Sustainability in a Commercial Context: Potential for Innovative Market-based Approaches

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Contents

Tables

Figure

Boxes

Abstract

Australia as an agricultural exporter faces both challenges and opportunities in the changes taking place in international markets and institutions. During the past decade, many countries throughout the world have been adopting more outward-oriented growth and development strategies aimed at integrating their national-level political, economic and environmental institutions with those at supranational and global levels. Australia actively participates in international organisations which promote harmonisation of national environmental standards. Australia also supports the Organisation for Economic Cooperation and Development's (OECD) effort to encourage member countries to pursue common policy approaches to sustainable development and the OECD's harmonisation activities related to agriculture. These trade and other policy reforms have important implications for Australia's export-oriented agricultural sector.

If the APEC region delivers on its promise to achieve free trade by 2010 or 2020, and includes agriculture as part of that liberalisation (a tall order, but that is what is currently promised), exports of farm products from Australia, particularly to East Asia, could grow very substantially. Since Australia already has high standards relative to other agricultural exporters, its competitiveness in international markets could be enhanced by upward harmonisation of existing standards as well as increases in other countries' production costs. Given the inexorable trend toward 'greener, cleaner' preferences for both products and production processes, it would be wise for Australia to concentrate its research efforts on maintaining its farmers' reputation as low chemical users.

The challenge for Australia will be to minimise the risk of food-importing countries thwarting new export opportunities. Australia can do this by being vigilant and active in the committees of pertinent international institutions, by maintaining our credibility through examples set by our own domestic policy choices, and by astute research investment decisions so as to develop appropriate production methods and products that maximise farm profitability in the wake of ever greener preferences of consumers at home and abroad.

Market-based incentives can filter though the entire economic system and their success will, in part, depend on the institutional framework being adaptable and flexible. Market-based approaches can falter due to market and institutional problems such as price-based causes of environmental degradation including externalities, underpricing of inputs, resources and outputs, lack of information and incomplete property rights, all of which affect agriculture in Australia.

The effectiveness with which price signals passing between consumers and agricultural producers may act as incentives for the adoption of sustainable practices depends on many factors. The most critical are:

- the degree to which consumer beliefs about sustainability are linked to price incentives, and
- the extent to which price signals passing between producers and consumers are modified by the processing sector.

The potential for signals from foreign consumer markets to provide incentives to farmers to adopt sustainable farming practices appears as limited as is the case with domestic consumers. This is especially so considering the diversity of foreign markets that are buyers of our agricultural commodities. However, to the degree that foreign consumers' concerns about issues such as food safety encourage the international harmonisation of standards and environmental practices, current trends in international trade forums encourage the adoption of sustainable practices.

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List of Abbreviations

ANZ	Australia and New Zealand
APEC	Asia-Pacific Economic Cooperation or Asian Pacific Economic Community
CFCs	Chlorofluorocarbons
DNA	DeoxyriboNucleic Acid
EPA	Environmental Protection Authority
ESD	Ecologically Sustainable Development
FAO	Food and Agriculture Organisation
GATT	General Agreement on Tariffs and Trade
ISO	International Standards Organisation
LWRRDC	Land and Water Resources Research and Development Corporation
NASAA	National Association for Sustainable Agriculture Australia
MEAs	Multilateral Environmental Agreements
NSESD	National Strategy for Ecologically Sustainable Development
OECD	Organisation for Economic Cooperation and Development
RIRDC	Rural Industries Research and Development Corporation
SEPP	State Environmental Planning Policies
SPS	Sanitary and Phytosanitary
TBT	Technical Barriers to Trade
UNCTAD	United Nations Conference on Trade and Development
UNEP	United Nations Environment Programme
WHO	World Health Organisation
WTO	World Trade Organisation

1. Introduction

1.1 Background

The increasing emphasis on sustainability presents today's farmers and agricultural policymakers with new opportunities and policy and research challenges. Institutional structures such as marketing, regulatory and research and extension systems require assessment of their ability to assist Australian agriculture meet domestic and international concerns about food safety and ecologically sustainable development.

Until recently, accounting for the environment or the concept of ecologically sustainable agriculture was seldom included in Australia's agricultural development policies. During the past decade or so, however, increasing international economic integration and heightened environmental concerns abroad, as well as changing attitudes at home, have forced Australian policymakers to rethink agriculture's relationship with the environment. There has been a significant research effort to develop ways of improving the biological sustainability of agricultural production, but only a recent emergence of interest in the role of institutions, price signals and markets to reflect the economic nature of the sustainability problem. Market-based approaches to identify and value environmental characteristics associated with production systems are emerging in a number of sectors and there are a range of regulatory approaches which embody market-based mechanisms (eg. tradeable pollution permits).

1.2 Objectives of the project

The broad objectives of this research project 'Sustainability in a Commercial Context: Potential for Innovative Market-based Approaches', supported by LWRRDC, are to:

- assess the trends in trade regarding environmentally friendly and sustainable production systems; and
- evaluate the implications of those trends for Australian producers, policymakers and R&D providers.

It is important to understand the international and national trends that are associated with environmental attributes of agricultural production systems because, as environmental constraints and opportunities to trade take on more prominence, the commercial importance of sustainable production systems will increase. In Section 2, 'International Developments and Sustainable Agriculture in Australia', Randy Stringer and Kym Anderson assess the current trends in global trade with respect to environmentally friendly and sustainable production systems, evaluate the implications of these trends for producers, industries and national-level policymakers, and identify the R&D implications and opportunities in relation to trade and market access strategies for Australian products.

In this project we also review how domestic and international concerns about sustainability and existing market structures have an impact on crop-based farming systems in north-west New South Wales. In Section 3, 'Why Markets for Natural Resources Might Fail', Fiona Scott examines some of the reasons why farmers might not use natural resources in a way that is acceptable to the broader community, both now and in the future. These reasons include attenuated property rights and consequent externalities, lack of knowledge about the long-term impacts of technologies, and inappropriate government intervention in input and output markets.

In Section 4, 'Market-based Approaches for Sustainability', Fiona Scott outlines market-based approaches by industry and government with the potential to make a significant contribution to overcoming sustainability problems.

In Section 5, 'Market Signals and Sustainability', Geoff Kaine evaluates the potential for innovative market-based approaches to improve the efficiency of price signals in providing feedback between consumers and producers, and commercial incentives for more sustainable production systems.

2. International Developments and Sustainable Agriculture in Australia

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2.1 Introduction

Over the past 50 years, agricultural policies, technological advances and substantial changes in relative prices have transformed Australian rural society and its ability to produce crop and livestock products. The search for economies of scale and new market opportunities has led to a persistent trend towards intensification, specialisation and concentration of agricultural production. This process has had profound impacts on outputs, inputs, and the resource base of Australian agriculture. During the past four decades, Australia's total agricultural land area increased by more than one-third in aggregate and doubled per farm, the area under irrigation expanded sixfold, the volume of farm chemicals used per year trebled, and the annual volume of farm production more than doubled. Yet the agricultural workforce has declined by a quarter and the total number of farms has fallen from 200,000 to 120,000 (ABARE, 1996; ABS, 1996).

These long-term trends in agricultural expansion, intensification and specialisation have brought about extensive changes in the use of natural resources and environmental goods and services. While crop productivity growth has been sustained by ever more intensive land use practices, by-products have been soil structure decline, wind and water erosion, and increased levels of soil salinity and acidity. Dairy and beef activities (especially cattle feedlots in the Murray-Darling Basin) are becoming more intensive and more dependent on purchased feeds, causing waste disposal and contamination problems. Pig, poultry and egg production are even more like industrial activities, using little farmland directly but very dependent on purchased feeds and also producing waste disposal and contamination problems.

