

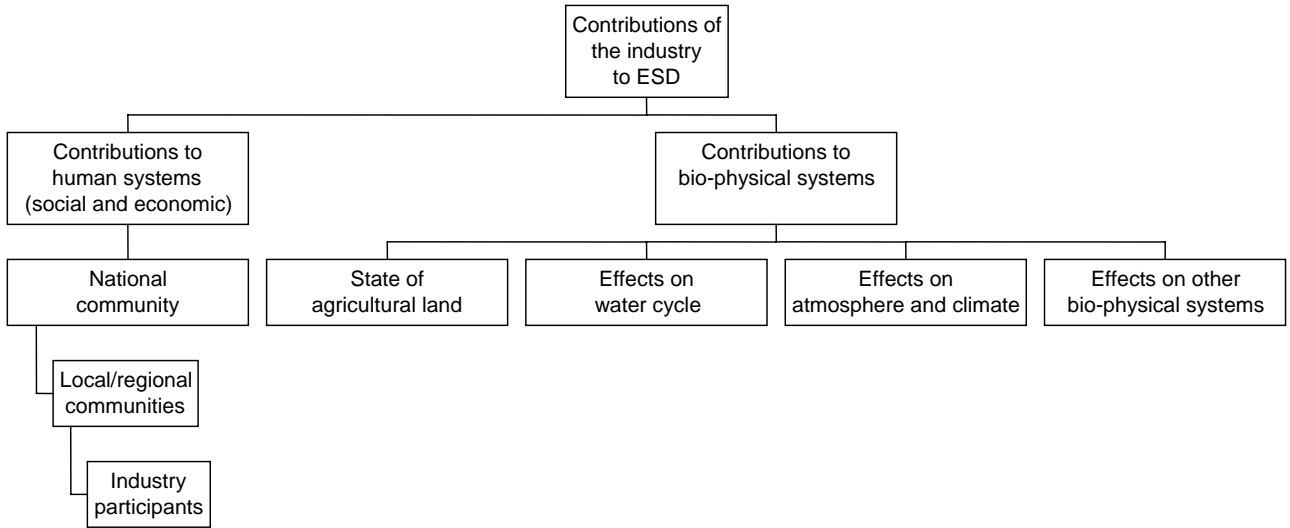
Appendix E: Generic profile material

This appendix provides profile material that is common to most industries. It consists of the generic component trees showing how the contributions of an industry to ecologically sustainable development have been subdivided into components. Individual components are hyperlinked. Clicking on the component takes the user to information on that component.

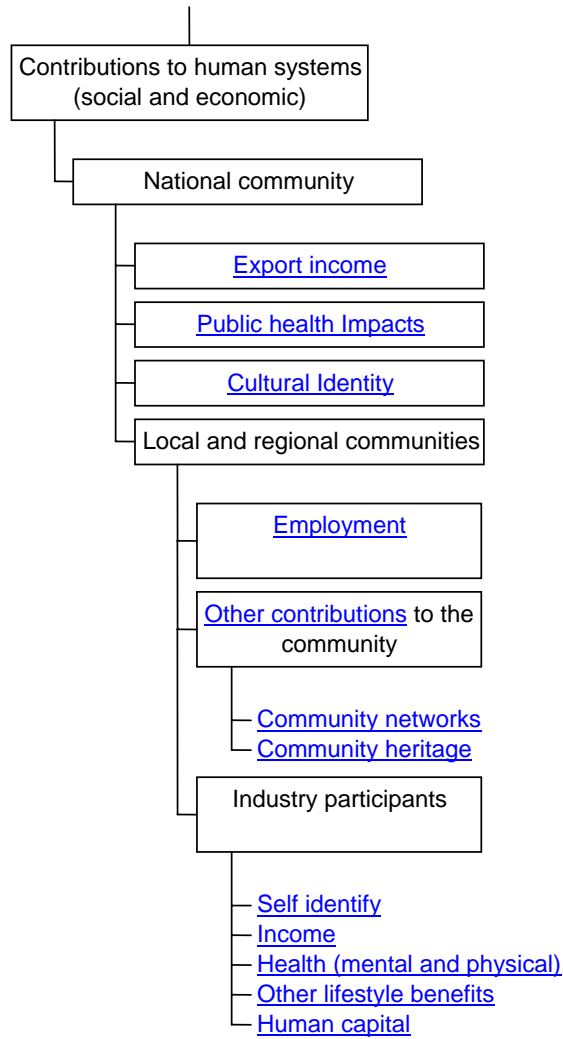
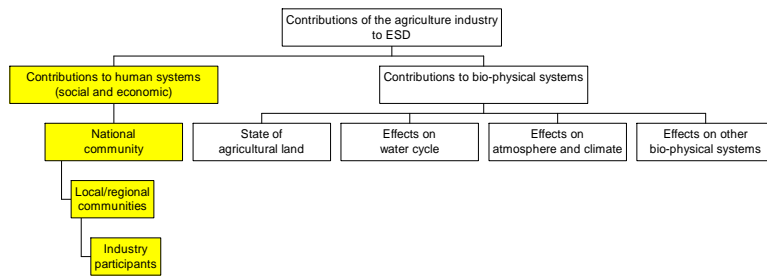
PLEASE NOTE

This material is incomplete. The intention is to demonstrate how a profile might eventually look, not provide a finished product. Desired outcomes, indicators and their interpretation (performance measures) are provided as examples only and will not necessarily be those that are adopted by the Signposts for Australian Agriculture framework. Agreement of desired outcomes, indicators and their interpretation (performance measures) will be part of an ongoing consultation process. Similarly, results to date, interactions with other components and external drivers are indicative only.

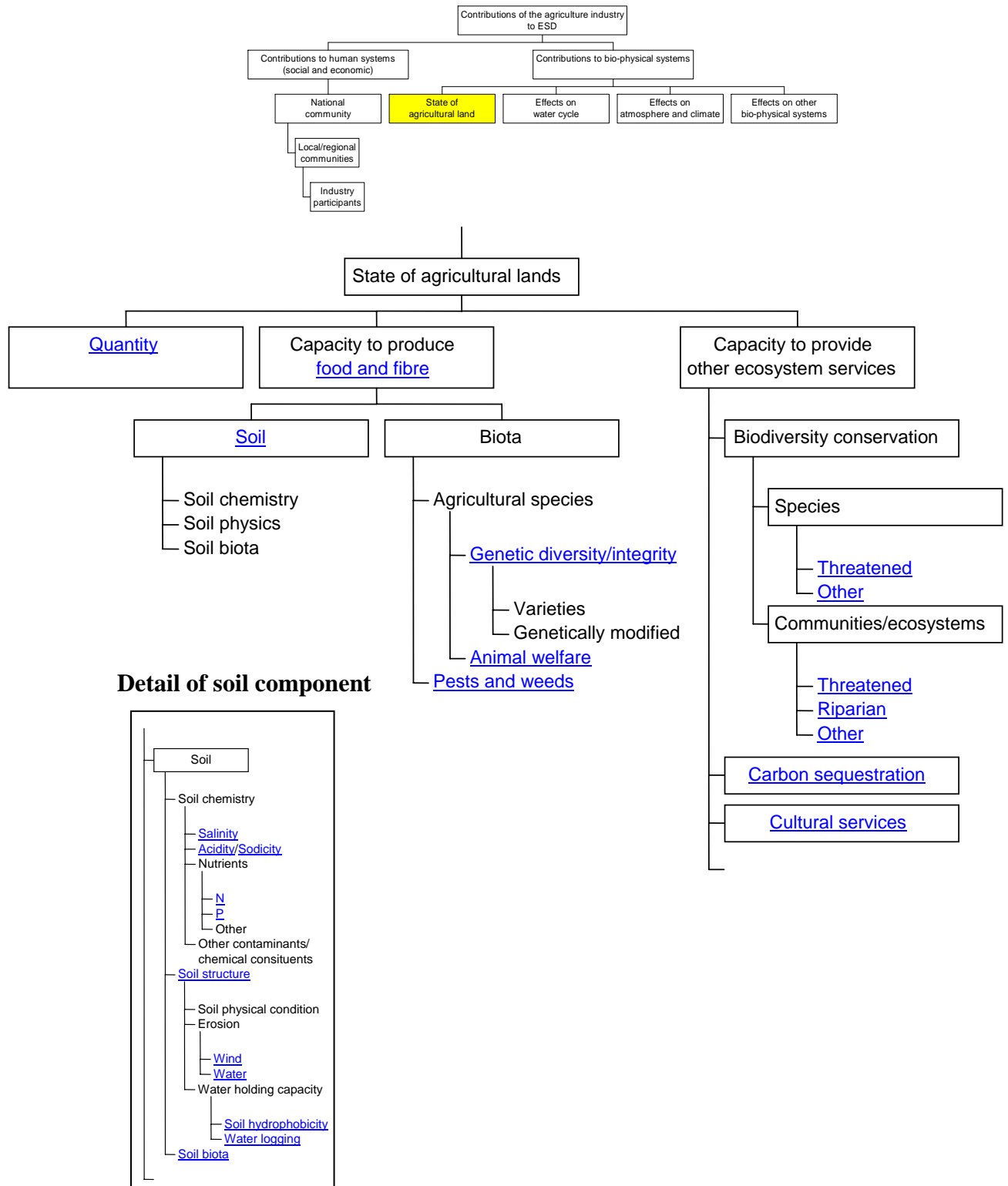
Top of tree



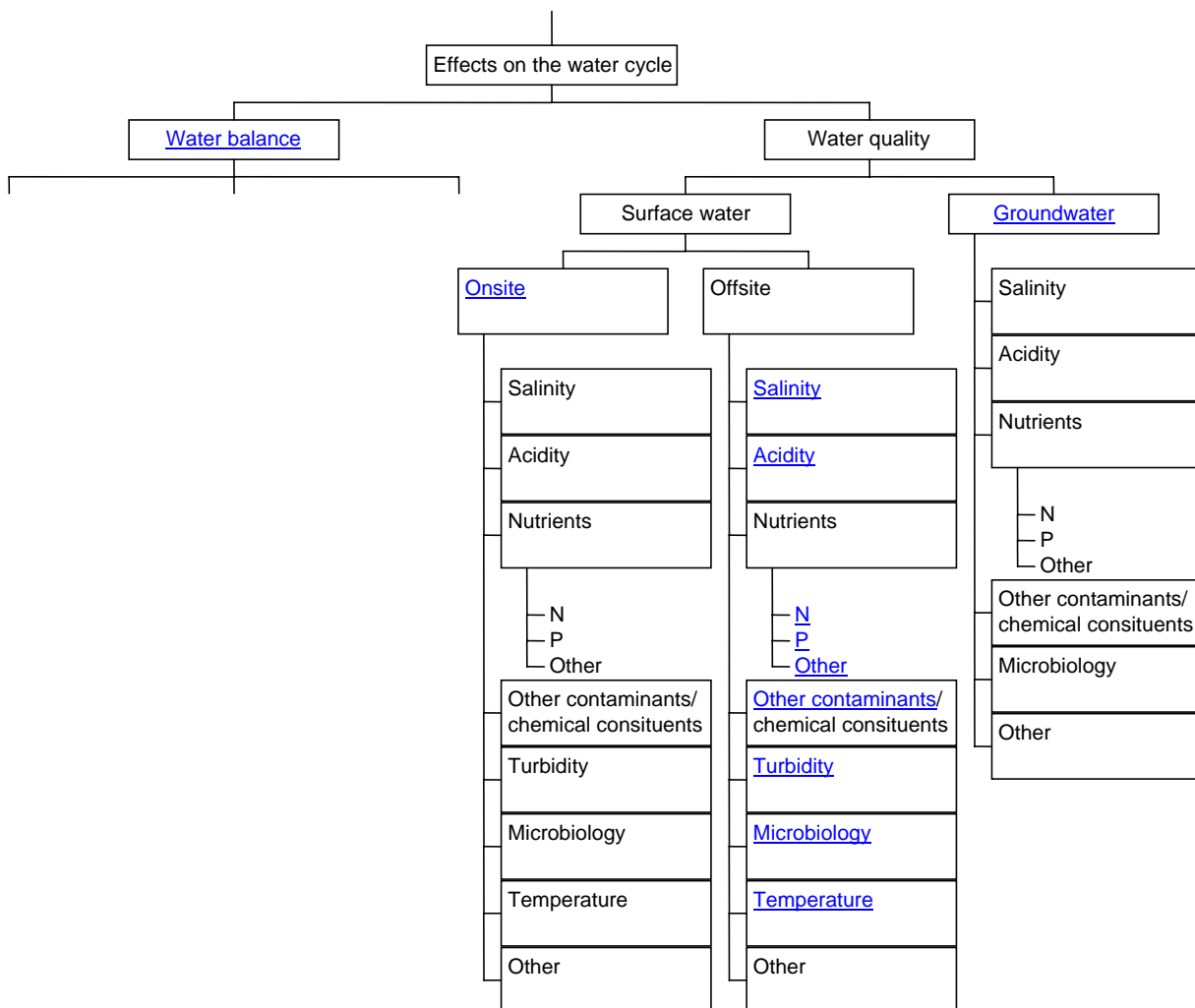
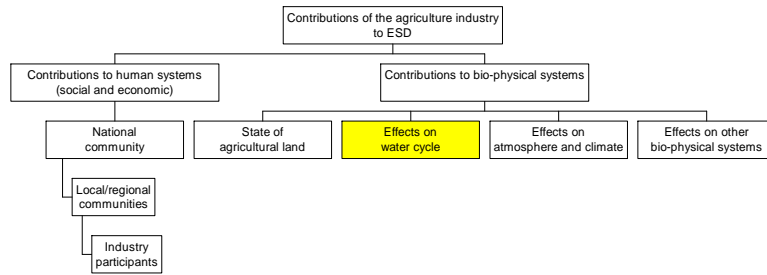
Contributions to human systems



