CCRSPI

CLIMATE CHANGE RESEARCH STRATEGY FOR PRIMARY INDUSTRIES

Australian Government

Rural Industries Research and Development Corporation

Life Cycle Assessments: A useful tool for Australian agriculture

Climate change poses specific challenges for Australia's primary industries, with mounting public concern and media scrutiny about the way food is grown and distributed through markets. As well, there is increasing domestic and international legal and regulatory pressures to reduce greenhouse gas (GHG) emissions.

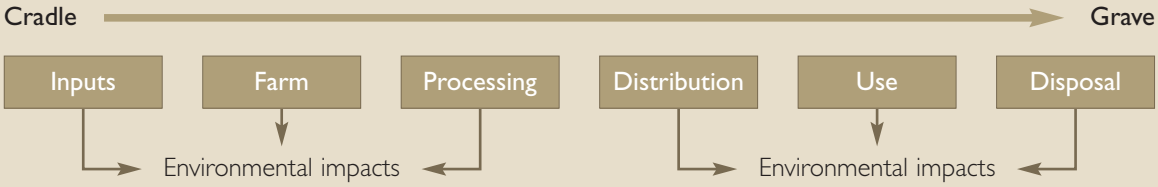
All primary industries use energy and water resources throughout their supply chains for purchased inputs, production, processing, refrigeration, transport and retail. Life Cycle Assessment (LCA) is a technique that enables industries to identify the resource flows (inputs such as energy and water) and environmental impacts (such as GHG emissions) associated with the provision of products and services. It is a tool that is being increasingly used by agricultural enterprises for evaluating the environmental impacts associated with a product, process or activity over its entire life cycle, from *cradle* to *grave*.

Why is Life Cycle Assessment important?

A glossary of climate change terms is provided at the end of this brochure.

Due to its systems-based approach, LCA gives the most detailed picture of the resource demands of a product, accurately informing 'triple bottom line' (i.e. economics, environmental and social) reporting. It is a tool that can better place the 'food miles' concept into perspective, and enables agricultural producers to respond to demands from consumer and environmental groups about the carbon and water footprints of agricultural products.

Scope of Life Cycle Assessment



LIFE CYCLE ASSESSMENT ASKS THE FOLLOWING QUESTIONS

Using renewable inputs?

Choice of extraction techniques?

Pollution from production or processing?

How will the product get to consumers?

How much energy will be used in the process?

How will the product be disposed of?

Can the product be recycled?

> "To manage emissions or sequester soil carbon on a mixed farm it is important that it be part of a whole farm life cycle assessment, rather than focusing on just one or two parts of the greenhouse gas emission story. LCAs for all our major crops and systems are fundamental for the grains industry to demonstrate its environmental credentials."
>
> Martin Blumenthal, Grains Research and Development Corporation

Photos: Alison Pouliot (front cover), Arthur Mostead (this page).

Life Cycle Assessment methodology

When undertaking an LCA there are four key steps that enable agricultural enterprises to gather information in a systematic way about the environmental impacts associated with the production of a particular good or service.

Steps	Tasks
1. Set goals and define scope	This step defines and describes the product, process or activity; establishing the aims and context in which the LCA is to be performed; and identifying the life cycle stages and environmental impact categories to be used for the assessment.
2. Develop an inventory analysis	This step identifies and quantifies energy, water, material and land usage, and the environmental release (e.g. air emissions, solid waste, wastewater discharge) during each life cycle stage.
3. Conduct an impact assessment	This step calculates likely financial and ecological effects of material consumption and environmental releases identified during the inventory analysis. Uses a risk assessment process.
4. Interpret results	This step integrates and explains the findings of the three preceding steps to develop policy, plans and actions to reduce environmental impacts.

Another way of showing the approach used to develop an LCA is below.