These changing technologies and management systems use soil, landscape, vegetation and water resources, not to mention farm chemicals, in ways that often result in pollution, contamination, resource degradation and habitat loss. In the case of intensive livestock operations and pesticide sprays, they also contribute to air pollution. A recent Prime Ministerial statement values Australia's annual land degradation alone at $1.5 billion, or 6% of the value of agricultural production (Gretton and Salma, 1996).[1]

For years, domestic policies inducing Australia's agricultural transformation were guided by socioeconomic objectives that seldom included explicit valuation of the environment, much less the concept of ecologically sustainable agriculture. Growth in production, enhanced producer income, stable prices for producers and consumers, and increased net exports of agricultural products tended to be the dominant objectives of farm policy in Australia. Policy instruments used to achieve these objectives included generous tax concessions for land clearing, publicly funded capital works to expand irrigation, and large fertiliser price subsidies.

During the past decade or so, however, increasing international economic integration and heightened environmental concerns abroad, as well as changing attitudes at home, have forced Australian farmers and policymakers to rethink the role agriculture can play in the economy and society and environment. For example, following the 1987 publication of the Brundtland Report by the World Commission on Environment and Development (WCED, 1987), the principle of sustainable development gradually became a guiding principle for Australian agriculture (see Box 1). The current trend at both local and national levels is to aim for more emphasis on sustainable agricultural development, recognising its dual goals of economic efficiency and environmental protection. Agriculture is broadening its role beyond increasing productivity, expanding export earnings and enhancing rural incomes to include also evolving concepts of managing ecological processes and protecting environmental resources. In this it is being accompanied by similar trends in other OECD countries and, increasingly, in middle-income countries as well.

[1] Production foregone is a static measure of the extra value of production that would have been obtainable with current land uses had there been no degradation. This valuation ignores the following: accumulated net benefits to the community of past agricultural production; accumulated net benefits due to the productivity of farming activities in those areas where degradation occurs; and the degradation that may occur due to farming practices becoming more specialiszed even though land productivity increases. For these reasons, the production equivalent is not a true reflection of current degradation costs. See Gretton and Salma (1996) for more details.

Box 1: *Ecologically sustainable agricultural development in Australia*

Australia began developing an ecologically sustainable development (ESD) program for agriculture in 1990 as part of a much larger National Strategy for Ecologically Sustainable Development (NSESD). NSESD was motivated by the 1987 report by the United Nations WCED (the Brundtland Report), *Our Common Future* (WCED, 1987). *Our Common Future* raised the level of international concern over whether current economic growth patterns could be sustained without significant changes in attitudes and actions.

Australia responded to this global challenge by committing to a process of adapting sustainable development concepts, programs and policies to domestic socioeconomic conditions, including prevailing agricultural production, consumption and trade patterns (NSESD, 1992). Policies to ensure the protection of essential ecosystem functions from degradation by agricultural activities have resulted from domestic pressures from an increasingly environmentally aware public, the scarcity of clean water and intact riverine ecosystems, and increasingly health-conscious consumers.
The major agriculture-related environmental problems include land and water degradation, water pollution, and human health risks from chemical residues in food (ESD, 1992). Specifically, Australian agricultural practices involve a number of potentially negative environmental consequences. For example:

- *poor irrigation practices* may lead to salinisation of water and soil and increased nitrate pollution of groundwater;
- *fertiliser use* can result in nitrate leaching into soils and water, eutrophication, and reduced soil fertility;
- *pesticide use* is associated with food contamination, risks to farm workers' health, water and soil contamination, and loss of plant and animal species;
- *land conversion* often involves deforestation, habitat loss, erosion, and degradation of water systems; and
- *machinery use and animal grazing* compact soil, reduce soil productivity, and disturb soil ecosystems.

Agriculture represented one of nine sectoral ESD Working Groups established in 1990 to examine sustainability issues and provide the foundation for policy directions. The Council of Australian Governments endorsed NSESD in December 1992, stating that the strategy was crucial in setting the scene for broad changes in directions and approach that governments take to ensure that Australia's future development is ecologically sustainable.

NSESD and Australia's agricultural policies in general are linked to international activities through treaty obligations and commitments. For example, Australia and other governments adopted the United Nations' action plan for sustainable development, Agenda 21, at the United Nations Conference on Environment and Development (UNCED) in 1992. UNCED resulted in a broad new mandate for environmental actions, programs and policies. While Agenda 21's overall focus is on global actions for sustainability in the twenty-first century, it commits individual countries to ensure their own national development is sustainable. Australia's NSESD accommodates this commitment.

This increasing emphasis on sustainability presents today's farmers and agricultural policymakers with a set of new opportunities but also with some policy challenges. The latter include:

- how to amend appropriate market incentives, institutional structures and regulatory systems so that they not only are compatible with ecologically sustainable agricultural development locally and nationally but also are able to meet standards agreed to internationally; and
- how to promote public and private research efforts in ways that encourage the adoption of sustainable technologies and management systems.

To address these tasks, producers, suppliers, processors, marketing bodies, industry associations, and governments need answers to several questions. First, what would be the future size and composition of Australian agriculture in an ever more integrating global economy under present environmental policies, bearing in mind ongoing economic growth, the Uruguay Round and APEC trade policy reform commitments? Second, what impact would recent or prospective international environmental agreements have on Australian agriculture, both directly via Australia's policy compliance and indirectly via changes in international prices of farm products. Third, what additional impact can be anticipated from unilateral changes to environmental policies at home and abroad? Fourth, how might Australian farmers respond to changes in consumer concerns for resource conservation and the environment? And finally, how should Australian agricultural research and development efforts, in particular, contribute to the Australian farmer response to these domestic and international developments? Each of these questions is considered in turn below.

2.2 Global economic growth, trade agreements and Australian agriculture

During the past decade, many countries throughout the world have been adopting more outward-oriented growth and development strategies aimed at integrating their national-level political, economic and environmental institutions with those at supranational and global levels. Economic and environmental integration initiatives include a revival of regionally based arrangements, further economic integration through the GATT/WTO, proliferation of multilateral environmental agreements, globalisation of manufacturing through foreign investments, widespread liberalisation of financial and foreign exchange markets, international technology transfers via trade and aid, global use of information technologies, and the diffusion of homogeneous consumer goods throughout the world. This ongoing integration has involved some harmonisation of national trade policies, environmental standards, legal codes, tax systems, property rights structures and other regulatory arrangements, as well as the creation of supranational regulation (Sachs and Warner, 1995; Lawrence, 1995; Cooper, 1994).

One reason countries are seeking outward-oriented development strategies and common policy reforms is to take full advantage of international economic integration possibilities. OECD countries, for example, are attempting to cut taxes, shrink public services, decentralise administrative functions and balance budgets. Developing countries are decentralising public agencies, liberalising domestic markets and pursuing macroeconomic stability, while transition countries are introducing market-oriented economies and privatising state enterprises. In most countries, this process is taking place alongside a wider examination of the basic role of government, prompted by tax-weary citizens dissatisfied with past government inefficiencies. But a key aspect of reforms has been trade liberalisation. The commitments made under the Uruguay Round and APEC umbrellas, in particular, will have very significant impacts on Asia–Pacific and global economic growth and structural adjustments.

These trade and other policy reforms have important implications for Australia's overwhelmingly export-oriented agricultural sector. On average, the country exports more than two-thirds of its value of production each year – accounting still for between one-fifth and one-quarter of all goods and services exported from Australia, despite the more rapid growth of non-farm exports in recent years. This dependence on exports means that farmers are well aware that their competitiveness in international markets depends not only on Australia's natural comparative advantage but also on policies at home and abroad, both farm and non-farm. In recent decades, few external events influenced Australian agriculture more than the farm price support provided under the European Community's Common Agricultural Policy. European protectionism, plus the replacement of Commonwealth preferential trade treatment towards Australian farm exports by ever higher European Community

agricultural trade barriers, help to explain the reduction in Australian farm exports to Europe since the early 1970s.