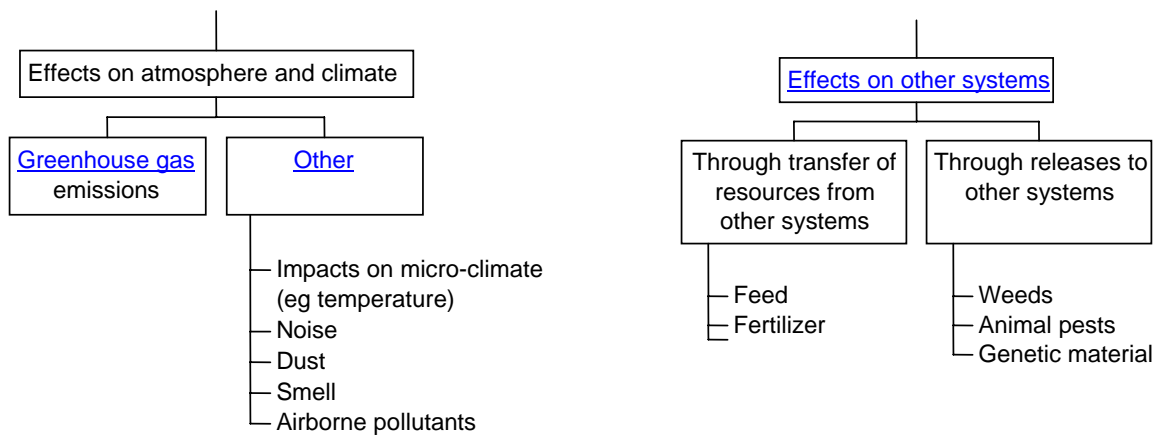
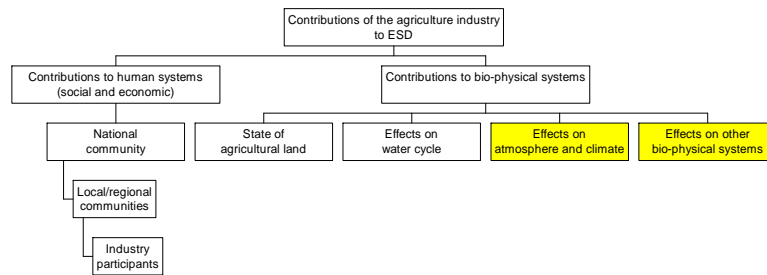
State of agricultural lands



Effects on the water cycle



Effects on atmosphere and climate and on other systems



Contributions of the agriculture industry to ESD /

All

The contributions of the industry to Australia's total quality of life: social, economic and environmental.

Desired outcome (operational objective)

The net contribution should be positive and increasing over time.

Indicator

An aggregated value or summary of all sub-components. 'Inclusive wealth' is one example of a single aggregated value. This level of aggregation may not be desired. Some (many?) people may prefer to base their decisions on less aggregated results, ie results for components at a lower level in the component tree.

Interpretation (performance measure)

Indicator, if used, should be positive and increase over time.

Results to date

Possible responses

Interactions with other components

External drivers

[Return to component tree](#)

Human Systems /

Human Systems

The contribution of the industry to Australia's social and economic systems.

Desired outcome (operational objective)

The net contribution should be positive and increasing.

Indicator

An aggregated value or summary of all sub-components.

Interpretation (performance measure)

Indicator should be positive and increase over time.

Results to date

Possible responses

Interactions with other components

External drivers

[Return to component tree](#)

Human Systems / National Community

Export Income

The contribution of the industry to Australia's export income.

Desired outcome (operational objective)

The contribution to export income should be maintained or increased

Indicator

Dollar value of exports

Interpretation (performance measure)

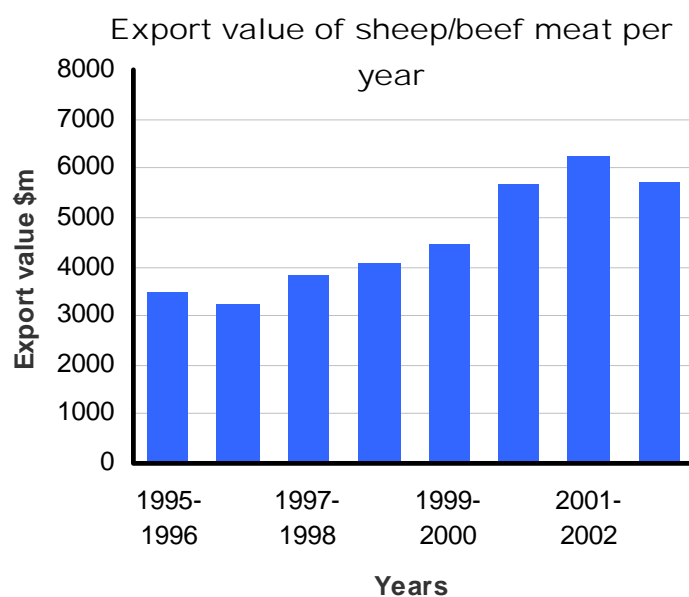
Indicator should remain constant or increase over time.

(This statement could be formalised to create a performance measure. A standardised performance measure ranging from 0 (unacceptable performance) to 1 (optimal performance) is useful for comparing and aggregating performance across different components).

Results to date

Farm exports contributed \$31.1 billion to the Australian economic in 2001-02 representing around 65 per cent of total agricultural output. The total value of farm exports has risen by an estimated 35 per cent over the past five years and represents 3 per cent of world agricultural exports.

Export income is specific to each industry (see industry reports). As an example of the type of information that is available we have included a graph for the meat and livestock industry (sheep/beef meat).



Source- ABARE Commodity Statistics 2003

For the meat and livestock industry (sheep/beef) export income has almost doubled over the past 8 years, with a slight reduction 2002-03 due to the drought.

Possible responses

Increased marketing activities. Actions to satisfying requirements of importing countries.

Interactions with other components

Any changes in ‘Capacity to produce food and fibre’ components could affect export income.

External drivers

Terms of trade. Exchange rates. Trade agreements. Requirements of importing countries – disease, animal welfare, environmental performance.

[Return to component tree \(human\)](#)

Human Systems / National Community

Public Health Impacts

The public health impacts of the industry's products. These include positive impacts through nutrition and negative impacts through illness or disease.

This component will need to be further subdivided for different product types.

Desired outcome (operational objective)

Positive impacts are increased; negative impacts are reduced or eliminated.

Indicator

Compliance with food safety requirements, eg Maximum Residue Limit (MRL) for Residues eg antimicrobial, pesticides, agrochemicals

Incidence of illness or disease traced to industry product.

Interpretation (performance measure)

Results to date

Possible responses

Interactions with other components

External drivers

[Return to component tree \(human\)](#)

Human Systems / National Community

Cultural Identity

The contribution an industry makes to Australia's national identity. Australians may gain a benefit from the existence of the industry because it has a special place in the country's history or identity. Conversely, they may gain a dis-benefit from the existence of the industry because they regard it as contrary to what they regard Australia should represent. Benefits may be realised through tourism.

Desired outcome (operational objective)

The industry contributes positively to Australia's national identity.

Indicator

Measure of public/tourist opinion. To be developed.

Interpretation (performance measure)

Results to date

Possible responses

Interactions with other components

External drivers

[Return to component tree \(human\)](#)

Human Systems / Local and Regional Communities

Employment

The benefits that the industry provides to local and regional communities through employment. Employment is regarded as a major route by which the industry contributes to local and regional communities.

Desired outcome (operational objective)

Maintain or increase employment.

(This statement could be formalised to create a performance measure. A standardised performance measure ranging from 0 (unacceptable performance) to 1 (optimal performance) is useful for comparing and aggregating performance across different components.)

Indicator

Number of people employed in the industry. Indicator reported by appropriate units (ie, by individual region, community, town)

Interpretation (performance measure)

Indicator should remain constant or increase.

(This statement could be formalised to create a performance measure. A standardised performance measure ranging from 0 (unacceptable performance) to 1 (optimal performance) is useful for comparing and aggregating performance across different components).

Results to date

Between 1996 and 2001 the total number of persons employed in agriculture, fisheries and forestry (AFF) across Australia increased by two per cent. Absolute numbers show that in 1996, 324 068 persons were employed in AFF increasing to 330 510 in 2001

The indicator for this component would ideally be displayed over time. As an example of this indicator we have provided some data in the industry studies from the NLWRA Australian Agriculture Assessment 2001 based upon 1998 ABS data.

Potential sources of information

ABS Census of Population and Housing: Time Series Profile (1996–2001)

ABARE farm surveys.

Possible responses

Increase competitiveness of the food and fibre industry. Increase operational efficiencies and human capital of employees.

Interactions with other components

The change in the percentage of persons employed by agriculture directly impacts on community networks and other human well being indicators and the income derived from food and fibre produce.

External drivers

International and local markets.

[Return to component tree \(human\)](#)

Human Systems / Local and Regional Communities

Other contributions to the community

Other industry contributions that are not adequately represented by employment. The sub-components of this component need further development.

Desired outcome (operational objective)

Indicator

Interpretation (performance measure)

Results to date

Possible responses

Interactions with other components

External drivers

[Return to component tree \(human\)](#)

Human Systems / Local and Regional Communities / Other contributions

Community networks

The contribution of the industry to community networks. Community networks are considered an important factor in determining the well-being of a community. Effective networks are important for communicating information between and among groups and for building trust and transparency within communities

>Desired outcome (operational objective)

Maintain or increase contribution to community networks

Indicator

Number of members of Landcare networks

Community facilities

Indicator reported by appropriate units (ie, by individual region, community, town)

Interpretation (performance measure)

Indicator should be increasing.

(This statement could be formalised to create a performance measure. A standardised performance measure ranging from 0 (unacceptable performance) to 1 (optimal performance) is useful for comparing and aggregating performance across different components).

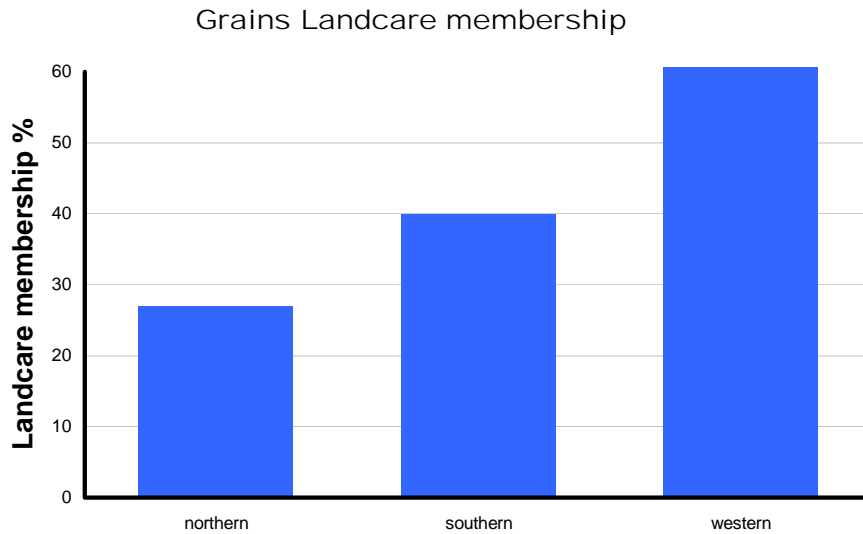
Results to date

There are now more than 4,500 Landcare groups across Australia, with nearly 40% of farms reporting membership of a Landcare or similar group (Nelson et al, 2004).

Taking account of the flow on effects of Landcare group activity, it is estimated that Landcare is a source of information for up to 75% of farmers (Cullen et al, 2003).

Source ABARE Farm Surveys

As an example of potential data for this indicator, the proportion of farmers who are members of landcare is provided for the grains industry (Figure).



Source NLWRA Australian Agriculture Assessment 2001

Data was collated for 1998-99 in the Australian Agriculture Assessment 2001, further data has been collected sporadically in the ABARE farm surveys and the ABS Agricultural Surveys. Ideally this indicator should be presented over time.

Possible responses

Increase membership of Landcare. Create stronger links between Landcare and industry groups.

Interactions with other components

Any changes in Landcare membership could impact on the quality of the environment

External drivers

Government funding,. Community perception.

[Return to component tree \(human\)](#)

Human Systems / Local and Regional Communities / Other contributions

Community heritage

The contribution of the industry to community heritage or identity. This component requires development. Communities may be able to turn this contribution into material benefit through tourism.

>Desired outcome (operational objective)

Maintain or increase contribution to community heritage.

Indicator

Interpretation (performance measure)

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Results to date

Possible responses

Interactions with other components

External drivers

[Return to component tree \(human\)](#)

Human Systems / Industry Participants

Self Identity

The self identity that farmers derive from being part of the industry. Self identity has been identified as an important factor in decisions about whether to remain or leave an industry.

Desired outcome (operational objective)

To maintain a positive self identity

Indicator

Needs development. Survey of industry participants.

Interpretation (performance measure)

Results to date

Possible responses

Interactions with other components

External drivers

[Return to component tree \(human\)](#)

Human Systems / Industry Participants

Income

The income (or loss) industry participants derive from the industry.

Desired outcome (operational objective)

Income should be positive and non-decreasing over time.

Indicator

Profit at full equity: average per farm

The above is the preferred indicator as identified in the SCARM (1998) report 'Sustainable Agriculture: Assessing Australia's Recent Performance'. Where profit at full equity is not available other indicators have been used, such as:

- Farm cash income
- Farm business profit

These are defined as:

Profit at full equity: Farm business profit, plus rent, interest and finance lease payments, less depreciation on leased items. It is the return produced by all the resources used in the farm business.

Farm cash income: The difference between total cash receipts and total cash costs.

Farm Business Profit: Farm cash income plus buildup in trading stocks, less depreciation and the imputed value of the owner manager, partner(s) and family labor. ABARE Farm Surveys (2003).