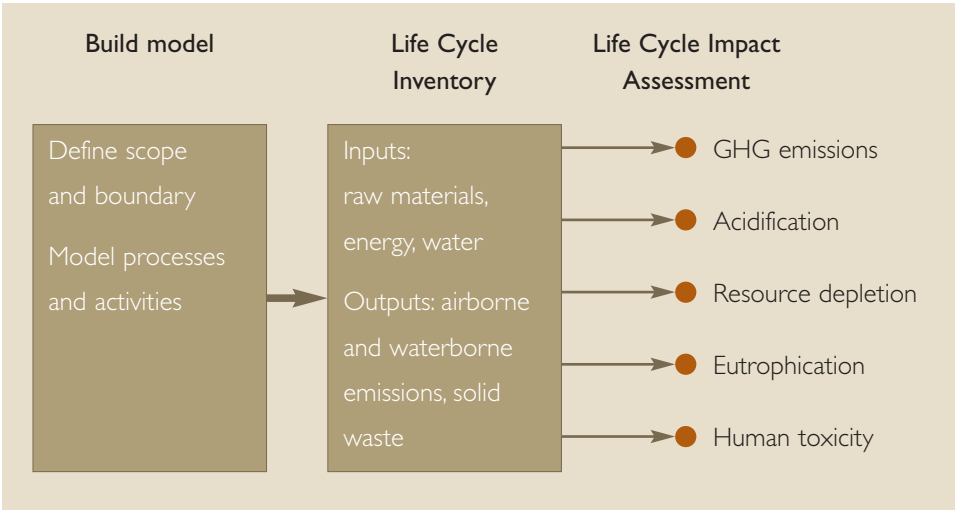
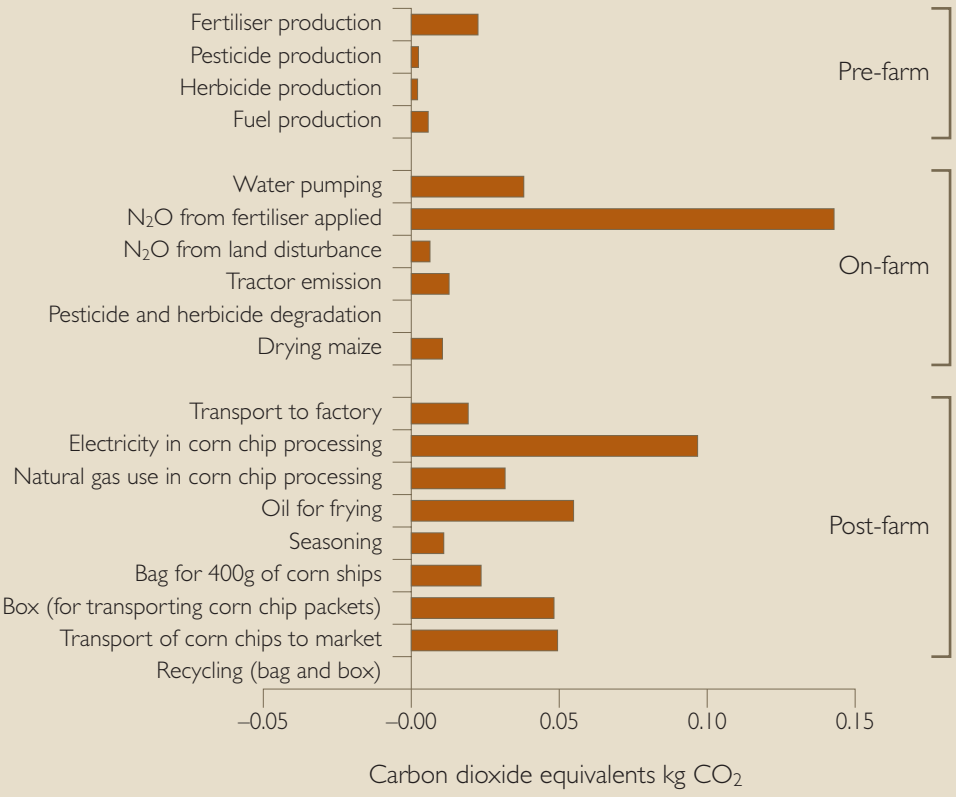


Photo Guy Roth.