Agricultural protectionism in industrial countries is a factor contributing significantly to the decline in the international price for farm goods relative to manufactured goods, and the fluctuation around that downward trend (Anderson and Hayami, 1986; Tyers and Anderson, 1992). Surplus production generated by these protectionist countries has been sold on world markets with the help of export subsidies, including in North America from the mid-1980s, in retaliation for European Community farm export subsidies. As a result, Australia has suffered doubly: from denial of access to markets in protectionist and subsidising countries, and from lower and more volatile prices in the residual international market (Tyers and Anderson, 1992).

Recently, the long-run trend in this type of protectionism has been slowed, if not reversed. Among the pressures forcing reductions in production and export subsidies are the Agricultural Agreement of the Uruguay Round of multilateral trade negotiations and a growing recognition of the linkage between agricultural subsidies and environmentally harmful agricultural practices. There are signs, however, that farm subsidies may reappear in new forms. For instance, a European Union Council Regulation (No. 2078/92) allows certain environmental subsidies to agriculture, including subsidies to reduce the use of fertiliser and plant health products; to promote environmentally sound production methods; to encourage extensive agricultural techniques; to maintain practices that are already compatible with the environment; and to assist organic farming.

Accelerating international integration and growing global concerns about resource depletion and environmental degradation are bringing greater scrutiny of domestic agricultural policies and practices. Negotiations of multilateral trade and environmental agreements call for establishing international standards and harmonising environmental policies that affect competitiveness in the international marketplace. A similar process has occurred within countries in the course of economic development: numerous local, state or provincial policies/standards have gradually been replaced by national standards and conformance assessment (National Research Council, 1995).

The aim of such harmonisation is not just to reduce administrative and conformance costs; it is also motivated by concerns in high-standards regions that costs of production are higher in their region than in regions with lower environmental standards, causing them to be less competitive. These differences become ever more important as traditional barriers to trade and investment between regions fall (eg. transport and communication costs and import tariffs).

The globalisation process and the proliferation of trade and environmental agreements, including those requiring upward harmonisation of environmental standards, alter the ability of Australia's agricultural sector to attract and/or retain resources and investment funds. While new opportunities are created, some other traditional activities become uneconomical. Until recently, Australia's agricultural activities have been largely insulated from environmental pressures and government restrictions. Producers have had the freedom to choose inputs and technological methods and to alter landscapes, subject to restriction only when necessary to meet a few product and safety standards. Now, however, various local, national and international pressures are forcing policymakers to address agriculture-related environmental problems and examine measures to promote more sustainable practices.

The Agricultural Agreement and Sanitary and Phytosanitary Agreement of the Uruguay Round, regional integration initiatives, and international conventions on biological diversity, forestry, desertification and climate change are all examples of external events that will have far-reaching implications for Australia's agricultural sector for decades to come. For example, the Framework Convention on Climate Change raises the possibility of carbon taxes being introduced or raised globally. This would have significant economic consequences, including for Australian agriculture. The Australian Bureau of Agricultural and Resource Economics (ABARE) estimates that a domestic carbon tax aimed at achieving a 20% reduction in greenhouse gas emissions from Australia's broadacre agriculture would on its own reduce annual farm net incomes by 36% (Phipps and Hall, 1994). This is a partial result though; a complete assessment would need to take into account the impact of higher carbon taxes on all sectors and in all countries.

Australian legislation and policy interventions to restrict environmentally damaging agricultural practices have been growing in number and severity since the mid-1980s. This increase is largely a reflection of evolving environmental values in society, but it is also a consequence of greater scientific understanding of agricultural pollution and resource degradation.

Australian policymakers must now answer to the growing power of international and national consumers, environmentalists and taxpayers whose converging interests in sustainable development incorporate desires for healthy food and water, for habitat protection, for rural landscape preservation and for preserving the diversity of our flora and fauna.

Before focusing more specifically on how pressures for environmental policy measures will impact on Australia's farm sector, it is useful to have a picture of the order of magnitude of changes that can be expected to influence the sector over the next decade as a result of ongoing economic growth (at very different rates in different regions), of Uruguay Round implementation (without and with China and Taiwan joining the WTO), and of APEC-inspired additional trade liberalisation (without and with the inclusion of agricultural policy reforms).

Australian producers spent a decade eyeing the Uruguay Round of multilateral trade negotiations, wondering how their international competitiveness would be affected. The negotiations represented an historical breakthrough for agriculture in the sense of being included high on the GATT agenda for the first time. That provided hope for at least some future progress towards greater market liberalisation and reduced domestic support in agriculture through providing a framework for more discipline, stability and transparency in agricultural trade.

The GATT agreement on agriculture, to be implemented mostly between 1995 and 2000,[2] has three main components: reduction in farm export subsidies, increases in import market access, and cuts in domestic producer subsidies. The fact that farm export subsidies are still tolerated continues to distinguish agricultural from industrial goods in the GATT, a distinction that stems from the 1950s when the United States insisted on a waiver for agriculture in the prohibition of export subsidies. Moreover, even by the end of this century, farm export subsidies must be only about one-fifth lower than they were in the late 1980s to comply with the agreement.[3]

A second distinguishing feature of the agricultural agreement is that it requires non-tariff import barriers to be converted to tariffs, which are then to be reduced and bound. However, the extent of tariff reduction by the end of the century is even more modest than for export subsidies: the unweighted average tariff cut must be 36%, but could be less than one-sixth as a weighted average, since each tariff item needs be reduced by only 15% of the claimed 1986–88 tariff equivalents.

Countries with import restrictions have agreed also to provide a minimum market access opportunity, such that the share of imports in domestic consumption for products subject to import restrictions rises to 5% by the year 2000 under a tariff quota (less in the case of developing countries; 8% in the case of rice in Japan in lieu of tariffication). But access is subject to special safeguard provisions, so that it only offers potential rather than actual access. Furthermore, it formally introduces scope for discrimination in the allocation between countries of these tariff quotas, and tends to legitimise a role for state trading agencies such as BULOG in Indonesia.

In terms of domestic producer subsidies, the Agricultural Agreement calls for the aggregate level of domestic support for farmers to be reduced to four-fifths of its 1986–88 level by the turn of the century. This, too, requires only modest reform in most OECD countries because much of that decline in support has already occurred. Moreover, many forms of support need not be included in the calculation of the aggregate measure of support, the most important being direct payments under production-limiting programs of the sort adopted by the United States and European Union. The use of such instruments, including environmental provisions, is likely to now spread to other countries and commodities as farm income support via trade measures becomes less of an option.

What are likely to be the net effects of these provisions and all the other agreements signed at the end of the Uruguay Round in April 1994? Since those agreements are to be phased in over a 10-year period, the only sensible way to answer that question is to have access to an empirical model of the world economy projected to 2005 without the Uruguay Round, and to compare that with a version of the model with the Round fully implemented. Such a study is reported in Anderson et al. (1996a, 1996b). However, it assumes no changes in the things discussed in subsequent sections (multilateral environmental agreements, quarantine restrictions, unilateral environmental policies, or

[2] For developing countries, the implementation period is ten rather than six years and the extent of reform required is less.

