Mues and Beare 2000). First, the actions to improve water quality in the GBR must be technically feasible to introduce. That is, there is a need to identify those changes to management or land use that can deliver a tangible reduction in the nutrient load being exported to the reef.

Second, the actions will have to pass a cost-benefit test to ensure they lead to an overall improvement in net social welfare. Several questions are likely to arise as you undertake this cost-benefit test. For example, what are the economic values affected by the water quality problems? How will a reduction in nutrient exports from a particular catchment change affect these economic values? Does water quality have to be improved beyond a certain threshold level before there are any tangible benefits in terms of the ecosystem response and the economic values of the GBR? What is the cost of achieving the improvements in water quality necessary to deliver ecosystem improvements?

Rather than use proxy measures of environmental outcomes that are unrelated to the economic values of the GBR, the biophysical relationships need to underpin the economic analyses. That is, scientific research that predicts the ecosystem response to improvements in water quality then need to be extended to consider the effect of the changes on the economic values of the changes.

The third prerequisite is the development of a viable policy instrument to create the incentives to implement the desired mitigation options.

In recognition of the potential value of integrated economic-biophysical analysis, ABARE has recently begun a project titled 'Integrated Assessment of Resource Management at the Catchment Scale'. The project will be undertaken as a series of case studies that will be used to highlight how biophysical information can be analysed in an economic framework to provide useful guidance on priority natural resource management interventions.

The Burdekin catchment in Queensland has been selected as the first case study. The objectives of the Burdekin case study titled 'Regional Communities and the Environment: A case Study of the Burdekin Catchment', have been fashioned to provide direct input to the three-step framework discussed above. Specifically, the objectives are to:

- provide an overview of the economic values underpinned by the natural resource base in the Burdekin catchment;
- summarise the inter-relationships between the use and conservation of natural resources in the region;
- estimate the effect on different resource users and local rural communities of changes in natural resource management practices in the region; and
- identify priority actions, policy options and information gaps that may be addressed as part of a regional natural resource management strategy for the Burdekin.

This case study is scheduled for completion by late 2002. ABARE will work closely will the Productivity Commission to ensure the results of the case study are available for incorporation into the Commission's final report (Bell R., Mues C. and Beare S. 2000, 'Salinity management: some public policy issues in the Murray Darling Basin', *Proceedings of the National OUTLOOK Conference*, Natural Resources volume 1, 29 February - 2 March, Canberra).

## 6 Research into Primary Industries by Land and Water Australia

This section will look at research into improving the efficiency of land management practice in areas adjacent to the GBR by Land and Water Australia. Land & Water Australia is a statutory research and development corporation within the Commonwealth AFFA portfolio and was established as the Land and Water Resources Research and Development Corporation in 1990 under the Primary Industries and Energy Research and Development Act in 1989.

Land & Water Australia is responsible for research and development (R&D) aimed at the productive and sustainable management of the land, water and vegetation resources underpinning Australia's primary industries and regional communities. The following research projects have been chosen to provide examples of research aimed at assisting primary industries to achieve national sustainable land use and are applicable to areas adjacent to the GBR

*Water and Nitrogen Balance in Agricultural Systems in the Wet Tropics of North Queensland:* by K.L. Bristow, P. J. Thorburn, C. A. Sweeny and H. P. Bohl a part of the Redesign of Australian Plant Productions Systems Program.

This research focused on the need to understand water and nutrient fluxes in both natural and agricultural systems, so that new and better design principles can be developed to improve agricultural systems in the wet tropics of Queensland. These systems can cause problems because they are out of balance with the natural environment and leak water and nutrients causing soil salinisation, acidification, erosion, rising water tables and decreasing river and groundwater quality some of which enters the GBR lagoon.

One of the key findings of the study was the challenge faced by agricultural producers to improve the matching of supply of water and nutrients to meet the actual needs of plant production systems. This research is particularly relevant to the sugar and horticultural industries which use large quantities of fertiliser, especially nitrogen, phosphorus and potassium and other agro chemicals as input into crop production.

*Acid Soil Action: Invest for Your Soil Now and for the Future* funded by Land & Water for the Soil Acidification Program.

This publication also comes with a kit to guide to farmers in assessing acid soil problems and decide on appropriate management strategies. Soil acidification has implications for water quality entering the GBR because it increases dry land salinity, increases nitrate pollution of groundwater, reduces vegetative cover and accelerates water runoff and erosion and increases the decline of pH of waterways and aquatic environments. This publication and the adoption of the kit have particular relevance to Queensland which has nearly 10 million hectares of highly acidic soils (pH ca 4.8) and over 30 million hectares of moderate acidity (pH ca 4.9 – 5.5).

*Principles and Tools for Protecting Australian Rivers* by N Phillips, J Bennett and D Moulton

This report provides principles and guidelines on the assessment process for determining the ecological values of waterways and the basis for defining conservation plans. Two management plans for Queensland Rivers, the Mary and Barron are used as case studies to illustrate the application of protection principles and tools for protecting river systems.

A review of case studies indicates that planning processes are almost solely targeted at the restoration of degraded systems, and not at the protection of significant assets (values). This finding probably reflects a strong emphasis on use values in planning processes and may have implications for less easy to assess values such as ecosystem and ascetic values strongly associated within regions such as the GBR and the Wet Tropics.

## 7 Quantifying National and International Values

The GBR acts as a major draw card for international visitors and its value to Australia would be greater than the value of tourism within the GBR regions. Many international tourists to the GBR visit other areas of Australia, although this effect would be difficult to quantify. In order to calculate economic importance from a national perspective, it may be appropriate to recognise that some profits go offshore to overseas investors.

In addition to the local, regional, state and national levels, it may be appropriate to consider the economic values of the GBR in an international context. As part of an economic valuation the PC could estimate the total expenditure by international visitors to the reef (as an illustration of international values), including expenditures that may not accrue to the nation - for example airfares. It is clear, however, that as a world heritage site international values, and potential deterioration of those values, are difficult to quantify.

### *Projections to 2020*

Soils formerly under richly diverse tropical rainforest are not very fertile and when cleared, are highly erodable. With high rainfalls, these exposed soils are also subject to significant leaching. It is likely that without remedial measures soil depletion will affect productivity by 2020 and impact on farm viability (noting that there are already high nutrient requirements because of low fertility and leaching).

The projection of values of agricultural industries to the year 2020 could consider whether farm management practices may change over the interim to reduce loss of soil and nutrients, and the effect of such practices on ongoing viability (sustainability). It may be appropriate for the PC to examine a couple of different scenarios according to different natural resource management regimes. For example, a projection of productivity under the status quo - including discussion of whether productivity can be sustained under current practices; and projections under more ambitious natural resource management investments for sustainability. Current investments in improved natural resource management would be likely to be evidenced by improved productivity by the year 2020.

The PC could note that increasing competition in global commodity markets and continued subsidies by major producers may continue to exert downward pressure on world prices. Perhaps the PC could also make projections under different assumptions about the world-trading environment.