An example of LCA — Smith's corn chips

Every year the Smith's Snackfood Company processes over 9000 tonnes of Australian grown corn into corn chips. The cost of foods like corn chips for the consumer are increasingly internalising the costs of environmental impacts on food systems (seen recently in terms of drought), and the introduction of an emissions trading scheme will have a further impact on the costs of some foods. In the corn chip example below, the LCA shows that 58% of the emissions from a packet of corn chips occur after the farm gate, in packaging, processing and retail. This information shows the Smith's company that the major source of GHG emissions from corn chip production is fertiliser emissions and electricity for processing. Knowing this will enable this company to make informed decisions regarding process improvement and reducing production costs, while also reducing environmental impacts.

Greenhouse gas emissions for a packet of corn chips



Source: Grant, T. & Beer, T. 2008, 'Life Cycle Assessment of greenhouse gas emissions from irrigated maize and their significance in the value chain', *Australian Journal of Experimental Agriculture*, vol. 48, pp. 1–8.

Photos: Allison Mortlock (chips), Biological Farmers of Australia / Soil Systems Australia (maize).

Life Cycle Assessment in action

LCA is increasingly being used to support regulatory and compliance systems. Overseas competitors are using LCAs to improve their practices and increase their market share, and it is now vitally important that Australian primary industries understand and use LCAs so they can maintain their presence in global markets.

LCA is a useful tool because it can provide detailed information to help businesses and industries better understand the environmental impact of their practices. It uses:

- **environmental accounting** — quantifies the environmental costs of industry activities and products across the life cycle,
- **supply chain risk management** — provides a better understanding of the environmental impacts of products provided by suppliers and identifies where risks lie given consumer preferences,
- **carbon accounting and trading** — the life cycle of carbon associated with products is the basis of determining 'carbon footprints' and can be an important source of information to enable participation in emissions and offset trading schemes,
- **production efficiency** — LCA shows industries where their greatest use of resources is and provides direction for efficiency gains.

Photos: Arthur Mostead (above), The University of Adelaide (below).

From the vineyard to the table — Yalumba wines

When the Yalumba Wine Company implemented a more structured approach to its 'commitment to sustainable winemaking' program, it wanted to clearly identify which of its activities along the value chain had a significant environmental impact. The application of a streamlined LCA was therefore a logical progression from the life cycle thinking and life cycle management that the company had adopted over the years. The LCA approach provided Yalumba with a holistic framework to strategically target its sustainability program effectively and efficiently. The LCA is proving an invaluable tool for Yalumba's business management and risk assessment.

Dr Cecil Camilleri, Manager of Sustainable Wines Programs

The diagram below identifies ways in which the outcomes of an LCA can be used by organisations/industries to demonstrate their environmental impacts, enhance product description, support decision making and meet reporting requirements. This is presented in the context of whether the issue is strategic or tactical, internal or external to the organisation/industry.