[3] While the budgetary expenditure on export subsidies is to be lowered by 39% from the base period, it is only the agreed cut in the volume of subsidised exports (21%) that is likely to bite since international food prices are expected to be considerably higher in the implementation period than in the depressed 1986–88 base period.

consumer preferences towards greener products), and so provides a base scenario for that later discussion. The study suggests that the world economy by 2005 would be better off by $180 billion per year (in 1992 United States dollars) because of the Round, or $230 billion if China and Taiwan join the WTO during that period. Economic welfare in Australia and New Zealand (hereafter ANZ – the two are not separated in the study) is estimated to be $2 billion better off per year (and 10% more with China and Taiwan in the WTO), with their trade volume up 8%. Net farm exports alone from ANZ are projected to be more than $3 billion larger per year because of the Round. Without the Uruguay Round, the share of agriculture in ANZ's gross domestic product is projected to fall 6% over the next decade, but with the Round implemented its decline is expected to be negligible because of expanded agricultural and food export opportunities. Compared with 1992, those exports net of imports are expected to be $11 billion greater in 2005 in real terms, as are mining exports. That represents a proportionately greater rise for farm products (more than 50%) than for other primary products or services (net exports of which are projected to be up $2 billion; the rise in manufactured net imports of $24 billion accounts for the rest, given the model's assumed constraint of no change in the overall trade balance). Of that $11 billion rise in net farm exports, $3 billion is due to the Uruguay Round and the rest to overall economic growth.

What impact would further liberalisation in the APEC region make over the next decade? The answer depends heavily on whether or not agriculture is included in the move towards APEC free trade. If it is, and if APEC economies have halved their remaining post-Uruguay Round trade restrictions by 2005 in their drive towards free trade in the region by 2010 for developed economies and 2020 for developing economies, Anderson et al. (1996b) project world trade in agricultural products to be one-sixth greater in 2005 than it would be following full implementation of the Uruguay Round. On the other hand, if agriculture is *not* part of the APEC reform – as some East Asian economies are hoping – then world farm trade would be only 2% greater and so Australian farmers would get much less joy from the APEC initiative.

In short, the relative decline in the importance of agriculture in the Australian economy could well be slowed over the next decade as the Uruguay Round is fully implemented, and even more so if the APEC free trade initiative is taken up and includes reform of food markets. While this is good news for Australian farmers, it is not the only set of international pressures affecting their future prospects.[4] We turn now to some other influences that have to do with the environment and food, animal and plant safety.

2.3 Other international agreements affecting Australian agriculture

Several other aspects of international agreements are likely to be of importance to farm incomes. One has to do with the environmental provisions contained in some trade agreements. Another has to do with the trade provisions in several international environmental agreements. Yet another has to do with the related attempts to harmonise various technical standards. And of particular importance is the Codex Alimentarius, particularly as it is likely to impact on quarantine import restrictions as interpreted by the WTO's dispute settlement mechanism. Each of these is considered in turn.

2.3.1 Recent trade agreements with environmental provisions

At the heart of the GATT are the non-discrimination requirements of Articles I and III. These obligate parties to treat imports from any GATT contracting party no less favourably than other imports (the most favoured nation requirement) and no less favourably, after border taxes are paid, than similar domestic products (the national treatment requirement). Article XX provides exceptions to these general rules, however, including provisions for some environmental regulations. Specifically, parts(b) and (g) of Article XX allow trade restrictions "necessary to protect human, animal, or plant life or health" and "relating to the conservation of exhaustible natural resources if such measures are made effective in conjunction with restrictions on domestic production or consumption", subject to requirement that such restrictions "are not applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail, or a disguised restriction on international trade". These provisos have ensured that

[4] Another often-expressed concern is the finite resource base available to produce food globally, and its reputed degradation. However, careful assessments of the resource base suggest that in net terms it is not diminishing (see the survey in Rosegrant, 1997). In fact, what *is* diminishing is the relative economic importance of those resources in food production.

the Article can be rather narrowly interpreted, which is partly why some environmental groups have called for further 'greening' of the GATT and have urged negotiators to address trade and environmental issues (Charnovitz 1991, Esty 1994).

It was one year before the publication of the *Our Common Future,* and well before the current build-up of international attention on sustainable development, that the Uruguay Round agenda was established (in 1986). Thus trade and environment did not form a separate agenda item for negotiation, nor was an environmental impact assessment undertaken for the package of Uruguay Round agreements. But, at the signing of the agreements in 1994, Ministers included a decision to establish a WTO Committee on Trade and Environment. This Committee's tasks are to "identify the relationship between trade measures and environmental measures in order to promote sustainable development" and to "make appropriate recommendations on whether any modification of the provisions of the multilateral trading system are required, compatible with the open, equitable and non-discriminatory nature of the system." It is also significant that the preamble to the agreement establishing the WTO describes part of its objective as:

> expanding the production and trade in goods and services, while allowing for the optimal use of the world's resources in accordance with the objectives of sustainable development, seeking both to protect and preserve the environment and enhance the means for doing so in a manner consistent with their respective needs and concerns at different levels of economic development.

Several recent events illustrate how Australian agriculture is affected by the entwining of trade and sustainable development issues. First, in 1992 UNCED outlined a work program on trade and environment in Chapter 2 of Agenda 21 which was picked up by several agencies in which Australia is an active participant. The international organisations involved include the OECD, UNCTAD and UNEP, in addition to the WTO. For example, in 1993 OECD countries agreed on a set of Trade and Environment Guidelines with the aim of encouraging member governments to work towards establishing national trade and environmental policies that are more compatible and supportive of each other. A years or so later, OECD Ministers endorsed a major report on trade and environment intended to contribute to ongoing WTO discussions (OECD, 1994). That report included sector-specific studies, including a report on the environmental effects of trade in agriculture by Runge (1994). It was followed in 1995 by a report specifically on sustainable agriculture (OECD, 1995). The OECD 1993 guidelines and a summary of its 1995 report are provided by the Council for International Business Affairs (CIBA, 1995).

Second, in 1993 Canada, Mexico and the United States signed an environmental side agreement to the North American Free Trade Agreement (NAFTA). This side agreement represents a significant international precedent, not only for NAFTA members, but for the world community as a whole. This precedent, together with the fact that the agreement among OECD countries to subject trade policies and trade agreements to environmental review, suggests that future trade reforms by NAFTA countries are likely to require some type of policy mechanism by which growing environmental concerns can be managed. It also raises the spectre of trade reviews of multilateral environmental agreements.

Third, while multilaterally agreed trade liberalisation makes it increasingly difficult for countries to protect their agricultural sectors overtly via import tariffs and production and export subsidies, it makes it increasingly tempting to use non-tariff trade barriers. Environmental, plant, animal, food safety and health standards, in particular, can in fact be 'captured' by protectionists to become non-tariff trade barriers that are complex, elusive and difficult non-tariff barriers to challenge. For this reason, the WTO expresses a strong preference for international standards, especially in relation to food, health and environmental concerns, so as to minimise the potential for countries to develop national standards for use as non-tariff barriers. Similarly, regional trade agreements and international environmental agreements have tended to encourage and sanction the use of international standards.

The Uruguay Round established new guidelines and principles governing sanitary (human and animal health) and phytosanitary (plant health) standards with an Agreement on the Application of Sanitary and Phytosanitary Measures (the SPS Agreement); and for governing non-tariff technical barriers with a revised Agreement on Technical Barriers to Trade (the TBT Agreement), previously known as the Standards Code. The revised TBT Agreement and the new SPS Agreement require international standards to be used as the basis for national standards when international standards exist. In particular, the SPS Agreement

designates the food standards set out in the Codex Alimentarius (Food Code) as the international standard to be applied to food safety.

The SPS Agreement establishes clear and detailed rights and obligations for environmental health and food safety issues, as well as measures to prevent the spread of pests or diseases among animals and plants. It outlines procedures for product inspection, treatment and processing, risk assessment and allowable maximum levels of pesticide residues and certain food additives. The TBT and SPS Agreements require the use of international standards over national standards when relevant international standards exit. The two agreements also adhere to the principles of non-discrimination against imported products; transparency in the development and implementation of standards; acceptance of equivalent technical standards of other countries; special and differential treatment for developing countries; and scientific justification as the basis for standards. The SPS Agreement further requires that scientific justification be based on risk assessment procedures and, where available, the risk assessment procedures developed by international organisations must be taken into account (Nairn et al., 1996).