ABARE farm surveys were used as the most detailed surveys of farm income.

ABARE uses surveys rather than a census and therefore use a sample of producers.

For some industries these detailed analyses do not exist. Other income sources could include ABS Agricultural Census or surveys specific to each industry.

Interpretation (performance measure)

The profit at full equity should be greater than zero and preferably increasing.

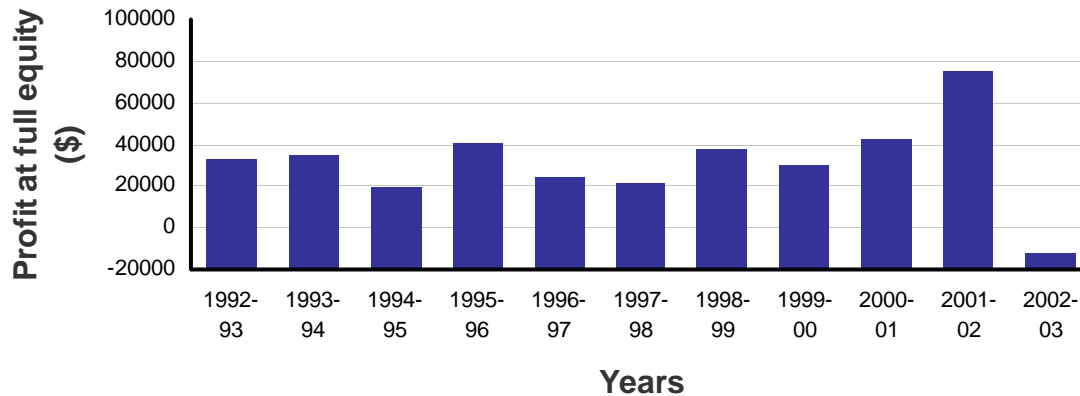
(This statement could be formalised to create a performance measure. A standardised performance measure ranging from 0 (unacceptable performance) to 1 (optimal performance) is useful for comparing and aggregating performance across different components).

Results to date

Profitability for the 1990's has been gradually downwards (CIE, 2002) across agricultural industries as a whole.

The income of Industry participants is specific to each industry (see industry reports). As an example of the type of information that is available we have included a graph for the dairy industry.

Dairy- Profit at full equity: average per farm



Source- ABARE Australian Farm Surveys 2003- AGSURF dataset.

For the dairy industry, income for industry participants had remained fairly stable for the past 10 years until 2002-2003 when the drought affected income.

Possible responses

Structural adjustment may enhance profitability on average across farms by moving out poor performing farmers. Farm business training can enhance a farmers capacity to achieve profits.

Interactions with other components

Income links to lifestyle benefits from the industry and to employment, as well as to all environmental and social components.

External drivers

Market prices and the value of the Australian dollar can have a big impact.

References

References

Standing Committee on Agriculture and Resource Management (1998) *Sustainable Agriculture: Assessing Australia's Recent Performance*, Vol. Report 70, CSIRO Publishing, Collingwood.

ABARE (2003) Australian Farm Surveys Report 2003, ABARE, Canberra.

[Return to component tree \(human\)](#)

Human Systems / Industry Participants

Health (mental and physical health)

The health of individuals participating in the industry. Includes both physical and mental health. Financial hardship, drought and other issues can lead to industry participants suffering from stress. Responses to stress are can be seen in both physical and mental outcomes.

Desired outcome (operational objective)

Physical Health: Decrease in farm deaths and injuries

Mental Health: Decrease in number of suicides, broken marriages

Indicator

Access to health services

OH&S incidents reports, eg. Tractor accidents

Most common sources of death sorted by age and gender eg. suicide

Life expectancy

Interpretation (performance measure)

Results to date

Possible responses

Interactions with other components

External drivers

[Return to component tree \(human\)](#)

Human Systems / Industry Participants

Other Lifestyle Benefits

Other lifestyle benefits derived by the industry participants.

Industry participants derive lifestyle benefits from agriculture that include enjoyment of the environment, satisfaction from managing a property, sense of independence and freedom to develop their own business.

Desired outcome (operational objective)

Benefits are maintained

Indicator

Requires further development, survey of attitudes, beliefs and values.

Interpretation (performance measure)

Results to date

Possible responses

Interactions with other components

External drivers

[Return to component tree \(human\)](#)

Human Systems / Industry Participants

Human capital

The human capital that resides in the industry participants.

Human capital is the knowledge skills and competencies that individuals develop during their life. Human capital is measured by formal and informal learning and includes competencies such as reading and writing, as well as skills acquired on the job such as the operation of technical equipment. Courses provided by industry and government institutions.

This component needs further subdivision to capture the various aspects of human capital residing in industry participants.

Desired outcome (operational objective)

Human capital should increase over time.

Indicator

Education and training courses

Interpretation (performance measure)

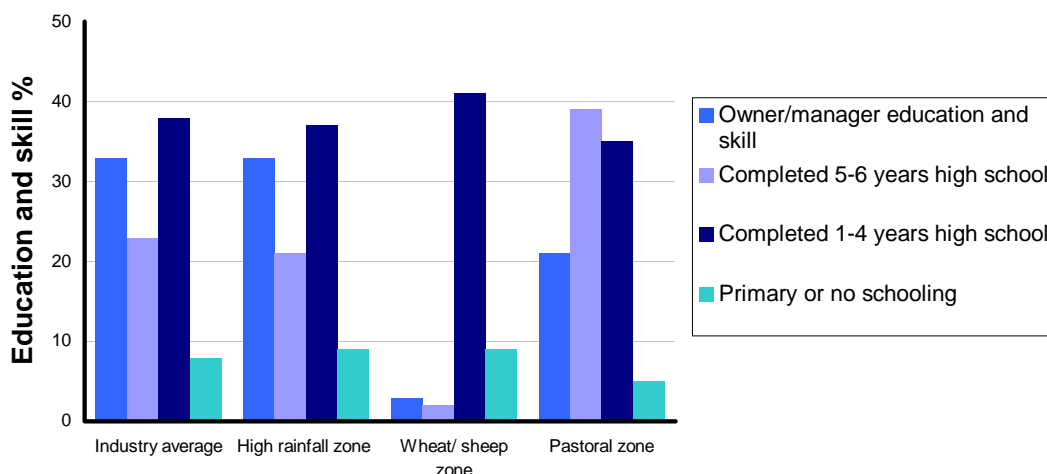
Indicator should increase over time.

(This statement could be formalised to create a performance measure. A standardised performance measure ranging from 0 (unacceptable performance) to 1 (optimal performance) is useful for comparing and aggregating performance across different components).

Results to date

As an example of potential data for this indicator, the percentage of farmers achieving different levels of formal education has been provided for the sheep and wool industries. Ideally, this would be extended in the future to include informal training and education (Figure).

Sheep and Wool : Owner/manager education and skill



Source NLWRA Australian Agriculture Assessment 2001

Data was collated for 1998-99 in the Australian Agriculture Assessment 2001, further data has been collected sporadically in the ABARE farm surveys and the ABS Agricultural Surveys. Ideally this indicator should be presented over time.

Possible responses

Many government programs are aimed at increasing the knowledge and skills of industry participants.

Interactions with other components

Any changes in human capital impacts on the capacity to produce food and fibre income.

External drivers

Universities, research and development agencies

[Return to component tree \(human\)](#)

Bio-physical Systems /

Bio-physical Systems

The contribution of the industry to bio-physical systems.

Biophysical systems have been sub-divided into the land managed by the industry, the water cycle, the atmosphere and 'other.'

Desired outcome (operational objective)

The net contribution should be positive and increasing.

Indicator

An aggregated value or summary of all sub-components.

Interpretation (performance measure)

Indicator should be positive and increase over time.

Results to date

Possible responses

Interactions with other components

External drivers

[Return to component tree](#)

Bio-physical Systems / State of Agricultural Lands

Quantity

The area of land managed by the industry.

Land managed by the industry is intended to include all the land managed by people as a result of them being engaged in the industry, not just the land actually grazed or cropped at any particular time. It includes areas set aside for wildlife conservation or other purposes. It excludes land that would be more sensibly ascribed to another industry. For example, a large softwood plantation is more sensibly attributed to a forest industry than to the meat and livestock industry even if both activities occur on a single property. The conceptual goal within the Signposts framework is to have all land attributed to one and only one industry so that combining across all industries gives a complete picture of the state of agricultural land in Australia.

The main role of this component is to provide contextual information that will be combined with information on the quality of agricultural lands to give an overall measure of the natural capital residing in agricultural lands. Its appearance in the tree as a stand alone component is intended to be temporary. When desired outcomes and indicators for other components have been properly defined to take into account quantity as well as quality the quantity component should be deleted.

Desired outcome (operational objective)

No generic desired outcome.

Targets or limits may be specified through state, regional or local planning processes. Ideally, there should be some process that allocates land to different uses in order to provide the greatest long term benefit to society.

Indicator

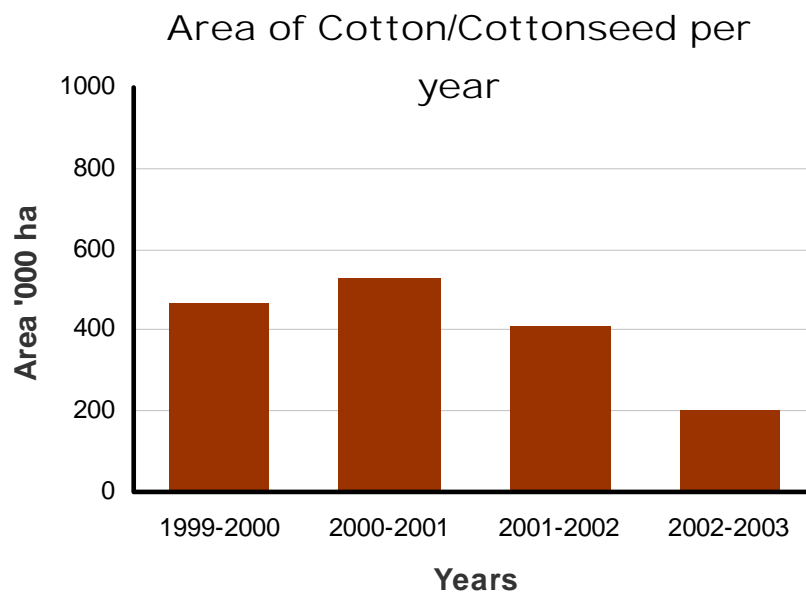
Needs development. Areas attributed to each commodity provide a rough indication but this may underestimate the area of land managed by the industry

Interpretation (performance measure)

This indicator will not be interpreted in its right (ie no performance measure) unless a desired outcome has been specified. It will, however, be combined with other indicators of the state of agricultural land to create performance measures that take into account both quantity and quality.

Results to date

As an example of the type of information that is available we have included a graph of the area in hectares of cotton in Australia.



Source- Australian Agriculture, Fisheries and Forestry At a Glance 2003.

From 1999-2000 to 2001-2002 cotton occupied over 400,000 ha, but this halved in 2002-2003 mainly due to the drought and water shortages. This does not necessarily mean that land managed by the cotton industry declined by the same amount. Results, earlier than those displayed in this graph, show the total area of cotton (ha) increased substantially over the past ten years.

Possible responses

No direct responses unless there is a desired outcome. Intensification and efforts to improve production /ha are examples of attempts to increase the ratio of benefit obtained per area of land used. This may result in an increase in net benefit or a decrease in area of land producing the same net benefit.

Interactions with other components

Changes in the area of land managed are likely to affect almost all other components to some extent.

External drivers

Competition for land use. Public perceptions of the industry. Market value.

[Return to component tree \(lands\)](#)

State of agricultural lands

Capacity to produce food and fibre

The production of food and fibre is the primary ecosystem service obtained from agricultural lands. Ecosystems on agricultural lands have been highly modified in order to enhance their capacity to produce food and fibre.

Desired outcome (operational objective)

Maintain or increase capacity to produce food and fibre.

Indicator

Either some aggregate or summary of the sub-components of this component or an integrative indicator such as primary productivity. Indicator presented as a map showing changes over time.

Interpretation (performance measure)

Indicator should be non-decreasing.

Results to date

The NLWRA (2001) maps mean annual net primary productivity. Need to identify by industry.

Possible responses

Interactions with other components

External drivers

[Return to component tree \(lands\)](#)

State of agricultural lands / Capacity to produce food and fibre

Soil

The condition of soils in agricultural lands.

Soil condition is an important factor in the capacity of agricultural land to produce food and fibre

Desired outcome (operational objective)

Maintain or increase soil quality for the purposes of producing food and fibre.

Indicator

Some aggregate or summary of the sub-components of this component. Could use expert rules as used by Sustainable Rivers Audit. Indicator presented as a map. Indicators for soil sub-components are included in National NRM Monitoring and Evaluation Framework.

Interpretation (performance measure)

Indicator should be non-decreasing.

Results to date

The NLWRA (2001) maps indicators of various soil sub-components. Need to identify by industry.

Possible responses

Interactions with other components

External drivers

[Return to component tree \(lands\)](#)

Capacity to produce food and fibre / Soil / Soil chemistry

Salinity

Soil salinity.

Desired outcome (operational objective)

The impact of salinity on land is minimised or reduced.
This component is a matter for target in the National NRM M&E Framework (2003).

Indicator

Location and size of salt affected area

Other possibilities:

- Area of revegetation in salinity areas with trees, shrubs and deep-rooted perennials.
- Area of protected cover in salinity areas.

Interpretation (performance measure)

Performance could be expressed as the proportion of lands managed by the industry that are not affected by salinity.

Results to date

Possible responses

Changes in land use and land management practices.

Interactions with other components

External drivers

Land use and management practices offsite.