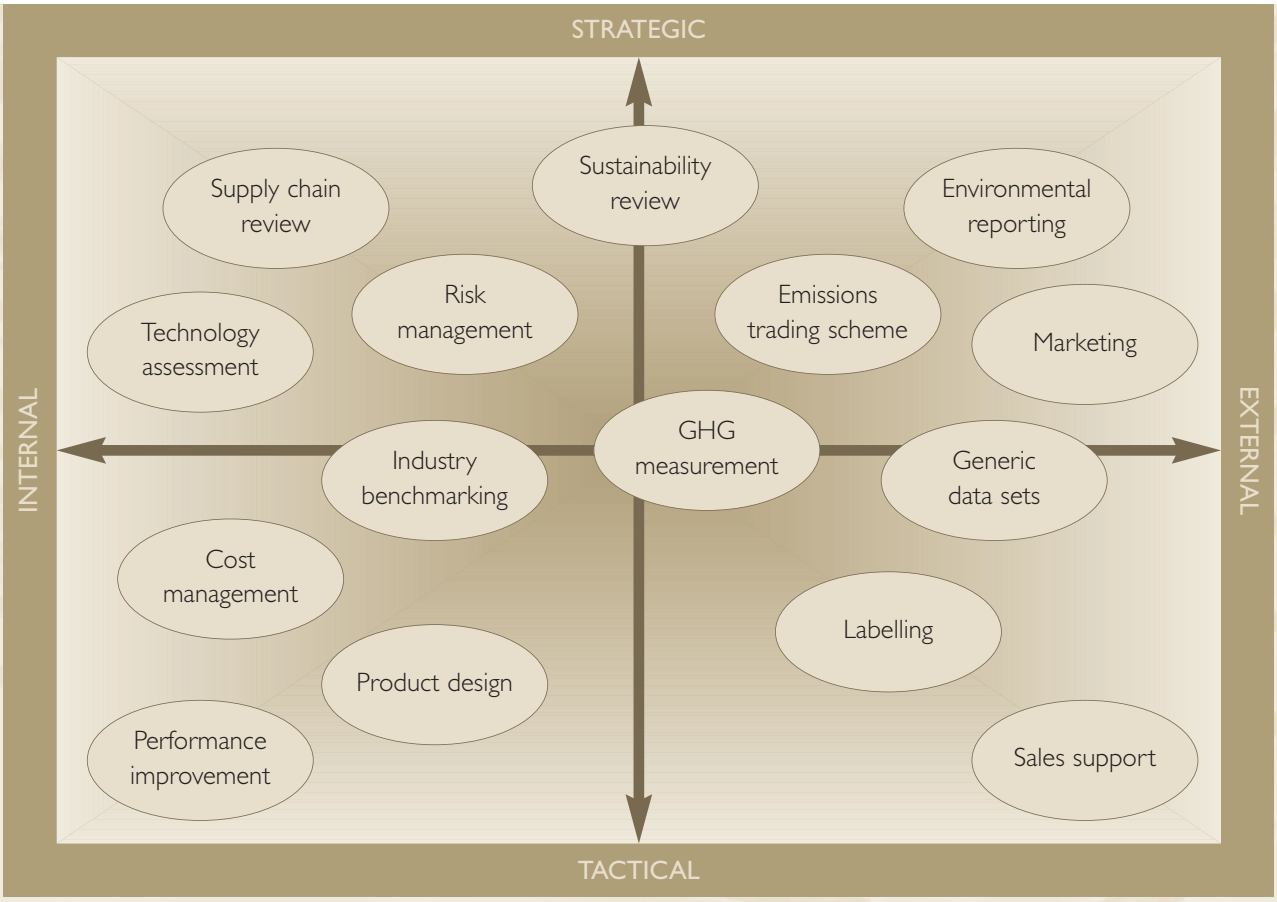


Photo RIRDC (chick),
Alison Pouliot (texture).

Using Life Cycle Assessment in Australian agriculture

LCA was originally developed for the manufacturing sector, and the technique requires modification to be able to be used in food and fibre production. Australian rural research and development corporations (RDCs) are currently collaborating in a number of areas to tailor the LCA approach for the domestic agricultural sector. There are five key areas of work being undertaken.

The ISO 14000 family of standards and guidelines addresses various aspects of environmental management. The aim of these standards and guidelines is to reduce the environmental footprint and decrease the pollution and waste a business produces — regardless of its size, location or income.

1. **Developing a standardised methodology**

   Although ISO 14000 exists, it allows considerable flexibility in various LCA methodologies. Differences in methodology choices have led to highly variable conclusions. A number of the rural RDCs, led by the Rural Industries Research & Development Corporation (RIRDC), have funded the development of a standard methodology for the use of LCA in agriculture in Australia. Work is ongoing on the methodology and results to date can be viewed via this weblink — https://rirdc.infoservices.com.au/items/09-028 (and https://rirdc.infoservices.com.au/items/09-029).