WTO members may establish measures which result in higher levels of protection than the relevant international standards only with appropriate scientific justification. This allows governments to challenge another country's food safety requirements based on evidence showing the measure in not justified. Canada, for instance is currently challenging Australia's justification for sanitary measures banning salmon imports. And the United States is currently challenging the European Union over its ban on imports of beef that may have been subjected to growth hormones. In the latter case, the WTO's dispute settlement mechanism will be calling scientific witnesses for the first time.

The TBT Agreement permits technical standards to affect trade only to the extent that they are the least trade-restrictive measures necessary to fulfil a "legitimate objective." Protecting human health and safety, animal and plant health, and the environment are all considered legitimate objectives.

2.3.2 Recent environmental agreements with trade consequences

During the past decade, Australia has negotiated a variety of multilateral agreements in response to global environmental challenges. Many of these agreements, including conventions and treaties on desertification, biodiversity, climate change, forestry and fisheries, have important consequences for agriculture. Furthermore, Australia is participating in various international bodies to harmonise criteria and codes of conduct for farming practices, sustainable forestry management and high-seas fisheries.

Over time, international agreements to protect the environment have become increasingly specific, outlining detailed strategies and procedures, establishing measurable objectives and common standards, and setting dates by which signatories must comply. Compliance often requires raising production or processing costs through changes in national legislation, state and local regulations, tax policy or regulatory systems. For Australian agricultural producers, concerns over environmental agreements are analogous to concerns over domestic standards and environmental controls that influence production costs, shift relative factor prices, and thereby affect short-term competitiveness.

This proliferation of multilateral environmental agreements raises questions about the legal relationship between them and existing and future national obligations in WTO and in regional integration agreements. Specifically, trade policy is being called upon to help achieve environmental objectives, either as a carrot to entice countries to sign or as a stick to ensure they abide by their obligations under a multilateral environmental agreement when the free-rider problem arises.

One of the more obvious ways to reduce free-rider problems is to include trade provisions in multilateral environmental agreements, as was done in the 1987 Montreal Protocol on reducing the use of CFCs and halon to slow ozone depletion. To date, no GATT contracting party has formally objected to that particular use of trade policy. Nor has any of them objected to the ban on trade in ivory, rhino horn and tiger products that are part of the Convention on International Trade in Endangered Species. Conflicts may well arise in the future, however, if trade provisions are drafted into more contentious multilateral environmental agreements (Anderson, 1996). That is why this matter figures prominently on the agenda of the new WTO Committee on Trade and Environment. Discussion on trade provisions and multilateral environmental agreements in the GATT/WTO have centred on the idea of providing waivers on a case-by-case basis. More recently, the idea of providing an 'environmental window' for multilateral environmental agreements within the GATT exceptions clause (Article XX) has also

been advanced by environmentalists – and strongly rejected by supporters of the rules-based multilateral trading system (Anderson, 1996).

This expanding intersection of trade and environmental agreements points to other questions of importance for Australian agriculture. How are non-parties to treaties affected? How are new international agreements balanced with existing agreements? Which international organisations or body of international law should have authority over conflicts? Questions such as these are leading to calls by some environmentalists for a world environment organisation to set rules, incorporate existing international agreements and negotiate new ones, monitor compliance and settle disputes over environmental policies – in the same way that the GATT/WTO have presided over trade rules and policies for the past five decades (Esty, 1994).

Esty argues that one advantage of a world environment organisation is that it could redirect environmentalists' attention away from the use of trade measures and towards the implementation of more appropriate policy instruments for achieving environmental objectives. It is claimed this approach could allow both sets of policies to contribute, in more effective and mutually supportive ways, to the common goals of sustainable development and improvement in the quality of life. Such an organisation is not likely to form in the foreseeable future, however, given the trend towards smaller government spending, especially on international agencies.

2.3.3 Harmonising national environmental standards

International trade agreements tend to promote common trade policies while many multilateral environmental agreements promote common environmental policies. Increasing integration of the world's economies is adding to this harmonisation process. Harmonisation of policies, laws, standards and regulations represents an attempt to encourage competition and trade by reducing international differences in national-level standards, including environmental regulations. Common, internationally recognised food standards are designed to protect health and safety – but only to the degree warranted by scientific evidence – and thereby improve market performance by lowering transaction costs and improving the quality of consumer information.

Reaching agreement on those standards is not easy though. On the one hand, by agreeing to an international food safety standard lower than the previous national standard, food-importing nations give up the ability to use domestic standards as a protectionist measure. Governments of food-exporting countries, on the other hand, may be reluctant to harmonise their standards upwards to an international norm when the costs, which fall narrowly on export producers, may exceed the national benefits to domestic consumers – unless a sufficient premium can be earned abroad for compliance with the higher standard.

Environmental interest groups are divided in their views on harmonisation. Some environmental groups mistrust harmonisation since it may lower domestic standards. Other environmental groups perceive harmonisation as a means of raising standards, both at home and abroad. Developing countries often view it simply as another way for wealthier countries to impose high standards on poor consumers not yet able to afford that luxury, and/or to limit their producers' competitiveness in rich-country markets.

In general, economists view harmonisation of environmental policies as inconsistent with market efficiency objectives. Differences in country-level environmental standards reflect legitimate differences in tastes and preferences for environmental quality, in attitudes towards environmental risks, and in assimilative capacities (Siebert 1985). Harmonisation entails compromises that may or may not improve overall national economic and social welfare. The likely outcome from harmonising emissions standards, for example, is that some countries produce an inefficiently large amount of pollution, while other countries produce an inefficiently small amount. The optimal market solution is to allow each country to create incentives to reduce damage at least to the level where the marginal cost of pollution reduction is equal to the marginal cost of damage caused. Since the willingness to pay for environmental quality is a function of income, and since assimilative capacities vary across and within countries, harmonisation typically will not be the optimal policy for achieving socially efficient levels of environmental quality.

Ruttan (1971) equates environment quality to a superior good to explain why a national preference for private versus public goods consumption is a key factor influencing production, consumption and trade patterns.

> …in relatively high-income economies the income elasticity of demand for commodities and services related to sustenance is low and

> declines as income continues to rise, while the income elasticity of demand for more effective disposal of residuals and for environmental amenities is high and continues to rise. This is in sharp contrast to the situation in poor countries where the income elasticity of demand is high for sustenance and low for environmental amenities (pp. 707–8).

Recent empirical research confirms at least part of Ruttan's statement. While economic growth involves increased pollution associated with production and consumption, rising per capita incomes mean: (1) society demands more environmental quality; and (2) more income is available to protect environmental services (see World Bank, 1992; Grossman and Krueger, 1995). This does not imply, however, that lower income countries desire environmental quality less or have a low income elasticity of demand for environmental amenities, nor that income elasticity rises inexorably with income. But it is consistent with the fact that people in relatively wealthy countries have greater capacity to pay for more of everything, including higher environmental quality (Anderson, 1992b).

Australia actively participates in international organisations which promote harmonisation of national environmental standards. It supports, for example, the WTO's TBT and SPS Agreements, which state that "environmental product standards should be based on international standards to reduce the possibility of standards acting as protectionist measures".

Australia also supports the OECD's effort to encourage member countries to pursue common policy approaches to sustainable development. It also supports the OECD's harmonisation activities related to agriculture's focus on production and processing methods, product life cycle management and packaging and labelling regulations. The OECD harmonisation program involves four activities:

1. review, registration or approval, including testing requirements;
2. mutual recognition of other countries' legally manufactured products, which may extend to labelling;
3. "accepted equivalence" of two countries' standards or technical "pre-market harmonisation" of administrative procedures for regulations, including environmental conditions; and
4. international standards achieved through multilateral agencies seeking acceptable standards for products or processes (eg. the WTO which encourages use of the Codex Alimentarius as the international food safety standards).