[Return to component tree \(lands\)](#)

Capacity to produce food and fibre / Soil /Soil chemistry

Acidity

Soil acidification is the accumulation of acid in the soil.

Soil acidification is a natural process which, in natural ecosystems, operates over many thousands of years. However, under agricultural management, acidification can accelerate with the rate of change being detectable over decades.

<http://www.nrm.gov.au/monitoring/indicators/soil/acidity.html>

Desired outcome (operational objective)

To minimise the area of soil that has undesirable levels of acidity.

Indicator

Average area of land limed by industry participants

Ideally, the indicator for this component would be based on soil pH testing. As this is unavailable for most industries at present, the 'average area of land that was treated with lime' has been used as a surrogate indicator. An alternative indicator could have been average lime sales (Kt) per farm. This provides some indication of the problem of acid soils over time, but it does not cover other treatments for acid soils, such as mulching, revegetating and breaking soil crusts, and may be confounded by farmer income and lime costs. It also does not cover farms which have alkaline soils.

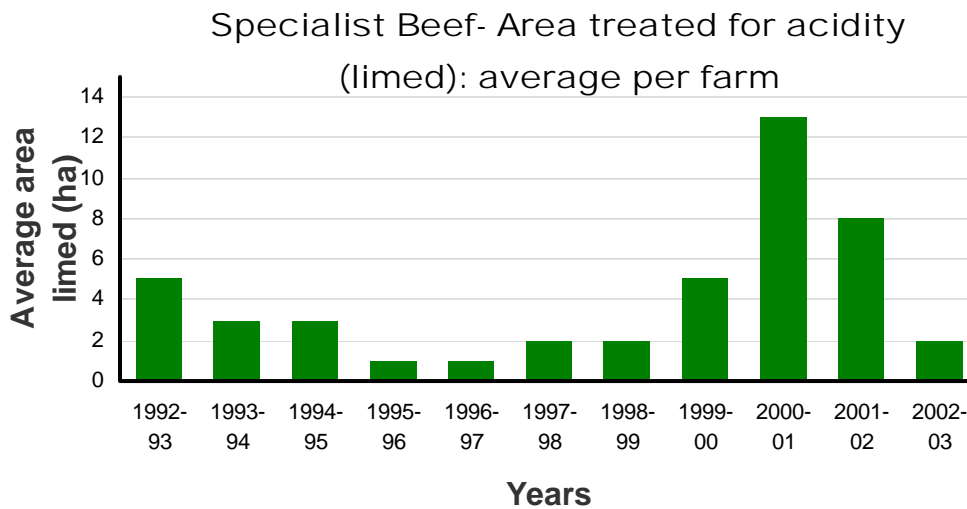
Soil condition is a matter for target in the National NRM M&E Framework (2003) and soil acidification is a recommended indicator.

Interpretation (performance measure)

Interpretation is ambiguous. We assume here that an increase in area treated indicates an increase in the area affected by acidity. However it could also be argued that an increase in area treated indicates a decrease in the area affected by acidity because more farmers are aware of the problem and are taking action to counteract it. An indicator based on soil measurement would be preferable.

Results to date

As an example of the type of information that is available we have included a graph for the specialist beef producers in the meat and livestock industry.



Source- ABARE Australian Farm Surveys 2003- AGSURF dataset.

The average area of land treated for acidity by specialist beef industry participants decreased in the mid 1990s, then increased dramatically between 1999-2000 and 2001-2002. Drought may have affected the area limed in 2002-2003.

The preferred indicator, soil pH, was collated by the NLWRA for the Australian Agriculture Assessment. The data needs to be combined with land use information to attribute measurements to individual industries.

Possible responses

Breaking the acid scalds to leech acid and salts will enhance revegetation. Mulching scalds and acid soils and revegetating with acid tolerant plants will tie-up acid soils (Woodhead, et al. 2000). Better management of nutrient and carbon cycles by applying fertilizers at appropriate times of year when the plants need it, and to reduce build up in soil. Another method is to apply lime to acid soil areas (NLWRA, 2001).

Interactions with other components

Changes in this component are linked to changes in soil nutrients, acidity in surface and ground water and other (acid water can activate some chemicals).

External drivers

The price of lime.

[Return to component tree \(lands\)](#)

Capacity to produce food and fibre / Soil /Soil chemistry

Sodicity

Sodicity is the build up of sodium in the soil resulting in poor water infiltration, surface crusting, erosion and water logging. It costs agriculture as much as \$2 billion each year in lost production. And its impacts extend to water catchments, infrastructure facilities and the environment

Desired outcome (operational objective)

Reduce area of sodic soils

Indicator

Exchangeable sodium percentage (ESP) at soil depths of 0-10cm and 50-60cm

Interpretation (performance measure)

Results to date

Possible responses

Application of gypsum.

Interactions with other components

Run-off from sodic soils carries clay particles into waterways and reservoirs causing water turbidity and increasing levels of nitrogen and phosphorus.

External drivers

[Return to component tree \(lands\)](#)

Capacity to produce food and fibre / Soil /Soil chemistry / Nutrients

Nitrogen

Nitrogen levels in lands managed by the industry.

Desired outcome (operational objective)

Nitrogen levels in the soil are maintained at appropriate levels. Level will depend on intended use.

Indicator

Soil nitrogen

Interpretation (performance measure)

Results to date

Possible responses

Interactions with other components

External drivers

[Return to component tree \(lands\)](#)

Capacity to produce food and fibre / Soil /Soil chemistry / Nutrients

Phosphorous

Phosphorus levels in lands managed by the industry.

This component is a matter for target in the National NRM M&E Framework (2003)

In many Australian soils, phosphorus is the key nutrient determining productivity both directly and through its effects on legume growth and consequently nitrogen fixation.

Phosphorus is the major fertiliser nutrient applied to pastures and represents a major part of the discretionary expenditure of many landholders. Annually, some \$300 million worth of phosphorus fertilisers are applied to pastures in Australia and an equal amount on crops (although amounts vary between years).

Phosphorus application is usually considerably greater than phosphorus removal and it is estimated that over \$9,000 million worth of phosphorus has accumulated in soils due to past applications of fertiliser. Most of it is in poorly available forms.

Desired outcome (operational objective)

Phosphorus levels in the soil are maintained at appropriate levels. Level will depend on intended use.

Indicator

Soil phosphorus.

Interpretation (performance measure)

Performance measure could be expressed as the proportion of the land managed by the industry that exceeds soil guidelines for phosphorus. (Based upon NLWRA, 2000)

Results to date

Possible responses

Interactions with other components

External drivers

[Return to component tree \(lands\)](#)

Capacity to produce food and fibre / Soil / Soil physics

Soil structure

To be developed.

Desired outcome (operational objective)

Indicator

Interpretation (performance measure)

Results to date

Possible responses

Interactions with other components

External drivers

[Return to component tree \(lands\)](#)

Capacity to produce food and fibre / Soil / Soil physics / Erosion

Wind erosion

Wind erosion on lands managed by the industry.

Erosion is the wearing away of land by water, wind and general weather conditions. This is a natural process but some land management practices have the potential to greatly increase the rate at which this occurs. The soil is selectively removed from its current location and may be deposited anywhere from metres to hundreds of kilometres away.

Desired outcome (operational objective)

Minimise/reduce wind erosion

Indicator

Various indicators including vegetation cover, area of soils affected by wind erosion, dust storm index (SCARM 1998)

Interpretation (performance measure)

Depends on indicator.

Results to date

Possible responses

Interactions with other components

External drivers

[Return to component tree \(lands\)](#)

Capacity to produce food and fibre / Soil / Soil physics / Erosion

Water erosion

Water erosion on lands managed by the industry.

Erosion is the wearing away of land by water, wind and general weather conditions. This is a natural process but some land management practices have the potential to greatly increase the rate at which this occurs. The soil is selectively removed from its current location and may be deposited anywhere from metres to hundreds of kilometres away.

Desired outcome (operational objective)

Minimise/reduce water erosion

Indicator

Interpretation (performance measure)

Results to date

Possible responses

Management of riparian vegetation.

Interactions with other components

External drivers

[Return to component tree \(lands\)](#)

Capacity to produce food and fibre / Soil / Soil physics / Water holding capacity

Soil hydrophobicity

Capacity of soil to store moisture and supply it to plants

Desired outcome (operational objective)

Indicator

Interpretation (performance measure)

Results to date

Possible responses

Interactions with other components

External drivers

[Return to component tree \(lands\)](#)

Capacity to produce food and fibre / Soil / Soil physics / Water holding capacity

Water logging

Waterlogging occurs when the soil is saturated with water and lacks most or all of the soil air.

Indicator

Interpretation (performance measure)

Results to date

External drivers

[Return to component tree \(lands\)](#)

Capacity to produce food and fibre / soil

Soil biota

Organisms living in the soil on lands managed by the industry.

Desired outcome (operational objective)

Indicator

Interpretation (performance measure)

Results to date

External drivers

[Return to component tree \(lands\)](#)

Capacity to produce food and fibre / Biota / Agricultural species

Genetic diversity/integrity

The diversity and integrity of the genetic material on which agricultural production depends.

Many of the productivity gains obtained by agriculture are a result of modification of species through traditional breeding techniques and more recently through genetic engineering.

Desired outcome (operational objective)

Maintain /improve genetic material.
Avoid unintended gene transfer.

Indicator

To be developed.

SCARM (1998) included an agricultural plant species diversity indicator. OECD Agri-environmental indicators include genetic diversity of agricultural species. FAO initiative for domesticated animals.

Interpretation (performance measure)

Results to date

Possible responses

Interactions with other components

External drivers

[Return to component tree \(lands\)](#)

Capacity to produce food and fibre / Biota / Agricultural species

Animal welfare

The welfare of agricultural animals including animal diseases.

Industries place a great deal of emphasis on the welfare of their animals because it improves production and also because of the widespread concern among society at large.

Desired outcome (operational objective)

To be articulated.

Indicator

To be identified.

Interpretation (performance measure)

Results to date

Possible responses

Interactions with other components

External drivers

Public opinion within Australia and internationally. Quarantine breaches.

[Return to component tree \(lands\)](#)

Capacity to produce food and fibre / Biota

Pests and weeds

The distribution and abundance of pests and weeds on agricultural lands.

Pests and weeds decrease the capacity of agricultural land to produce food and fibre. This component will be sub-divided according to the needs of each industry.

Desired outcome (operational objective)

Eradicate /minimise /reduce /manage pests and weeds.
The desired outcome will depend on the nature of the pest or weed.

Indicator

Interpretation (performance measure)

Results to date

Possible responses

Interactions with other components

External drivers

[Return to component tree \(lands\)](#)

State of agricultural lands / Capacity to provide other ecosystem services / Biodiversity conservation / Species

Threatened species

The extent to which agricultural lands managed by the industry harbour threatened species.

Desired outcome (operational objective)

Populations of significant species... are maintained or rehabilitated.

This is the National NRM M&E Framework Outcome (2003).

Indicator

Relative abundance of each species and/or area, location and condition of key habitat of each species

These are indicators in the National NRM M&E Framework, (2003). The 'area, location and condition of key habitats of each species' may be used a surrogate for the abundance of the species until monitoring of the species itself can be implemented, or may be used as an indicator in its own right to ensure the species has somewhere to live. 'Habitat' appears a less useful term in aquatic ecosystems.

Significant native species and ecological communities is also a Matter for Target (National NRM M&E Framework, 2003).

Interpretation (performance measure)

The indicator should be increasing or maintained.

Results to date

This indicator is not currently measured by agricultural industries. The indicator was collated to some extent in the NLWRA and State of the Environment but results are reported for States and regions rather than industries. As a result the contributions from a particular industry are difficult to separate out from contributions by other agricultural industries, other industries, other users in the region, or from nature. In regions where one industry dominates research may be able to tease out the contributions of the industry in this region. Data collation for the NLWRA was a once off. Monitoring may be carried out through industry NRM surveys.

Possible responses

Setting aside areas of habitat for the species is often the first step. This is often carried out through an MOU with a State (eg wildlife refuges) or Commonwealth department or even with NGOs such as the WWF. Development of Ecosystem Service payments will be an important future mechanism for implementing on-farm species conservation. Carrying out management practices that favour the

species existence, such as pest and weed control, even putting up nest boxes, sometimes implementing specific burning regimes, grazing management, etc.

Interactions with other components

Often interacts with biota pests and weeds component and closely with nature conservation of communities and ecosystems components.

External drivers

Changes to legislation on threatened species and listing of new species.

[Return to component tree \(lands\)](#)

State of agricultural lands / Capacity to provide other ecosystem services / Biodiversity conservation / Species

Other species

The extent to which agricultural lands managed by the industry harbour other species (ie those not listed as threatened).

Desired outcome (operational objective)

Biodiversity and the extent, diversity and condition of native ecosystems are maintained or rehabilitated

Outcome from the National NRM M&E Framework Outcome (2003).

Indicator

Biodiversity index

This is usually a combination of the number of species and each species abundance, often compared to what should have been present at the site in 1750 (ie before Europeans arrived).

A biodiversity index is often a subset of a bigger index looking at the the ecosystem as a whole, its condition (eg structure and function) and relationship to other ecosystems in the region (eg interconnectedness). Most of these biodiversity indexes are under development and differ between States. An example includes 'habitat hectares' in Victoria.

Interpretation (performance measure)

Indicator should be non-decreasing.

Results to date

This indicator is not usually measured by agricultural industries. A surrogate indicator often used at a high level is mapping of native vegetation, with the assumption that native vegetation is correlated with total biodiversity. This surrogate indicator is collated through NLWRA Australian native vegetation assessment (2001) but results are reported for States and regions rather than industries. As a result the contributions from a particular industry are difficult to separate out from contributions by other agricultural industries, other industries, other users in the region, or from nature. The NVIS has continued collating this information.