2. **Data availability**

   LCA needs good quality Life Cycle Inventory (LCI) data. While large LCI databases are available in Europe and the USA for inputs such as fertiliser and pesticides, the same inventories do not yet exist in Australia. AusLCI is an initiative to develop standard database arrangements for all major emitters in Australia, including agriculture. Industries are currently being engaged through the RIRDC process to consider the AusLCI initiative (http://www.auslci.com/).

3. **System boundaries**

   The system boundary defines which processes, activities and products will, or will not be included in an LCA. Some studies stop at the farm gate, while others follow the product to the plate. Systems can also operate across an enterprise or business unit, as well as focusing on a product or process. Developing standard arrangements for system boundaries is being considered as part of the further LCA methodology development discussed in point one above.

Photo Australian Pork Limited.

4. **Allocation of resource usage and environmental impacts**

   Most agricultural systems produce more than one product, for example, wheat farming produces grain and straw; and beef enterprises produce meat and leather. There are different ways of allocating the input resources and the resulting environmental impacts across each of the products that are produced. Some level of agreement as to the best way to do this is being considered as part of further methodology development.

5. **Communication**

   There are many challenges in obtaining LCA data and presenting and marketing its results. LCA is a complex process which needs to be carefully communicated with consistent, clear and reliable messages. This is fundamental to the development of a standard methodology so the consumer is comparing 'like with like'. Work is being undertaken to develop an LCA that suits the Australian environment, making it easier for agricultural producers to use LCA and communicate the results to their customers.

Next steps

Workshops held across Australia with primary producers have shown that LCAs are one of the key concerns throughout the sector. To date, some initial LCA studies have been conducted, and more are underway to determine the 'cradle to grave' environmental impacts of different agricultural products in the Australian context. Specific studies include dairy, beef, eggs, chicken meat, grains, cotton, wine and sugar. Most of these studies are the first attempt at LCA for that industry, and work is also ongoing to resolve differences in methodology and system boundaries. The RIRDC is committed to providing agricultural industries with information as soon as it is available.

Photos: Arthur Mostead (cattle), LWA (wheat), Richard Humphrys (bales), Johann Jaritz (steak).

Who is RIRDC?

RIRDC Innovation for rural Australia

RIRDC is a rural research and development corporation that strives for a more profitable, dynamic and sustainable rural sector by maximising knowledge outcomes from research and development (R&D) investments in:

- new industries — such as coffee, alpacas and olives,
- established industries — such as horses, chicken meat, rice and fodder crops,
- national rural issues — comprising those major issues that cut across sectors and regions, such as trade liberalisation, climate change, food security, and increasing community resilience through work on-farm health and safety, leadership and learning.

RIRDC has strong collaborative partnerships with other rural RDCs and other R&D investors and providers. RIRDC is an an active member of the CCRSPI partnership — collaborating, coordinating and communicating so that information can be shared, knowledge generated, and responses developed to deal with climate change. Additional fact sheets and information on RIRDC can be accessed at www.rirdc.gov.au, or contact RIRDC directly by telephoning 02 6271 4100 or by e-mailing rirdc@rirdc.gov.au.

What is the Climate Change Research Strategy for Primary Industries (CCRSPI)?

CCRSPI works through collaboration, coordination and communication.

CCRSPI is a collaborative partnership between all state and territory governments; the rural RDCs; experts from the university sector and the Federal Government (through the Department of Agriculture, Forestry and Fisheries and the CSIRO). CCRSPI was set up in recognition of the need for a national response to the challenges of climate change, and the reality that research dollars are better invested when duplication is avoided and knowledge is shared.

RIRDC is a partner of CCRSPI and has been a strong supporter of the need for coordinated research and sharing of knowledge between primary industries on this important topic.

For more information www.ccrspi.com.au

Photo Arthur Mostead.

Climate change glossary

Abatement is the reduction of greenhouse gas (GHG) emissions or enhancement of GHG removal from the atmosphere by sinks such as forest planting or carbon storage in agricultural soils.

