ASSESSING THE ENVIRONMENTAL IMPACTS OF THE GRAINS INDUSTRY: AN OVERVIEW

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Summary. As part of its response to the Ecologically Sustainable Development challenge for agriculture the Grains Research and Development Corporation is sponsoring an environmental assessment of the grains industry. Environmental assessments should cover the extent, severity and trends of unintended consequences that may result from the operations of the grains industry. The grains industry system is described as a series of subsystems within the biophysical environment which, through various processes and inputs, has impacts on the environment (biophysical, operational and human). The grains industry, and agronomists, would benefit from adopting the concept of product stewardship as a means of promoting the ecological sustainability of the resource base.

INTRODUCTION

The challenge for Australia's cropping industries is to ensure that they contribute to long-term productivity and to economic well-being, protect the biological and physical resource base on which agricultural industries depend, and improve human health and safety - i.e. that they promote ecologically sustainable development (3). Although the large majority of Australians are unaware or unsure of the Ecologically Sustainable Development (ESD) process, there is nonetheless a high level of public concern in Australia about the environment that includes water pollution, land degradation and land clearing as major issues (4).

The grains industry in Australia is a large and complex one. Any one of 25 crops may be produced on numerous farms across Australia; harvested grain might follow one of several pathways, along road and rail networks to the various storage facilities; much of it will arrive at processing destinations to provide a range of products to the final consumer. Each of these stages relies on complex processes which make use of external and natural resources to create various desirable (grain or food) and undesirable (environmental degradation) outcomes. As part of its response to the ESD challenge, the Grains Research and Development Corporation (GRDC) is sponsoring an environmental assessment of the grains industry. The assessment will focus on the unintended consequences to the environment of the inputs and processes of getting grain-based products from farm paddocks onto consumer plates. This paper outlines our approach and briefly discusses some possible responses.

A GENERAL FRAMEWORK

A comprehensive environmental assessment would include the full range of impacts and provide an understanding of the extent of the issue and of trends over time. For this study, time and area have been defined as a generation, or 30 years, for the broadacre, dryland cropping regions of Australia.

The grains industry may be considered as a set of sub-systems operating within, and impacting on, the larger biophysical environment. They are:

- agri-supply sub-system providing agricultural inputs (e.g. chemicals and fertilisers);
- the crop production sub-system on farms;
- the transport and storage sub-systems on roads, rail and depots; and
- the grain processing sub-system producing human or animal foodstuffs.

Each subsystem consists of components - the inputs, the processes and the products - which interact and exchange with the biophysical environment to produce environmental impacts. The products, as commodities or processed food, are eventually exported from the grains industry.

It is important to recognise that undesirable environmental consequences may arise either from the processes involved or from the inputs to each subsystem. Examples of impacts arising from processes are land degradation resulting from farming operations or waste products resulting from food processing operations. Examples of environmental impacts arising from the use of inputs are cadmium residues in food derived from fertiliser contamination or chemical residues in grain from pest control operations.

Some environmental impacts may be considered as confined to the sub-system in which they arise. Soil acidity is an example of an environmental impact arising from cropping operations which remains largely confined to the crop production sub-system. Conversely, some environmental effects arising within a sub-system may impact on the total biophysical environment. Chemical contamination of water, whether from farming, storage or processing operations, can have impacts widely dispersed from the operational environment. It is highly significant that energy, supplied mostly as fuel and electricity to the operations, is unusual in terms of the environmental assessment of the grains industry: energy is a major input for all sub-systems in the progress from paddock to plate, and the impacts on the biophysical environment commonly include, among others, air quality and climate change.

ENVIRONMENTAL ASSESSMENTS

To facilitate the analysis, the individual environmental components and characteristics that might be affected by these processes and residues have been grouped under the headings of operational sub-systems (for farm, storage, transport and processing), biophysical environment, and human environment (Table 1).

Table 1. Components and characteristics of the environment assessed as extent (E), severity (S) and trend (T) for residues and processes in the grains industry.

System components	Characteristics	Criteria		
		E	S	T
	1. Operational subsystems			
farm	grain quality, alternate land uses, energy, wastes			
storage	alternative land uses, energy, grain residues			
transport	alternative land uses, energy, grain losses			
processing	alternative land uses, energy, wastes			
	2. Biophysical environment			
land	erosion, deposit/sedimentation, salinity, acidity, chemical residues,			

	drainage/waterlogging
surface water	solids, chemicals, nutrients, flow regime
ground water	movement, chemicals, nutrients
air quality	chemicals, solids, odour
biodiversity	flora, fauna, microbia
climate change	greenhouse gases, temperature, rainfall
3. Human environment	
amenity	noise, aesthetics
health & safety	illness, injury, hospital services, medical costs

The focus is on the cumulative effect on an environmental characteristic, rather than the impact contributed by individual operations. Any single operation, although intended to affect only production, is likely to impact on more than one environmental characteristic. Many such impacts are not immediately obvious and rarely measured, but are known to vary with soil factors, such as pH and texture, and climate attributes, such as rainfall and temperature. The validity of the environmental assessments will depend on extent and accuracy of data, information and the degree of understanding of these impacts.