Possible responses

Development of Ecosystem Service payments may be an important future mechanism for implementing on-farm species conservation. Setting aside areas of habitat for native species is a commonly used step often through an MOU with a State (eg wildlife refuges) or Commonwealth department or even with NGOs such as the WWF. Management practices that allow production while maintaining native species such as certain grazing or burning regimes, pest and weed control

and setting aside buffer strips or nature conservation areas seem to be the best ways to achieve positive results.

Interactions with other components

Often interacts with biota pests and weeds component and closely with nature conservation of communities and ecosystems components.

External drivers

Loss of habitat on neighbouring lands.

[Return to component tree \(lands\)](#)

State of agricultural lands / Capacity to provide other ecosystem services / Biodiversity conservation / Communities and ecosystems

Threatened

The extent to which agricultural lands managed by the industry harbour threatened ecological communities and ecosystems.

Desired outcome (operational objective)

Significant ecological communities/ecosystems are maintained or rehabilitated

This is desired outcome of the National NRM M&E Framework (2003). Other outcomes that relate to this component include:

- Biodiversity and the extent, diversity and condition of native ecosystems are maintained or rehabilitated.
- Ecosystem services and functions are maintained or enhanced.

Indicator

Extent and condition of each significant ecological community/ecosystem on industry lands.

Extent (area in ha) and condition of each significant ecological community are national indicators and matters for targets (National NRM M&E Framework, 2003). Extent could also be measured by presence-absence, or length (river ecosystems).

Interpretation (performance measure)

The indicator should be increasing or maintained.

Results to date

This indicator is not usually measured by agricultural industries. The indicator is collated to some extent in the NLWRA and by Department of Environment and Heritage and State agencies for threatened species and communities reporting and State of Environment reporting. However, results are reported for States and regionally rather than industries. As a result the extent of ecological communities on industry land is hard to separate out from the extent on land occupied by other agricultural industries, other industries, other users in the region, or from nature reserves. Similarly if remote sensing is used difficulties also exist allocating native vegetation to specific industries, although techniques for combining land use/tenure with vegetation mapping, may be a way around this. Data collation is being maintained through NVIS and DEH. Some industries do collect this information through NRM surveys, such as the wool and dairy industries, although these surveys are usually once off.

Possible responses

Farmers may often set aside areas for biodiversity conservation under an Agreement with a State (eg wildlife refuges program) or Commonwealth department or with NGOs such as the WWF. Development of Ecosystem Service payments will be an important future mechanism for implementing on-farm conservation of ecological communities. Management practices that

combine production with biodiversity conservation such as certain grazing or burning regimes, setting aside of areas for riparian buffers/shelter belts may often be the best mechanisms for achieving biodiversity conservation.

Interactions with other components

Often interacts with pests and weeds component and closely with biodiversity conservation of species components. Also links to the Riparian community component, to all water quality components, to soil salinity, and to soil erosion (both through wind and water) components.

External drivers

Changes to legislation on threatened species and communities and listing of new ecological communities.

[Return to component tree \(lands\)](#)

State of agricultural lands / Capacity to provide other ecosystem services / Biodiversity conservation / Communities and ecosystems

Riparian

The riparian communities and ecosystems within the lands managed by the industry.

Riparian communities can be very diverse and may be, for example river red gums, small dense shrubs like tea trees, perennial species such as sedges and grasses, or any combination.

Desired outcome (operational objective)

Biodiversity and the extent, diversity and condition of native ecosystems are maintained or rehabilitated (National NRM M&E Framework, 2003).

With the assumption that maintaining or improving condition should ensure 'Ecosystem services and functions are maintained or enhanced' (National NRM M&E Framework, 2003).

Indicator

see 'communities and ecosystems /other'

Interpretation (performance measure)

Results to date

Possible responses

Ecosystem Service payments or Agreements between farmers and other agencies may become important future mechanisms for implementing water quality control, species and community conservation, and salinity management through riparian conservation. Management practices that combine production with nature conservation such as grazing regimes, burning, setting aside of areas for riparian buffers/shelter belts, agroforestry, may often be the best mechanisms for achieving riparian conservation.

Interactions with other components

Links to all water quality components, to soil salinity, to soil erosion both through wind and water components and to nature conservation of species and communities.

External drivers

Policies to recognise and pay for ecosystem services.

[Return to component tree \(lands\)](#)

State of agricultural lands / Capacity to provide other ecosystem services / Biodiversity conservation / Communities and ecosystems

Other

The other ecological communities and ecosystems on lands managed by the industry

Desired outcome (operational objective)

Biodiversity and the extent, diversity and condition of native ecosystems are maintained or rehabilitated (National NRM M&E Framework, 2003).

Ecosystem services and functions are maintained or enhanced (National NRM M&E Framework, 2003).

Indicator

Ecological community or ecosystem extent and distribution, by condition.

Extent could be measured in ha for land vegetation, length for rivers, and number for wetlands.

Extent could also be compared with pre-European extent.

Extent could also be the proportion of farms- presence/absence.

Condition is usually measured compared to pre-European condition for native communities and ecosystems. Condition could alternatively be related to ecosystem function when pre-European condition is unknown.

The National NRM M&E Framework indicators are as follows- For regionally significant native vegetation that is the subject of targets in regional plans:

- The extent of native vegetation by IBRA subregion measured in hectares,
- The extent of each present native vegetation type by IBRA subregion measured in ha,
- The proportion remaining of each native vegetation type by IBRA subregion measured as a percentage of the pre-European extent.
- The proportion of each native vegetation type in each IBRA subregion that is estimated to be in specified condition classes based on a selected set of attributes.

For Inland aquatic ecosystem river and wetland integrity indicators see National NRM M&E Framework (2003).

‘Native vegetation communities integrity’ and ‘Inland aquatic ecosystem integrity (rivers and other wetlands)’, are the relevant Matters for targets (National NRM M&E Framework, 2003)

Interpretation (performance measure)

Indicator should be non-decreasing.

Results to date

Same as Threatened communities and ecosystems component

Possible responses

Same as Threatened communities and ecosystems component

Interactions with other components

Same as Threatened communities and ecosystems component

External drivers

Development of biodiversity index and ecosystem service policy and research. Funding for onground works through landcare/bushcare, etc

[Return to component tree \(lands\)](#)

State of agricultural lands / Capacity to provide other ecosystem services

Carbon sequestration

The amount of carbon that lands managed by the agricultural industry absorb from the environment. The absorption occurs mainly through plants.

Desired outcome (operational objective)

To increase carbon sequestration by the industry

Indicator

Carbon sequestered on agricultural lands.

Alternative indicators:

- Area of vegetation set aside for carbon sequestration.
- Number of plants, by type (eg tree, shrub, grass- annual/perennial) by age.

Interpretation (performance measure)

Larger values of the indicator are preferred. The performance measure could incorporate a target.

Results to date

Information is not available by agricultural industry. The Australian Greenhouse Office has estimated carbon emissions/sequestration across agriculture as a whole (AGO, 2002).

Change in CO₂-equivalent emissions and removals for Agriculture, 1990-2002

	1990 Mt CO ₂ -e	2002 Mt CO ₂ -e	Change Mt CO ₂ -e	% Change
Agriculture	95.1	105.6	10.5	11.1%
Land Use, Land Use Change & Forestry	120.4	29.2	-91.2	-75.8%

In the Agriculture sector an increase in emissions from crop production was partly offset by a decline in livestock emissions that was caused by reductions in livestock numbers.

Land Use, Land Use Change and Forestry (Kyoto accounting). The Kyoto accounting provisions take into account emissions from deforestation, and the carbon sequestered in reforestation activities (i.e. plantations) established since 1990.

AGO (2002) *Analysis of Recent Trends and Greenhouse Indicators 1990 to 2002* AGO. Website-
<http://www.greenhouse.gov.au/inventory/2002/trends/index.html> Updated 10 May 2004, Accessed 30/7/2004.

AGO (2004) *Greenhouse and agriculture*. AGO, Website-
<http://www.greenhouse.gov.au/agriculture/index.html>, Updated 8/6/2004, Accessed 30/7/2004.

Possible responses

Carbon credits, may be a useful mechanism for increasing carbon sequestration. Agroforestry is now occurring on agricultural lands. Minimum tillage, reducing burning of stubble/cane, maintaining ground cover, reduced clearing, less use of mechanical instruments (eg tractors), all have an impact on CO2 emissions.

Interactions with other components

This component is directly related to the greenhouse gases component under atmosphere. It may be more convenient to deal with net emissions (ie emissions minus removals) under atmosphere than distinguish carbon sequestration separately.

External drivers

International agreements. Green energy. Agroforestry. Vegetation clearing laws and regulations

[Return to component tree \(lands\)](#)

State of agricultural lands / Capacity to provide other ecosystem services

Cultural services

The capacity of lands managed by the industry to provide non-material benefits including aesthetic and spiritual benefits. See UN Millennium Assessment for a description.

Component to be developed.

Desired outcome (operational objective)

Indicator

Interpretation (performance measure)

Results to date

Possible responses

.

Interactions with other components

.

External drivers

[Return to component tree \(lands\)](#)

Effects on the water cycle

Water balance

The net effect of the industry on the distribution and abundance of water. In addition to the traditional pathways of evapo-transpiration, runoff and drainage, this component also takes into account water extracted and applied by irrigated industries. Groundwater and surface water are both included.

This component is complex and requires further development. Current work by BRS and others will be used here.

Desired outcome (operational objective)

To be developed

Indicator

Interpretation (performance measure)

Results to date

Some aspects such as use of irrigation water are readily available. Others such as deep drainage are not well characterised.

Possible responses

Interactions with other components

External drivers

[Return to component tree \(water\)](#)

Effects on the water cycle / Water quality / Surface Water/

Onsite

The quality of surface water on lands managed by the industry.

Within the lands managed by the industry, water is a resource and its quality determines the value of the natural capital residing in those lands. A distinction is made between the onsite surface water quality and the impact the industry might have on offsite water quality through various mechanisms. The relevance of onsite water quality will depend on the nature of the industry and the size and configuration of the lands attributed to that industry.

Sub-components are the same as for surface water / offsite, but the detail of the desired outcome may differ. Desired outcomes for onsite may be drawn from the Water Quality Guidelines for primary industries – irrigation, general use and livestock drinking water, whereas desired outcomes for offsite may be drawn from the Water Quality Guidelines for aquatic ecosystems (ANZECC 2000).

Desired outcome (operational objective)

As for offsite but different guidelines may be appropriate (see above).

Indicator

As for offsite

Interpretation (performance measure)

Indicator should satisfy appropriate guideline.

Results to date

As for offsite. Distinction between onsite and offsite not usually made and may not be required in some situations.

Some industries, such as cotton, wool and sugar have developed reports on water quality and riparian vegetation that mainly relate to management practices rather than monitoring outcomes.

Possible responses

As for offsite. Also see results section.

Interactions with other components

As for offsite

External drivers

As for offsite

[Return to component tree \(water\)](#)

Effects on the water cycle / Water Quality / Surface Water / Offsite

Salinity

The salinity that an agriculture industry contributes to surface water.

Salt occurs naturally in surface water, and this component is of most concern when salt concentrations are outside specific bounds. This component is a matter for target in the National NRM M&E Framework (2003), and is specified in the Water Quality Guidelines (ANZECC 2000) and water resources and agriculture reports of the NLWRA (2000 & 2001, respectively).

Desired outcome (operational objective)

Salt entering surface water as a result of industry activities is minimised or maintained below acceptable limits.

This outcome is based upon the Water Quality Guidelines and the NLWRA water resources report. The national high level outcome is: 'The impact of salinity on ... water resources is minimised, avoided or reduced' (National NRM M&E Framework, 2003).

Indicator

Requires development of an indicator that links amount of salt to the industry.

BRS research may provide cost-effective ways to do this.

In-stream salinity as measured by: Electrical conductivity (EC) + Flow, or Total Dissolved Solids (TDS) + Flow (National NRM M&E Framework, 2003).

ABS Agriculture surveys, ABARE Farm Surveys, and RDC industry specific surveys have measured indicators for salinity in agriculture however these have tended to be once off and measure farmer attitudes/responses salinity on-site (rather than off-site).