The three categories of harmonisation with special significance for Australian agriculture are: *product standards* (food safety, eco-labelling, and regulatory processes for agricultural chemicals); *production and processing methods* (including environmental control technology, harvesting methods, and certification requirements); and *environmental performance standards* (water, soil and species protection).

For example, international food product standards set limits on concentrations of additives, contaminants and pesticide residues in food. Agricultural and food chemical use in Australia is low by OECD standards, but Australian Bureau of Statistics (ABS) data indicate producers use 2,500 types of farm chemicals and 2,000 animal health products containing some 400 active ingredients to control 5,000 significant pests. Australian producers treat some 15 million hectares of land with herbicides, 3 million hectares with insecticides, and close to 1 million hectares with fungicides. Estimates of annual net productivity gains attributed to farm chemical use range from $2.5 billion to $5 billion (ABS, 1996).

Incidents involving residues in Australian beef highlight the economic consequences of trade-related food residue problems. For instance, in 1987 a ban on beef exports to the United States was avoided only after intensive cattle lot testing was introduced in response to organochlorine residues discovered in Australian beef. The testing procedures alone cost the cattle industry an estimated $50 million (Hill et al., 1997). Other incidences include sulphonamides found in Australian veal exported to the United States in 1990; penicillin in Australian beef exported to Canada in 1991; organochlorines, organophosphates, synthetic pyrethroids, hormone growth promotants and antibacterials found in various export markets; and the more widely know case of chlorfluazuron residues found in Australian beef in New South Wales in 1994.

Another example is cadmium residues in sheep meat. A large part of Australia's sheep grazing areas are phosphate-deficient, but the superphosphate fertilisers to offset that deficiency contain cadmium. Australia's maximum permissible level of cadmium in fertiliser is 350 milligrams per kilogram of phosphorus, while some European countries have much lower permissible levels

(for instance, Sweden's maximum level is 50 milligrams per kilogram – CIBA, 1995). Efforts to harmonise cadmium levels in fertilisers, or to phase out trade in goods containing cadmium, could have a significant impact on Australian livestock producers who depend on superphosphate fertilisers for their pastures.

Harmonising production and processing methods has become another especially contentious issue for trade and environmental negotiators. In the past, trade rules disallowed countries from restricting imports of products because of how they are alleged to be produced. Environmentalists contest this approach, claiming that many production and processing methods cause severe environmental degradation. The famous case of tuna illustrates the complexities that can be involved. The United States banned its fisheries from using tuna fishing practices which inadvertently catch and kill dolphin. Following that ban, Mexican fishing fleets expanded their tuna fishing in the same waters and exported tuna to the United States. Dolphin lovers in the United States demanded a ban on imports of tuna from Mexico and other countries that maintained fishing practices that killed dolphins. Even though only some of that imported tuna may have been caught in dolphin-unfriendly nets, all tuna imports were banned because there was no way of distinguishing the acceptable from the unacceptable. A GATT dispute settlement panel ruled the import ban illegal under existing trade agreements between the United States and Mexico, and a more efficient solution has now been found: Mexican fishing techniques are monitored, and those catching tuna using dolphin-friendly practices can label their cans accordingly, allowing United States consumers to boycott cans without such a label if they so wish.

To contribute to this debate, the OECD established a research project on trade and environmental implications of production and processing methods. It attempted to identify the circumstances under which governments should restrict trade based on production and processing methods, what the appropriate restrictions should be given potential environmental and trade impacts, and what disciplines need to apply (OECD, 1994b; Robertson, 1995).

The Food and Agriculture Organisation (FAO) also has produced two recent reports to address the growing importance of production and processing methods for agricultural trade and sustainable development. First, it developed a manual on quantitative assessment methodology of production-related environmental impacts (FAO, 1994). Second, it completed a series of studies on how production and processing methods relate to production and trade in basic foods (FAO, 1996).[5] These reports apply a life cycle approach to assess environmental impacts of sequential stages of production and processing, and then assess the cost and trade consequences of environmental regulations.

Of particular importance to Australia is the section on grains and livestock interactions. It concludes that harmonisation of environmental regulations affecting grain production is likely to occur very slowly, beginning with the WTO's SPS Agreement. It also suggests that the harmonisation of production and processing methods for grains is more likely to raise environmental standards to a higher level than currently prevail in most countries. Overall, Australia's existing high standards and practices suggest that it is well positioned to take advantage of efforts to harmonise environmental standards upwards, since that is likely to raise the production costs of competitors relative to their own.

2.3.4 The Codex Alimentarius and the WTO's SPS Agreement

The food standards agreement known as the Codex Alimentarius came into force in 1962. It has been administered by the Codex Alimentarius Commission, a subsidiary body of the UN's FAO and the World Health Organization (WHO). The Codex Alimentarius Commission consists of 146 member countries responsible for setting the guidelines and principles necessary to protect consumer health, ensure fair trade practices and promote international harmonisation of food standards. The code was adopted as the international standard applied to food safety standards under the Uruguay Round's SPS Agreement.

Over time, the nature of food safety issues has evolved from broad commodity-based concerns (contamination, spoilage and adulteration) to establishing 'horizontal' standards which apply across a range of commodities, such as maximum limits for pesticide residues and organically grown food standards (Campbell, 1994). The Codex Alimentarius Commission is increasingly occupied with establishing health and safety standards for food additives, pesticides, animal drug residues, contaminants and naturally occurring toxicants.

[5] Australia is a member of the FAO's– Committee on Commodity Problems which requested the reports. The five reports cover rice, oilseeds, livestock, grains; and grain/livestock interactions.

In addition to establishing labelling standards for food and nutrition, Codex has recently established food hygiene codes related to production and harvesting methods, processing facilities, personnel hygiene, and hygienic processing requirements. The criteria to ensure controls are based on limits or characteristics which may be physical (time or temperature), chemical or biological.

Codex standards, guidelines and principles cover most aspects of food production and processing and include all principal foods distributed to consumers. The purposes of Codex are to facilitate food trade, promote fair practices in food trade, and organise food standards set by other international organisations. The SPS Agreement further highlights health aspects of food trade by specifically referencing Codex standards, guidelines and recommendations as they relate to health protection.

With respect to food safety, the WTO's SPS Agreement covers only measures taken to protect human and animal health from risks posed by additives, contaminants, toxins or disease-causing organisms in food, beverages and feedstuffs. International trade can be restricted only when the available scientific evidence demonstrates that a restriction is necessary to protect human or animal health, and then only to the extent strictly necessary to ensure health protection.

Neither the WTO nor the Codex Alimentarius Commission determine levels of food safety and animal and plant health for member countries. Governments have the choice of assessing risks and determining the acceptable risk level or using the Codex standards. The SPS Agreement strongly encourages them to use the latter for food safety, the International Office of Epizootics for animal health, and the International Plant Protection Convention for plant health. Countries are not allowed to set higher standards for imported products than for domestic products. However, national standards can be higher that international norms without violating the SPS Agreement, but countries using their own national standards when relevant international standards exist are required to justify their higher standards should a trade dispute arise. Moreover, if an exporting country "objectively demonstrates" that its measures achieve the importing party's level of protection, the importing party must accept the measures as equivalent even if they differ (Stanton, 1994).