Adaptation to climate change is a response to the impacts of changing environmental factors such as temperature and rainfall on production systems, and the social and economic consequences of these environmental impacts. Adaptation can occur in a planned manner in response to known changes, or in an autonomous manner as farming systems change gradually over time.

Biosequestration is the removal from the atmosphere and storage of GHG through biological processes such as growing trees, and practices that enhance soil carbon in agriculture.

Carbon accounting is the accounting undertaken to measure the amount of carbon dioxide equivalents (CO_2-e) that will be released into the atmosphere as a result of a defined activity or process or at the whole of enterprise level. Carbon accounting can focus solely on carbon, or can convert all GHG into a carbon equivalency figure. Australia has a National Carbon Accounting System details of which can be found at http://www.climatechange.gov.au/ncas/index.html

Climate change is the term used to refer to changes in long-term trends of environmental factors such as temperature and rainfall. These changes can be due to natural variability or as a result of human activity.

Carbon footprint is the total amount of GHG produced to directly and indirectly support human activities. It is usually expressed in equivalent tonnes of carbon dioxide equivalent (CO_2-e).

Photos: Roger Charlton (olive grove), courtesy of Fisheries R&D Corporation (fish), Alison Pouliot (ripples).

Carbon neutral is when an activity, event, household, business or organisation can voluntarily declare carbon neutrality by reducing GHG emissions, and purchasing offsets such as 'green' energy for any residual emissions in order to achieve zero net emissions.

Carbon sequestration is the long-term storage of carbon from the atmosphere. Trees (and all plants) sequester CO_2 from the atmosphere through the process of photosynthesis. CO_2 can also be sequestered in soils.

Carbon sinks are processes that remove more CO_2 from the atmosphere than they release. Trees, soils and oceans are important carbon sinks.

Food miles is a term that refers to the distance food is transported from the time of its production until it reaches the consumer. It is one dimension used in assessing the environmental impact of food, and the sustainability of food production systems.

Fugitive emissions are those emissions that are released in the course of product processing or resource extraction, e.g. leaks from gas pipelines and waste methane from black coal mining.

Greenhouse gas (GHG) emissions refer to the six gases recognised under the Kyoto Agreement that cause global warming. These are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). These gases are measured as carbon dioxide equivalents (CO_2-e). This measure is used to compare the emissions from various GHGs based upon their global warming potential. For example, the global warming potential for methane over 100 years is 21. This means that emissions of 1 million tonnes of methane are equivalent to emissions of 21 million tonnes of carbon dioxide over a 100 year period.

Mitigation is a human intervention to reduce the sources of, or enhance the sinks for greenhouse gases, e.g. biodigestion of farm manure for electricity generation, methane capture and flaring, or planting trees on farmland.

Photos: Richard Humphrys (truck), Arthur Mostead (plantation), RIRDC (chimney). Chris Baty (boats). Back cover Australian Wool Innovation.

Useful links

Australian Life Cycle Assessment Society — **www.alcas.asn.au**

Victoria Eco Innovation Lab's Submission to the Senate inquiry into food production in Australia — **www.ecoinnovationlab.com/reportssubmissions/145-submission-senate-inquiry-into-food-production-in-australia**

Adelaide Thinkers in Residence, Vine to Dine: sustainable value chain analysis case study of South Australian wine — **www.pir.sa.gov.au/wine**

Environmental Protection Agency Victoria's summary of LCAs — **www.epa.vic.gov.au/lifecycle/whatis.asp**

Department of Climate Change's explanation of LCAs and contact details for LCA panel — **www.climatechange.gov.au/greenhousefriendly/business/lca.html**

Dr Cecil Camilleri of Yalumba Winery's peer-reviewed paper from the 2009 Australian Conference on Life Cycle Assessment — **www.yalumba.com/library/ccamilleri%20LCA-VCA.pdf**

For further information

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Australian Government
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RIRDC Innovation for rural Australia

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CLIMATE CHANGE RESEARCH STRATEGY FOR PRIMARY INDUSTRIES

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