Interpretation (performance measure)

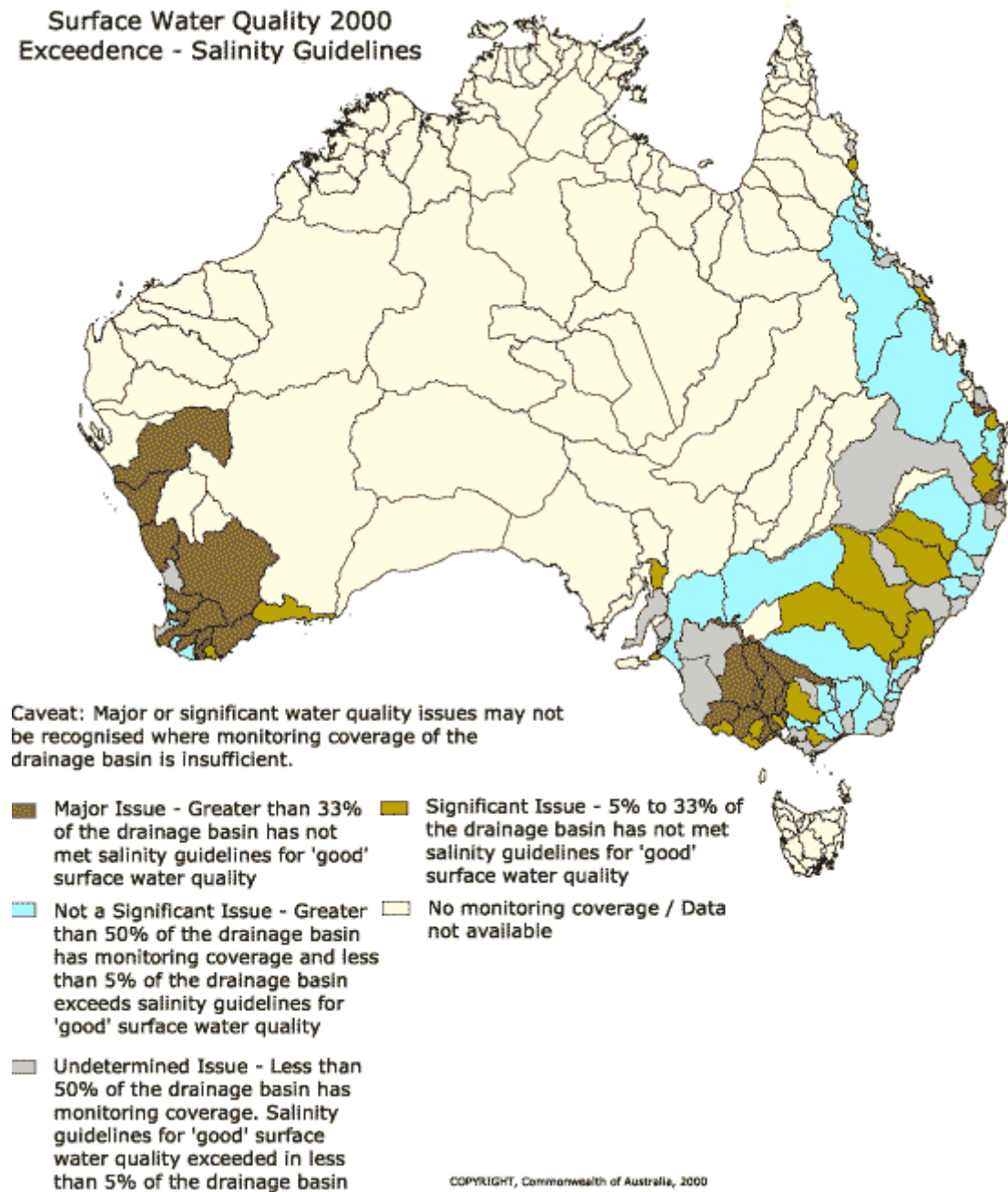
Will depend on the indicator selected.

For general guidelines see ANZECC (2000) aquatic ecosystems chapter which provides EC trigger values for different surface water ecosystems.

Results to date

This indicator is not currently measured for most agricultural industries. Data were collated by the NLWRA but results are reported for regions and water catchments rather than industries (Figure). As a result the contributions from a particular industry are difficult to separate out from contributions by other agricultural industries, other industries, other users in the region, or from nature. In regions where one industry dominates, research may be able to tease out the contributions of the industry in this region. Data collation for the NLWRA was a once off, and data is also unavailable for some catchments. A monitoring program could be set up for specific industries, following the ANZECC (2000) guidelines.

**Surface Water Quality 2000
Exceedence - Salinity Guidelines**



Source: NLWRA Australian Water Resources Assessment 2000

Possible responses

Land and Water Australia has been working with agriculture industries, for example Wool, Cotton, and Sugar, and with Research and Development Corporations to develop guidelines for dealing with agricultures impacts on water quality.

Management responses include reducing water tables by planting perennial vegetation, creating buffer zones of perennial vegetation to minimise run off of salts.

Interactions with other components

Examples include groundwater salinity, soil salinity, biodiversity conservation components particularly riparian vegetation, and surface water salinity onsite.

External drivers

Public awareness of salinity in drinking or surface water. Water table level.

[Return to component tree \(water\)](#)

Effects on the water cycle / Water Quality / Surface Water / Offsite

Acidity

The change in water pH that an agriculture industry contributes to surface water.

The pH of Australian surface water is variable. The component relates to how agriculture may change water pH, particularly outside specific bounds. Although not a 'Matter for target' (National NRM M&E Framework, 2003) pH is specified in the Water Quality Guidelines (ANZECC 2000) and water resources report of the NLWRA (2000). Water may become more acid or more alkaline as a result of agriculture, with the former being more common. pH outside the range normally experienced in aquatic ecosystems may affect biodiversity, either over the short term such as fish kills or over the long-term such as changing vegetation to acid tolerant species. Low pH water may react with metals and other elements changing water quality (and colour) and affecting infrastructure.

Desired outcome (operational objective)

Changes in the pH of surface water as a result of industry activities are minimised or maintained below acceptable limits.

This outcome is based upon the Water Quality Guidelines and the NLWRA Water Resources Assessment 2000. The national high level outcome 'Surface... water quality is maintained or enhanced' (National NRM M&E Framework, 2003) may relate to this component.

Indicator

Change in pH of water resulting from industry participants.

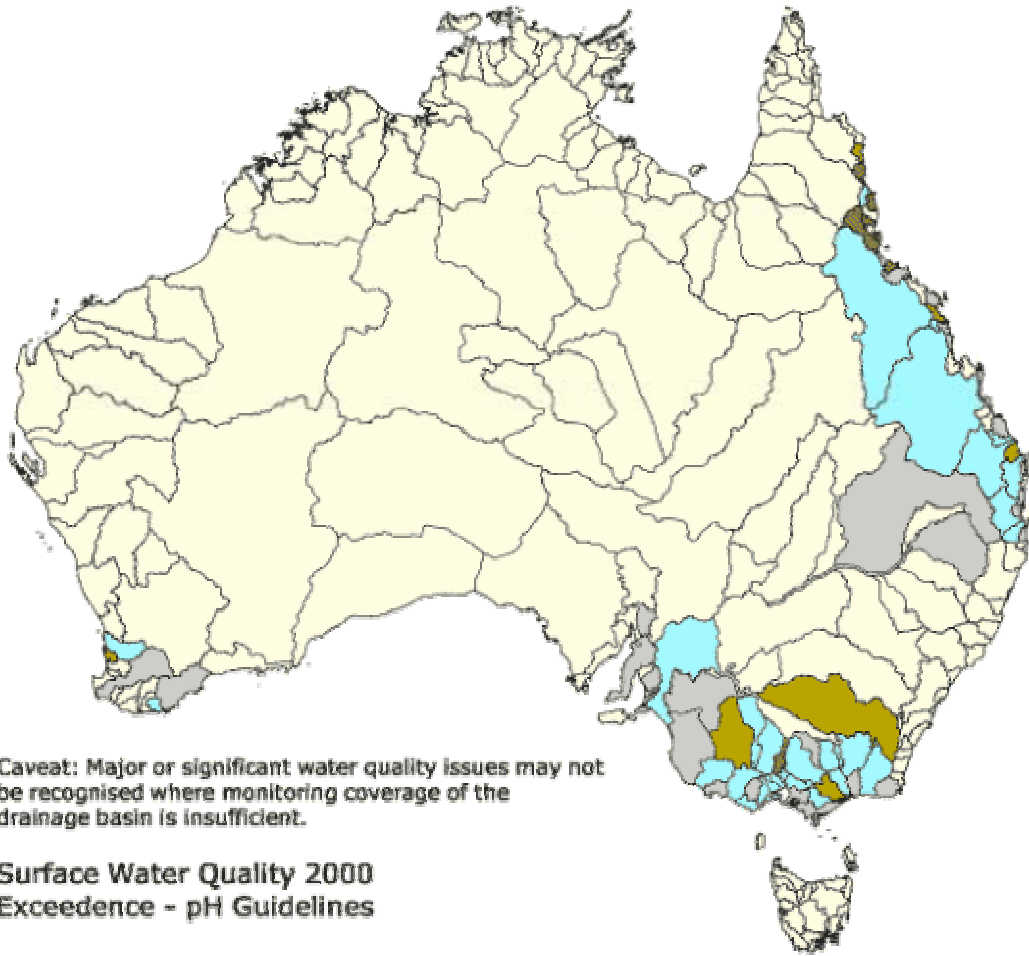
Interpretation (performance measure)

Performance measure could be expressed as the proportion of industry participants that are within water quality guidelines.

For general guidelines see ANZECC (2000) aquatic ecosystems chapter which provides pH trigger values for different water ecosystems.

Results to date

This indicator is not currently measured for most agricultural industries. Sugar may be an exception. Data were collated by the NLWRA but results are reported for regions and water catchments rather than industries (Figure). As a result the contributions from a particular industry are difficult to separate out from contributions by other agricultural industries, other industries, other users in the region, or from nature. In regions where one industry dominates, research may be able to tease out the contributions of the industry in this region. Data collation for the NLWRA was a once off, and data is also unavailable for a number of catchments. A monitoring program could be set up for specific industries, following the ANZECC (2000) guidelines.



Caveat: Major or significant water quality issues may not be recognised where monitoring coverage of the drainage basin is insufficient.

Surface Water Quality 2000 Exceedence - pH Guidelines

- Major Issue - Greater than 33% of the drainage basin has not met pH guidelines for 'good' surface water quality
- Significant Issue - 5% to 33% of the drainage basin has not met pH guidelines for 'good' surface water quality
- Not a Significant Issue - Greater than 50% of the drainage basin has monitoring coverage and less than 5% of the drainage basin exceeds pH guidelines for 'good' surface water quality
- Undetermined Issue - Less than 50% of the drainage basin has monitoring coverage. pH guidelines for 'good' surface water quality exceeded in less than 5% of the basin
- No monitoring coverage / Data not available

Source: NLWRA Australian Water Resources Assessment 2000

Possible responses

Breaking the acid scalds to leech acid and salts will enhance revegetation. Mulching scalds and acid soils and revegetating with acid tolerant plants will tie-up acid soils, reducing the acidity of water and sediment run-off (Woodhead, et al. 2000).. Riparian buffer strips of perennial vegetation should help reduce sediment and water run-off (NLWRA,Agriculture report 2001)

Interactions with other components

Soil erosion from water, soil and water contaminants (heavy metals), biodiversity conservation ecosystems such as riparian zones.

External drivers

Public pressure as a result of fish kills or changes in water colour.

[Return to component tree \(water\)](#)

Effects on the water cycle / Water Quality / Surface Water / Offsite / Nutrients

Nitrogen

The nitrogen that an agriculture industry contributes to surface water.

Nutrients such as nitrogen occur naturally in surface water, and this component is of most concern when nitrogen levels are outside specific bounds. This component is a matter for target in the National NRM M&E Framework (2003), and is specified in the Water Quality Guidelines (ANZECC 2000) and water resources and agriculture reports of the NLWRA (2000 & 2001, respectively). High levels of nitrogen in surface water may cause algal blooms. Changes in nitrogen concentration may cause changes in aquatic vegetation and species diversity.

Desired outcome (operational objective)

Nitrogen entering surface water as a result of industry activities is maintained within acceptable limits.

This outcome is based upon the Water Quality Guidelines and the NLWRA Water Resources Assessment 2000. The national high level outcome is 'Surface... water quality is maintained or enhanced' (National NRM M&E Framework, 2003).

Indicator

Total Nitrogen resulting from industry participants.

Total Nitrogen + flow leaving sub-catchment or whole catchment (National NRM M&E Framework, 2003).

Total Nitrogen is a measure that sums the concentration of the major forms of nitrogen including ammonia, organic nitrogen, nitrate and nitrite (NLWRA, 2000).

Alternative indicators may include oxides of nitrogen NO_x (ANZECC, 2000). A surrogate indicator may include the amount of fertilisers applied on agricultural land (eg ABARE Farm Surveys).

Interpretation (performance measure)

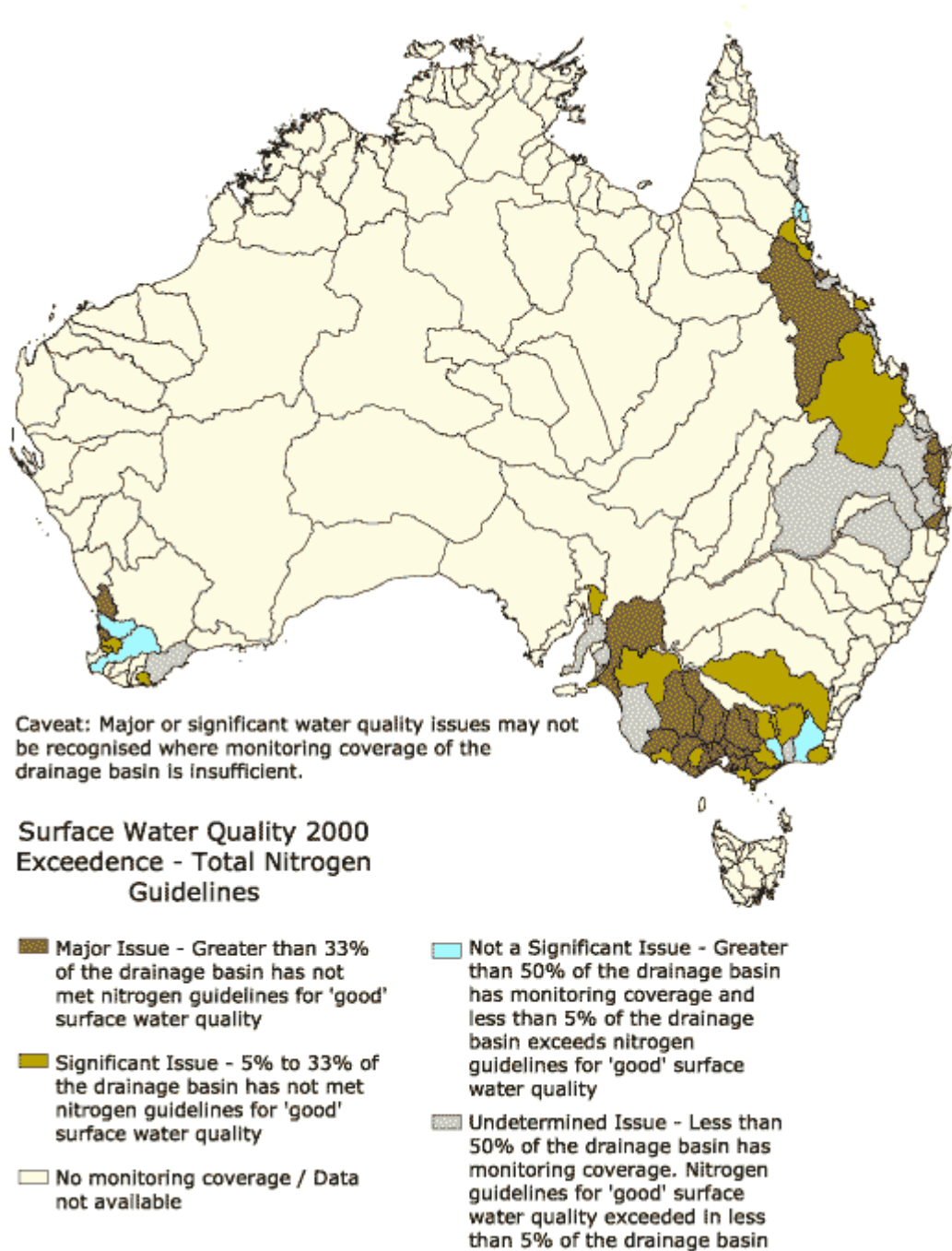
Performance measure could be expressed as the proportion of industry participants that are within water quality guidelines.