Under previous GATT agreements, a country's import restrictions to protect human, animal and plant life were difficult to challenge. The new rules under the SPS Agreement require a country's sanitary and phytosanitary measures to be based on "scientific principles and not maintained without sufficient scientific evidence". It is telling that during the 47 years of the GATT, virtually no formal trade disputes on sanitary and phytosanitary measures arose. In the first 18 months of the WTO's formation, by contrast, seven formal complaints had been lodged under WTO dispute settlement procedures. The SPS Agreement is thus likely to help those agricultural exporters who have been facing unduly restrictive barriers in potential export markets abroad, and to reduce returns to those producers who have enjoyed protection from import bans on quarantine grounds that cannot be scientifically justified. In the latter cases, removal of unjustified import barriers could boost domestic consumer welfare by more than it would harm domestic producer welfare, as well as boost producer welfare abroad, of course (the usual gains from trade liberalisation). From Australia's perspective, getting rid of our own excessive quarantine restrictions would also make it easier for us to argue with other governments and in international forums for similar reforms abroad.

Economists have paid relatively little attention to this issue of technical barriers to trade. Now, however, is an opportune time for Australian economists to make amends, following the release of the Nairn Report (Nairn et al., 1996) which has brought the issue of quarantine at least under more of a spotlight in Australia. Risk assessment based on empirical evidence is being demanded increasingly in domestic policy debates and for the resolution of international disputes. The Nairn Report correctly stresses the role model Australia could play in developing state-of-the-art quantitative risk assessment procedures. But if those procedures do not include all the relevant economic effects, inappropriately high standards will result. This is because the main losers from excessive quarantine restrictions are – as with traditional protectionism – domestic consumers and exporters at home and overseas suppliers of the allegedly offensive product, all of whom are typically less influential than the industry (and sometimes environmental) groups lobbying for the import barrier. The building in of appropriate economic analysis in risk assessment procedures can help to correct that imbalance, to the benefit of Australia and, in particular, its consumers and exporters. Our exporters would be helped indirectly by less excessive Australian quarantine restrictions potentially in three ways

1. via the standard general equilibrium effects of reduced protectionism at home;
2. via the export to other countries and such institutions as the WTO's dispute settlement body of a more complete risk assessment procedure that ultimately would lead to less excessive quarantine restrictions to our export markets abroad; and
3. via the enhanced position of Australia's trade negotiators who could argue in bilateral talks against excessive barriers to our potential export markets without appearing hypocritical.

Indeed, Anderson (1997) shows that economic analysis at the outset of a quarantine inquiry might even eliminate the need for expensive technical risk assessment in some cases, for it might show that *under no circumstances* would quarantine restrictions be justified because the country would always be better off under free trade – even if it caused the import-competing industry to close down. Just as was the case with the tariff review in the 1970s, perhaps it is time for Australia – for its own sake as well as to set a good example to its trading partners – to undertake a systematic economic review of all its existing quarantine restrictions on imports. Both the Productivity Commission and ABARE are well qualified to undertake such a proactive review, having recently been involved in reactive reviews in response to requests from our trading partners (see, for example, the assessments for New Zealand apples – ABARE, 1997; and Canadian salmon – Industry Commission, 1996).

2.4 Unilateral changes to environmental policies at home and abroad

Even more actively than in international forums, governments in OECD countries are experimenting unilaterally with a variety of domestic policy measures to promote sustainable agricultural practices. The overall aim of these measures is to alleviate four broad types of agriculture-related environmental problems. They are:

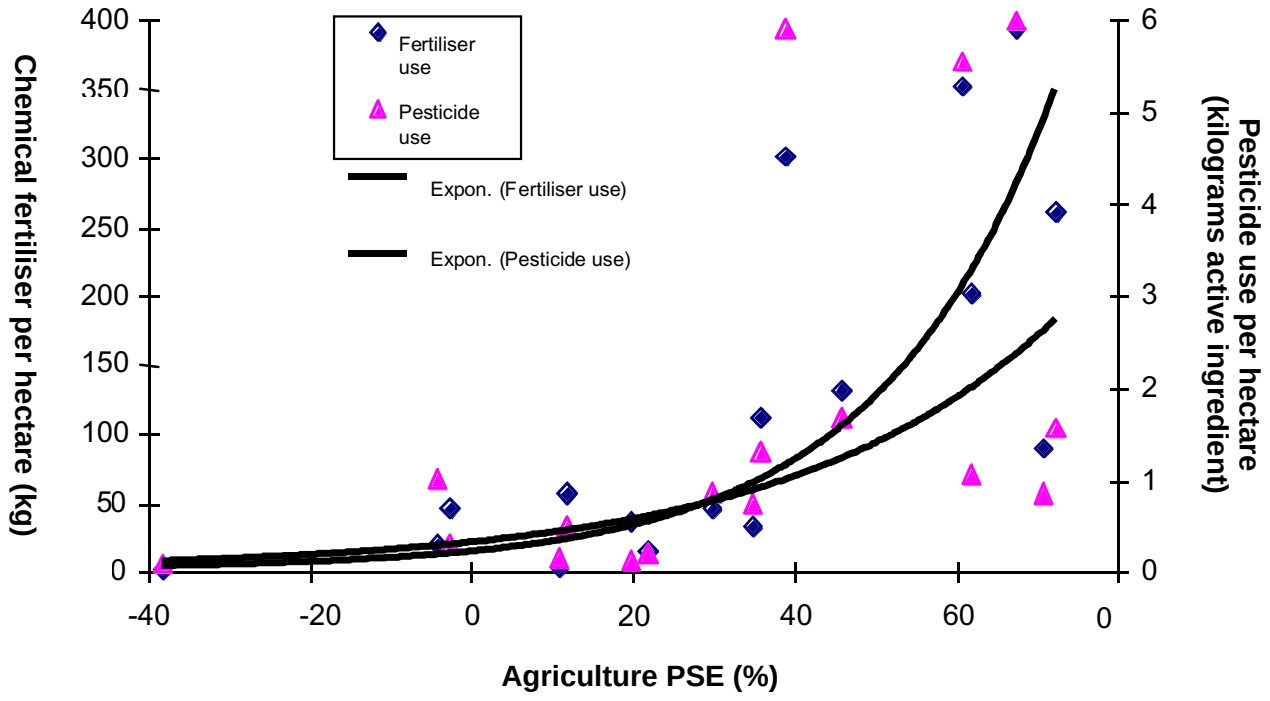
- pollution and contamination of soil, water, air and food resulting from increased use of farm chemicals and from livestock effluents;
- degradation of natural resources, and particularly deterioration in the available quantity and quality of soil, water, forests and rural landscapes;
- disturbance and reduction of biotopes and wildlife habitats; and
- reduction in wildlife species and loss of biological and genetic diversity of plants and animals.

The severity and mix of these environmental problems vary between and within countries, as have the public and private sector responses. A particular practice may have little or no environmental impact in one area, while in another area the same practice may have unacceptable adverse consequences. The role many agricultural policies play in contributing to harmful practices also is now widely acknowledged. For example, a decade of research has documented how agricultural price supports encourage over-exploitation of rural environmental resources and misuse of landscape amenities (Bonnieux and Rainelli, 1988; Young, 1989; Anderson, 1992b). With respect to farm inputs, it is clear from Figure 1 that chemical fertiliser and pesticide applications are strongly correlated with producer price incentives. Countries with relatively low producer prices, such as Argentina, Australia and Thailand, use less than one-twentieth the amounts of chemical fertiliser per cropped hectare that high-priced countries such as Switzerland use. There is a similarly high correlation between producer price incentives and the use of farm pesticides. And within Australia, liberal farm income tax concessions for clearing natural scrub from farms encouraged excessive tree felling – to the point where wind erosion and stock losses because of lack of shelter are now encouraging farmers to replant trees.

OECD countries have responded to these issues by reforming harmful policies, by introducing new policy measures aimed at protecting the environment, and by complementing or strengthening existing policies and regulations. These measures range from providing financial assistance to farmers who refrain from harmful practices in environmentally sensitive zones, to reducing or eliminating investment subsidises that support intensive livestock production and wetland drainage. In Australia, they include the provision of more and better information on sustainable practices, particularly through the Landcare program.