Assessments of the impacts need to be based on the criteria of extent, or probability, of the effect (E), its severity of impact (S) and trend (T) for increasing, stable or diminishing impact. A good example of a diminishing impact is the level of chemical residues in grain for export. The percentage of samples containing residues (E) has consistently fallen during the period 1989 to 1992 (T). Most of the residues were detected at levels well below the maximum residue limit (MRL) permitted for each chemical (S) and show a very high compliance for wheat grain. The residues detected were mostly those of grain protectants used in the storage sub-system and hence reflect recent moves to use less chemicals in this sub-system.

Assessments thus should be concentrated on those environmental impacts that cover the largest area and have greatest severity and diminish with smaller areas and lesser severity. An important aspect will be estimating the trend, since this will determine the likely future significance of issues.

There are environmental impacts - air quality, health and safety, climate change, amenity values and chemical residues - that are common to all sub-systems. Other environmental impacts accrue largely from a particular sub-system, such as that on biodiversity, surface water, land resources and ground water from the crop production sub-system.

Within all the operational sub-systems impacts occur on energy efficiency, wastes, quality and the potential for alternate land uses. Within the crop production sub-system for example, effects on grain quality arise from contamination by heavy metals (such as cadmium, lead and mercury) that are taken up from either soil, fertiliser, or atmospheric deposition. Used chemical containers may pose a problem in this sub-system because their wastes are concentrated.

The biophysical environment experiences many impacts from the grains industry. Coarse assessments of land degradation, prepared for the Decade of Landcare (2), indicate that the cropping areas of Australia are likely to be at risk from at least one form of land degradation, and often multiple forms. Furthermore, one likely consequence of high levels of erosion after storms is the impact on water quality, such as turbidity, eutrophication and residues resulting from the considerable amounts of phosphorus, nitrogen and chemicals attached to the transported plant or soil particles. Some other less well known issues are those relating to ground water, air quality, biodiversity and climate change. For example cropping, by a combination of land clearing, herbicide use and cultivation, has great impacts on biodiversity (1). Also cropping operations such as stubble burning, soil carbon rundown, nitrous oxide emissions from fertilisers and fossil fuel emissions contribute to greenhouse gas emissions. The result might be that a farm could vary from a sink of 5 t CO_2 equivalent/ha to an emitter of up to 6 t CO_2 equivalents/ha (5).

Amenity values such as aesthetics and noise are important components of the human environment. Likewise, aspects of health and safety - illnesses, injuries, the provision of extra emergency, hospital and medical services - are affected by the operations of the grains industry.

RESPONSES

Governments have responded to concerns from consumers by legislating for certain standards of food hygiene and safety, and recently, to control the amount of land clearing in some states. Market forces are pushing processors to seek out producers who can supply them with products of a standard quality. Governments are assisting agri-industries to manage their responses through research, marketing, and export enhancement programs.

For the grains industry the time horizon used in this analysis invokes the concept of *land stewardship*, the care for the resource base on which cropping depends. This entails responsibilities to stakeholders (employees, suppliers, government, local community); customers, and the next generation.

The chemical and fertiliser industries have recently adopted *product stewardship* for the responsible care of chemicals from *cradle to grave*. It is likely that they will be taking an increasingly active interest in how chemicals are used and disposed. In addition, legislation on safe use of chemicals and the use of residues as a non-tariff trade barrier make a strong case for the grains industry to also adopt product stewardship. Because it links environmental concerns with marketing and consumer preferences, the grains industry could use this concept to improve its customer relations and to encourage thinking beyond the farm gate to truly develop a responsible market-oriented attitude.

This overview highlights the paucity of information available on environmental impacts. A national program of monitoring trends of these impacts is a major issue for the effective management of the agricultural resource base.

Agronomists, as service providers to agriculture, can contribute to reducing the unintended environmental consequences of cropping and to bettering the status of resource base by:

• promoting the stewardship ethic for land and product;

• collaborating in research to gather findings with wider application and better understanding of all impacts - intended and unintended; and

• integrating findings into extension and decision support that is transferable as knowledge based systems.

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