For general guidelines see ANZECC (2000) aquatic ecosystems chapter which provides Total Nitrogen trigger values for different water ecosystems.

Results to date

This indicator is not currently measured for most agricultural industries. Data were collated by the NLWRA but results are reported for regions and water catchments rather than industries (Figure). As a result the contributions from a particular industry are difficult to separate out from contributions by other agricultural industries, other industries, other users in the region, or from nature. In regions where one industry dominates research may be able to tease out the contributions

of the industry in this region (See Table for Nitrogen sources and sinks). Data collation for the NLWRA was a once off. In addition data was unavailable for some catchments. A monitoring program could be set up for specific industries, following the ANZECC (2000) guidelines. The Dairy industry is dealing with this component through their NRM programs.



Source: NLWRA Australian Water Resources Assessment 2000

Total nitrogen budgets (t/yr) for major agricultural regions.

Region	Hillslope PN	Gully PN	Bank PN	Point source DN	Run-off DN	Floodplain sedimentation PN	Reservoir sedimentation PN	Dentrificatio n DN	Export TN	Percent	Times natural
Murray-Darling Basin	36 352	17 556	17 736	1 208	33 126	53 309	15 952	22 388	14 330	29	2.1
NSW North	7 759	1 108	1 583	0	4 511	3 682	38	427	10 815	4	2.2
NSW South	8 926	2 666	1 710	663	6 442	5 364	1 590	804	12 650	6	1.8
Vic East	1 500	731	865	253	5 897	1 222	39	699	7 285	3	1.3
Vic West	527	851	694	0	3 318	1 167	78	537	3 609	1	1.7
WA South	982	4 038	1 196	694	15 282	4 481	57	5 250	12 404	6	2.5
Indian	445	1 368	444	0	2 032	1 972	0	1 016	1 301	1	2.7

Source: NLWRA Australian Agriculture Assessment 2001

Possible responses

Land and Water Australia has been working with agriculture industries, for example Wool, Cotton, and Sugar, and with Research and Development Corporations to develop guidelines for dealing with agriculture's impacts on water quality.

Erosion control would provide significant reductions in sediment run-off loads, reducing nutrient loads. Appropriate use of fertilisers (including timing) in areas that have high surface water run-off to minimise nutrient run-off. Riparian buffer strips of perennial vegetation should help reduce sediment and water run-off (NLWRA, 2000, & 2001). Point source discharges from intensive rural industries provide an opportunity for managing nutrient run-off by keeping nutrients on-site.

Interactions with other components

Soil nutrients, soil erosion from water, biodiversity conservation ecosystems such as riparian zones, and potential impacts on groundwater.

External drivers

Public pressure as a result of blue green algae incidences. Ecosystem service payments.

[Return to component tree \(water\)](#)

Effects on the water cycle / Water Quality / Surface Water / Offsite / Nutrients

Phosphorous

The phosphorus that an agriculture industry contributes to surface water.

Nutrients such as phosphorus occur naturally in surface water, and this component is of most concern when phosphorus levels are outside specific bounds.

This component is a matter for target in the National NRM M&E Framework (2003), and is specified in the Water Quality Guidelines (ANZECC 2000) and water resources and agriculture reports of the NLWRA (2000 & 2001, respectively). High levels of phosphorus in surface water may cause algal blooms. Changes in phosphorus concentration may cause changes in aquatic vegetation and species diversity.

Desired outcome (operational objective)

Phosphorus entering surface water as a result of industry activities is maintained within acceptable limits.

This outcome is based upon the Water Quality Guidelines and the NLWRA Water Resources Assessment 2000. The national high level outcome is 'Surface... water quality is maintained or enhanced' (National NRM M&E Framework, 2003).

Indicator

Total Phosphorus resulting from industry participants.

Total Phosphorus + flow leaving sub-catchment or whole catchment (National NRM M&E Framework, 2003). Total Phosphorus is a measure that sums the concentration of the major forms of phosphorus including dissolved forms, insoluble particulate forms and phosphorus already incorporated in phytoplankton (NLWRA, 2000). Alternative indicators may include FRP, filterable reactive phosphate (ANZECC, 2000). A surrogate indicator may include the amount of fertilisers applied on agricultural land (eg ABARE Farm Surveys).

Interpretation (performance measure)

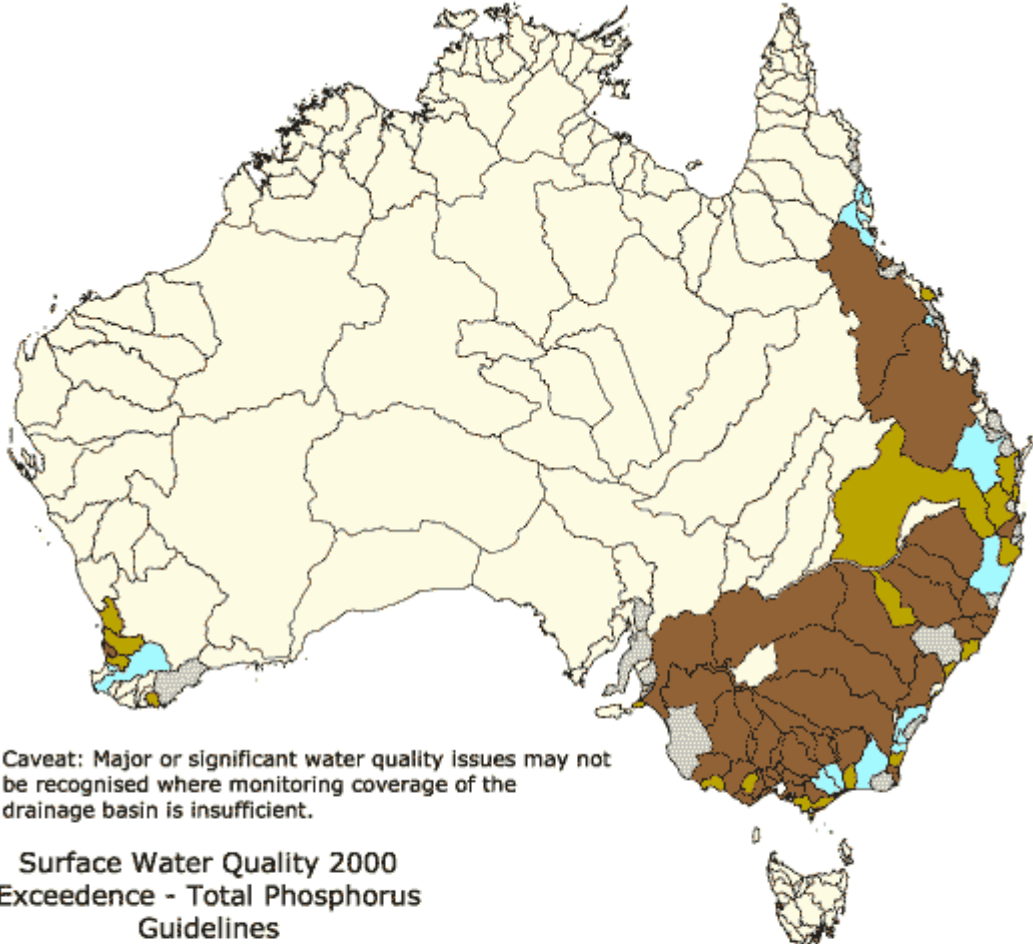
Performance measure could be expressed as proportion of industry participants within water quality guidelines.

For general guidelines see ANZECC (2000) aquatic ecosystems chapter which provides Total Phosphorus trigger values for different water ecosystems.

Results to date

This indicator is not currently measured for most agricultural industries. Data were collated by the NLWRA but results are reported for regions and water catchments rather than industries (Figure). As a result the contributions from a particular industry are difficult to separate out from contributions by other agricultural industries, other industries, other users in the region, or from nature. In regions where one industry dominates research may be able to tease out the

contributions of the industry in this region (see Table for Phosphorus sources and sinks in agricultural dominated catchments). Data collation for the NLWRA was a once off, and data is unavailable for some catchments. A monitoring program could be set up for specific industries, following the ANZECC (2000) guidelines.



Caveat: Major or significant water quality issues may not be recognised where monitoring coverage of the drainage basin is insufficient.

**Surface Water Quality 2000
Exceedence - Total Phosphorus
Guidelines**

- Major Issue - Greater than 33% of the drainage basin has not met phosphorous guidelines for 'good' surface water quality
- Significant Issue - 5% to 33% of the drainage basin has not met phosphorous guidelines for 'good' surface water quality
- No monitoring coverage / Data not available
- Not a Significant Issue - Greater than 50% of the drainage basin has monitoring coverage and less than 5% of the drainage basin exceeds phosphorous guidelines for 'good' surface water quality
- Undetermined Issue - Less than 50% of the drainage basin has monitoring coverage. Phosphorous guidelines for 'good' surface water quality exceeded in less than 5% of the drainage basin

Source: NLWRA Australian Water Resources Assessment 2000

Total phosphorus budgets (t/yr) for major agricultural regions.

Region	Hillslope (PP)	Gully (PP)	Bank (PP)	Point source (DP)	Run-off (DP)	Floodplain sedimentation (PP)	Reservoir sedimentation (PP)	Export (TP)	Export percent	Times natural
Murray-Darling Basin	10 719	4 387	4 434	124	1 306	16 295	3 977	699	4	2.6
NSW North	987	277	396	5	199	572	10	1 282	7	3.6
NSW South	1 902	667	428	101	283	1 314	279	1 788	9	2.8
Vic East	207	183	216	4	266	303	13	559	3	1.5
Vic West	41	213	174	0	144	285	17	269	1	1.9
WA South	53	1 009	299	146	569	1 254	17	805	4	2.6
Indian	46	342	111	0	81	466	0	115	1	6.5

Source: NLWRA Australian Agriculture Assessment 2001

Possible responses

Land and Water Australia has been working with agriculture industries, for example Wool, Cotton, and Sugar, and with Research and Development Corporations to develop guidelines for dealing with agricultures impacts on water quality.

Erosion control would provide significant reductions in sediment run-off loads, reducing nutrient loads. Appropriate use of fertilisers (including timing) in areas that have high surface water run-off to minimise nutrient run-off. Riparian buffer strips of perennial vegetation should help reduce sediment and water run-off (NLWRA, 2000 & 2001). Point source discharges from intensive rural industries provide an opportunity for managing nutrient run-off by keeping nutrients on-site.

Interactions with other components

Examples include soil nutrients, soil erosion from water, biodiversity conservation ecosystems such as riparian zones, and potential impacts on groundwater.

External drivers

Public pressure as a result of blue green algae incidences. Ecosystem service payments.

[Return to component tree \(water\)](#)

Effects on the water cycle / Water Quality / Surface Water / Offsite / Nutrients

Other nutrients

The other nutrients that an agriculture industry contributes to surface water.

Desired outcome (operational objective)

As for other nutrients (see P and N)

This component is not a matter for target in the National NRM M&E Framework (2003), or recorded in the water resources and agriculture reports of the NLWRA (2000 & 2001, respectively). However it is specified in the Water Quality Guidelines (ANZECC 2000).

Desired outcome (operational objective)

Indicator

Interpretation (performance measure)

Results to date

Sometimes carbon is monitored, although was not collated in the NLWRA water or agriculture reports.

External drivers

[Return to component tree \(water\)](#)

Effects on the water cycle / Water Quality / Surface Water / Offsite /

Other contaminants and chemical constituents

The other contaminants and chemical constituents that an agriculture industry contributes to surface water. The component depends on the industry involved.

There are dozens of other contaminants and chemical constituents that may occur naturally or artificially in surface water. These may include major and minor constituents, trace elements/heavy metals, organic contaminants, pesticides and radiological contaminants. The level at which a chemical exceeds acceptable bounds and becomes a contaminant or toxicant, varies greatly. High levels of contaminants can affect aquatic biodiversity and/or contaminate human food. Some chemicals can be toxic but break down quickly and cause minimal problems, whereas others, such as some heavy metals, may accumulate in the food chain over long periods of time. This component is consistent with the Water Quality Guidelines (ANZECC 2000). Major and minor constituents differ in the levels that they usually occur and/or are toxic.

Desired outcome (operational objective)

Indicator

Interpretation (performance measure)

Results to date

Possible responses

Depends on the major and minor constituent involved and its severity, plus on the water source that the chemical is entering. Storage and disposal has to often take into account the long-term nature of these chemicals.

Interactions with other components

Soil chemistry, Public health, Groundwater water quality.

External drivers

Community and consumer attitudes. Research into appropriate trigger levels. Public health.

[Return to component tree \(water\)](#)

Effects on the water cycle / Water Quality / Surface Water / Offsite

Turbidity

The turbidity that an agriculture industry contributes to surface water.

In surface water turbidity, or the suspended particulate matter, is a natural feature. This component is of most concern when the turbidity exceeds natural bounds, with either too much or not enough. This component is a matter for target in the National NRM M&E Framework (2003), and is specified in the Water Quality Guidelines (ANZECC 2000) and the water resources report of the NLWRA (2000). High levels of turbidity in surface water tends to cause deoxygenation, temperature changes, plant and algal growth and other features. Turbidity outside normal ranges may change water ecosystem biodiversity either directly or indirectly.

Desired outcome (operational objective)

The effect of industry activities on water turbidity is minimised.

This outcome is based upon the Water Quality Guidelines and the NLWRA Water Resources Assessment 2000. The national high level outcome is 'Surface... water quality is maintained or enhanced' (National NRM M&E Framework, 2003).

Indicator

Turbidity resulting from industry participants.

Alternative indicators may include Total Suspended Solids + Flow Both Turbidity and TSS are national NRM M&E Framework indicators (2003). Turbidity is often measured in Nephelometric Turbidity Units (NTU), that measure the capacity of light to penetrate through water. Total suspended solids (TSS) measured in milligrams per litre (mgL-1) may also be used as a measure of turbidity (NLWRA, 2000).

Interpretation (performance measure)

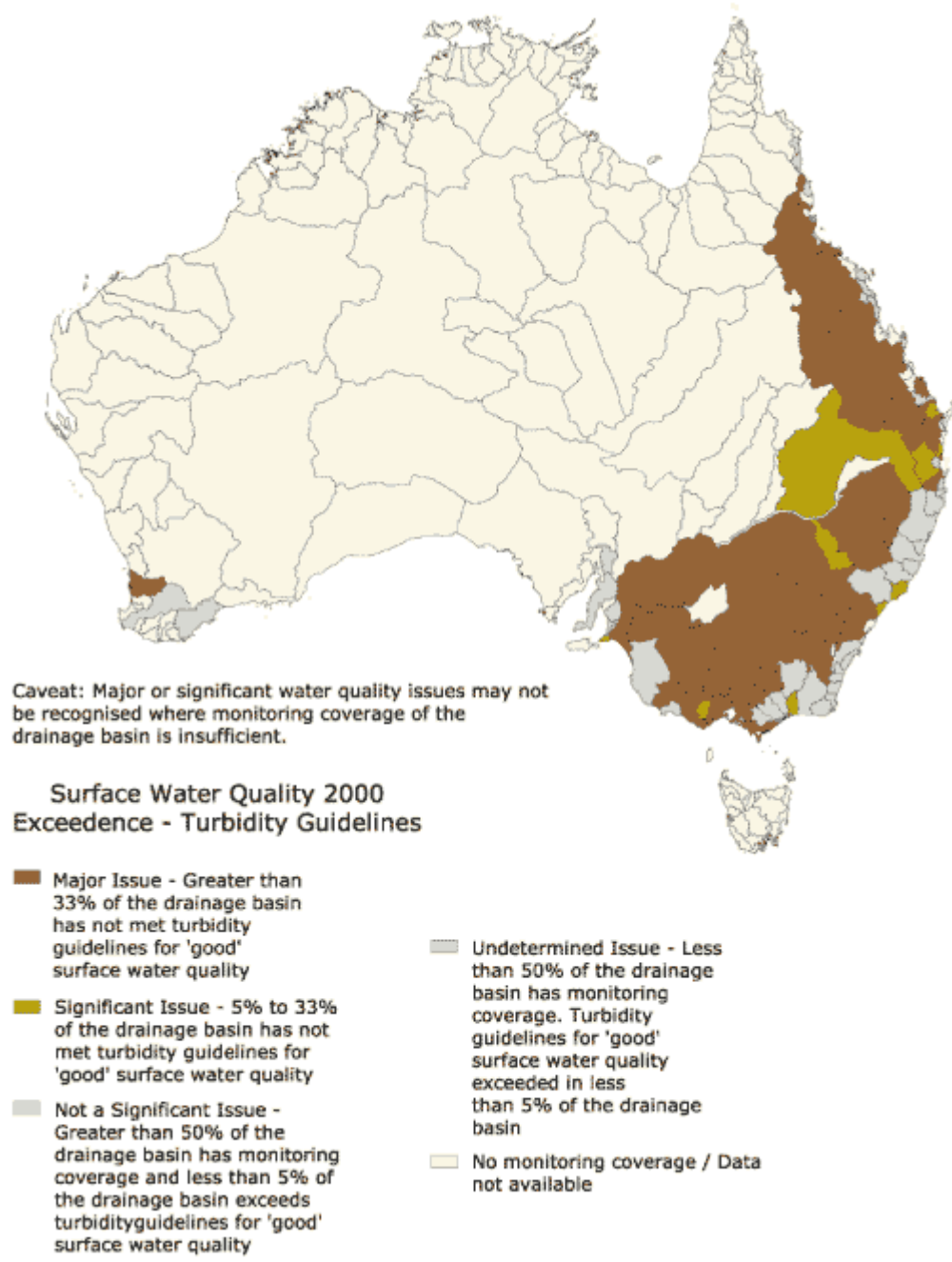
Performance indicator could be expressed as the proportion of industry participants within water quality guidelines for turbidity.

For general guidelines see ANZECC (2000) aquatic ecosystems chapter which provides turbidity trigger values for differing water ecosystems. These trigger values are variable and set the base from which specific catchment trigger points need to be developed.

Results to date

This indicator is not currently measured for most agricultural industries. Data were collated by the NLWRA but results are reported for regions and water catchments rather than industries (Figure). As a result the contributions from a particular industry

are difficult to separate out from contributions by other agricultural industries, other industries, other users in the region, or from nature. In regions where one industry dominates research may be able to tease out the contributions of the industry in this region. Data collation for the NLWRA was a once off, and data is unavailable for some catchments, particularly trends. A monitoring program could be set up for specific industries, following the ANZECC (2000) guidelines.



Source: NLWRA Australian Water Resources Assessment 2000

Possible responses

Land and Water Australia has been working with agriculture industries (wool, cotton and sugar) and with Research and Development Corporations to develop guidelines for dealing with agriculture's impacts on water quality.

Erosion control would provide significant reductions in sediment run-off loads, reducing turbidity. Riparian buffer strips of perennial vegetation should help reduce sediment and water run-off. Increasing turbidity where necessary is probably outside the scope of agriculture and mainly related to catchment management bodies.

Interactions with other components

Soil erosion by water, biodiversity conservation ecosystem components such as riparian zones. Turbidity also links closely to water nutrients and water temperature components.

External drivers

Natural turbidity levels. Erosion levels upstream. Water allocations/flow regimes.

[Return to component tree \(water\)](#)

Effects on the water cycle / Water Quality / Surface Water / Offsite

Microbiology

The microbiological organisms or pathogens (ie bacteria, viruses, and parasites) that an agriculture industry contributes to surface water.

This is not the impact of nutrients (for example) on offsite water microbiology. This is the direct contributions of microbiological organisms to offsite water. The contributions of microbiological organisms to water should be eliminated wherever possible. These can impact aquatic ecosystems and provide risks to food and farm safety. This component is specified in the Water Quality Guidelines chapter on primary industries (ANZECC 2000) and covered in the NLWRA water resources report (faecal coliforms) to some extent.

The component depends on the industry involved.

Desired outcome (operational objective)

Contribution of microbiological organisms should be minimised.

National high level outcome. Surface... water quality is maintained or enhanced (National NRM M&E Framework, 2003).

Indicator

Microbiological organisms discharged into water.

Alternatively, faecal coliform counts provide some indication of the levels of some microorganisms in the water. As these occur naturally, they would have to be compared to a guideline.

Interpretation (performance measure)

Performance measure could be expressed as the proportion of industry participants within water quality guidelines.

Trigger points for microbiological organisms are specified in the Water Quality Guidelines (2001). Ideally the contributions should be minimised or zero.

Results to date

This indicator tends to be specific to each industry involved, or even sectors of industries. Data may be obtained from the National Pollutant Inventory or from EPAs of each State. National Residue Survey takes samples for some industries. Dairy industry has been monitoring this component and the meat industry has been researching this component...

Data were collated by the NLWRA (faecal coliforms) but results are reported for regions and water catchments rather than industries. As a result the contributions from a particular industry are difficult to separate out from contributions by other agricultural industries, other industries, other users in the region, or from nature. In regions where one industry dominates, research may be able to tease out the contributions of the industry in this region. Data collation for the NLWRA was a once off, and data is unavailable for most catchments. A monitoring program could be set up for specific industries, following the ANZECC (2000) guidelines for primary industries.

Possible responses

This depends on the pathways that microbiological organisms are entering the water sources. Generally this component is only going to be significant where agriculture is intensive, such as dairy, feedlots, horticulture (if it uses manure). As a result, management techniques for point sources are most useful, such as best management practices for effluent and animal wastes.

Interactions with other components

Public health impacts, Groundwater water quality, Soil, Water nutrients (onsite and offsite).

External drivers

Temperature, water quality and other factors may affect whether microbes survive or not. Community attitudes on appropriate trigger levels.

[Return to component tree \(water\)](#)

Effects on the water cycle / Water Quality / Surface Water / Offsite

Temperature

Desired outcome (operational objective)

The contribution that an agriculture industry makes to surface water temperature.

This is the direct contribution of agriculture enterprises to water temperature. Variation of water temperature from 'natural' can have an impact on aquatic ecosystems directly as well as change the degree of other impacts (eg contaminants). This component is specified in the Water Quality Guidelines for aquatic ecosystems (ANZECC 2000).

Indicator

Water temperature change from 'natural' resulting from industry participants.

Interpretation (performance measure)

The proportion of industry participants that are exceeding (outside the bounds of) the water quality guidelines should be minimised.

For trigger values see ANZECC (2000) aquatic ecosystems chapter. The indicator needs to be compared to 'natural reference' ecosystems.

Results to date

This indicator is not currently measured for most agricultural industries. Temperature is relatively easy to measure, although comparisons with a 'natural' reference is more difficult. A monitoring program could be set up for specific industries, following the ANZECC (2000) guidelines.

Possible responses

Land and Water Australia has been working with agriculture industries (wool, cotton and sugar) and with Research and Development Corporations to develop guidelines for dealing with agriculture's impacts on water quality. This issue is discussed in the Cotton Riparian zone report.

The creation of Riparian buffer strips that approximate what was present 250 years ago (such as trees or sedges that provide shade) plus ensuring turbidity levels do not fall outside recommended levels, should provide some influence on water temperature and its variability.

Interactions with other components

Water turbidity and Riparian ecosystems are the primary linkages.

External drivers

Climate change. Other industries. Towns and cities.

[Return to component tree \(water\)](#)

Effects on the water cycle / Water Quality / Surface Water / Offsite

Other

Desired outcome (operational objective)

Indicator

Interpretation (performance measure)

Results to date

Possible responses

Interactions with other components

External drivers

[Return to component tree \(water\)](#)

Effects on water cycle / Water Quality

Groundwater

The contributions the agriculture industry makes to ground water quality.

For these components refer to the Surface Water / offsite components. Components for turbidity and water temperature are not relevant to groundwater.

Desired outcome (operational objective)

As for surface water offsite.

Indicator

As for surface water offsite.

Interpretation (performance measure)

As for surface water offsite.

Results to date

Information is limited. The NLWRA Water Resources Assessment 2000 reported on groundwater salinity. Although the same indicators can be measured for groundwater as surface water, only salinity seems to be measured consistently. The NLWRA reported results for regions rather than industries. Contributions from a particular industry are difficult to separate from contributions by other agricultural industries, other industries, other users in the region, or from nature. Data collation for the NLWRA was a once off, and data is unavailable for most catchments.

Possible responses

Interactions with other components

Soil components particularly salinity and acidity.

External drivers

Users in recharge zones can affect groundwater quality in discharge zones. Amount of recharge can affect water quality.

[Return to component tree \(water\)](#)

Effects on atmosphere and climate

Greenhouse gas emissions

The greenhouse gases that the industry emits (ie Carbon Dioxide and Methane) to the atmosphere.

Desired outcome (operational objective)

Minimise or maintain below specified limits.

Indicator

Greenhouse gas emissions as estimated by Australian Greenhouse Office.

Interpretation (performance measure)

Indicator should be as small as possible or below the specified limit.

Results to date

Greenhouse gas emissions have been estimated by the Australian Greenhouse Office for agriculture as a whole but not by individual industry.

Possible responses

Minimising tractor usage through minimum tillage, reduction in spraying etc.

Reducing animal numbers.

The Dairy industry has investigated methane reduction techniques to some extent.

Interactions with other components

Interacts with the carbon sequestration component. Net impact for carbon is emissions minus sequestration.

External drivers

[Return to component tree \(atmosphere/other\)](#)

Effects on atmosphere and climate

Other

Other impacts of the industry on atmosphere and climate including impacts on micro-climate, emission of airborne pollutants (pesticides, dust, smell) and noise. Many of these will be specific to a particular industry.

Desired outcome (operational objective)

To minimise impacts or maintain within acceptable limits. Limits may depend on location, eg proximity to populated areas.

Indicator

Interpretation (performance measure)

Results to date

Possible responses

Interactions with other components

External drivers

[Return to component tree \(atmosphere/other\)](#)

Bio-physical Systems / Effects on other systems

Effects on other systems

The effects of the industry on off-site systems other than through water and atmosphere. They include effects on other systems through removal of material (feed, fertilizer, fuel) and the effects on other systems through releases of material (weeds, animal pests, genes)

This component requires further sub-division that will be specific to individual industries.

Desired outcome (operational objective)

Indicator

Interpretation (performance measure)

Results to date

Possible responses

Interactions with other components

External drivers

[Return to component tree \(atmosphere/other\)](#)