Over the past several years, governments have begun noticeably promoting sustainable practices in three ways in particular. First, environmental and sustainability concerns are being integrated into the formulation, planning and implementation of agricultural policies. Environmental units and divisions are being established within agricultural departments, and the policymaking

Figure 1: *Relationship between agricultural producer subsidy equivalent (PSE) for 1979–89 and the use of chemical fertilisers and pesticides per hectare of arable and pasture land (Anderson and Strutt, 1995)*



(The trend for fertilisers is: $y = 12e^{0.046x}$, $R^2 = 0.7$ for pesticides it is: $y = 0.3e^{003}x$, $R^2 = 0.5$.)

responsibilities and autonomy of these environmental units has increased over time. Some countries are beginning to design programs to more fully integrate agricultural and environmental polices. Recently in Victoria, for example, the agriculture department was entirely subsumed in an enlarged Department of Natural Resources and the Environment.

Second, existing agricultural policies are being modified to reduce their negative consequences and to increase their positive effects. Research programs and policy analysis are now routinely monitoring the socioeconomic and environmental effects of agriculture.

And, third, OECD countries are attempting to employ market-based incentives, to legislate stricter regulatory measures, to test experimental programs, and to redirect advisory services. A wide range of economic and market-based policy options are available, but limited experience to date with alternatives means that the optimal package of measures is unclear. Since soils, climates, ownership patterns and market structures vary so widely between regions and countries, there is an urgent need to carefully assess potential impacts of the numerous options before choices are made.

One example of how OECD countries are responding to a common agricultural hazard in diverse ways is in their approaches to pesticides. Countries differ in both their requirements for crop protection and their strategy for pesticide registration. Some countries prefer registration approval of a wide range of specific products, while others favour a narrow list of products (OECD, 1995). Several OECD countries have made commitments and set targets to reduce pesticide use (see Table 1, page 16), but supporting measures range from strict regulations to simply providing information and educational services.

Table 1: *National targets for reducing agricultural pesticide use, selected countries*

Country	Year established	Base period	Reduction relative to base period
Canada	n.a.	1985	50% by 2000 Quebec; 2002 Ontario
Denmark	1986	1981–85	25% by 1990; 50% by 1997
Netherlands	1991	1984–88	50% by 2000
Norway	1990	n.a.	50% by 1995
Sweden	1987	1981–85	50% by 1990

Source: OECD, 1995; UN-ECE, 1992.

The European Union provides an example of a supranational effort to address sustainable agricultural issues. The European Community's Regulation 797/85 changed the basis for receiving financial assistance, specifically restricting assistance for intensive pig, poultry and egg producers. Related legislation established environmentally sensitive zones (Article 19, Regulation 797/85), and programs for land set-asides, extensification and conversion (Regulation 1094/88). The more recent Regulation 2078/92, established in 1992, introduces a wide range of programs to encourage and maintain production methods compatible with environmental and landscape management. Additional proposals include assistance for organic farming and the designation of nitrate-vulnerable areas.

A recent OECD study reviews a number of national-level approaches promoting sustainable agriculture, including extension and education, research and development, certification and labelling, and monitoring progress in improving sustainability (OECD, 1995). This study outlines the types of inducements and supporting activities countries are funding to reduce harmful environmental impacts and enhance sustainable practices. Examples of these activities, ranked in decreasing order of budgetary expenditures, include:

- direct payments to farmers who reduce harmful environmental practices;
- grants to assist farmers converting to low input and organic techniques;
- grants for capital equipment required to improve environmental practices;
- tax credits for investments to improve the environment;
- government-funded research into sustainable agricultural practices;
- government-funded demonstration projects;
- grants to contribute to the costs of farmers' organisations;
- government-funded training;
- government-funded information programs;
- certification and labelling of products produced using organic or otherwise environmentally friendly farming practices.

The approach chosen by countries varies greatly. Austria, Finland, Norway, Switzerland and Sweden employ policies to encourage 'low-impact' agriculture as part of a broad policy reform effort. France and Germany tend to promote a farm-level and regional approach. France, for example, initiated a Sustainable Development Plan, with a pilot project involving 200 farms agreeing to adopt farm-level development plans based on principles of sustainability. Japan implemented a four-year program beginning in 1994, known as the Comprehensive Program for the Promotion of Sustainable Agriculture. This new program provides grants to local governments to help fund demonstration projects, information activities and facilities for recycling (OECD, 1995).

Much of the financial assistance provided in the above programs is a substitute for distortive price and trade policies that are now having to be reduced following the Uruguay Round. Cairns Group countries will need to keep pressure on the WTO's Committee on

Agriculture to ensure that these programs do not become simply agricultural support policies in 'green' guise. The Cairns Group can also lead by example with more cost-effective environmental measures. For example, Canada and New Zealand, like Australia, are encouraging community-based, self-reliant approaches to sustainable agriculture. This concept involves organising farmers and graziers into Landcare groups responsible for managing water and land resources in their local areas.

Australia began developing its program for ecologically sustainable agriculture as part of a nationwide effort, the National Strategy for Ecologically Sustainable Development (see Box 1, page 3). Australia committed itself to a process of adapting sustainable development concepts, programs and policies to domestic socioeconomic conditions and prevailing agricultural production, consumption and trade patterns (NSESD, 1992). Policies to ensure the protection of essential ecosystem functions from degradation by agricultural activities originated from domestic pressures from an increasingly environmentally aware public, a growing scarcity of clean water and intact riverine ecosystems, and an expanding group of health-conscious food consumers.

A 1993 survey by the Rural Development Centre of the University of New England polled farmers in all Australian States about rural environmental issues (see Box 2, page 18). The study demonstrated that Australian farmers have a strong concern and awareness of the importance of sustainable agricultural practices. It also showed that farmers support many policies designed to reduce damaging practices and to safeguard the environment and human health. The report also makes it clear that, although most Australian farmers are willing to accept some outside advice and influence, they uphold their right to make final decisions on farming practices and to use their land as they see fit, without excessive bureaucratic interference.

2.5 The greening of consumer demand at home and abroad

Meeting treaty obligations and national and local environmental legislation requiring a greater commitment to sustainable agriculture normally entails increased net costs for producers. But that does not necessarily mean lower profits for farmers, because foods and agricultural products that satisfy high health and environmental standards often bring premium prices.

Food consumers, whether motivated by green concerns or by concerns for health and food safety, are increasingly interested in where food comes from and how it is produced, processed, packaged and distributed. Green food consumers tend to consider a broad range of product characteristics in addition to price, including taste, nutritional value, health and safety and, increasingly, production and processing methods. According to a 1990 survey, 83% of Australian consumers preferred food without chemicals, even at increased prices (Larcombe, 1991). And Japanese consumers are even more discerning.

Organic farming, low-input farming and other alternative farming systems attempt to avoid intensive and chemical-based methods. In Australia, like most other OECD countries, numerous farmers are adopting alternative farming systems but for a variety of different reasons. Examples include farmers searching for ways to reduce input costs or to respond to 'green' consumer interest in organic produce; or, in some cases, farmers are simply responding to individuals and organisations advocating non-conventional farming practices to preserve natural resources for philosophical reasons. Crop rotations, integrated pest and weed management systems, soil and water conserving tillage, intercropping, silvipasture, and precision applications are all examples of alternative agricultural methods now being used in different parts of the country.

The increasing demand for organically grown produce has led to the development of national guidelines in several countries. Denmark, Sweden, Germany, Switzerland, Austria and the United Kingdom have set out official minimum standards for organic produce. In 1990, the European Community introduced a uniform set of regulations for the production, labelling and marketing of organic food in European Community member counties.

Once established, organic farming systems need not compare unfavourably, in terms of gross margin, with conventional farming systems. An analysis of 40 organic and biodynamic farms in Denmark indicates that factors of production receive about the same remuneration in organic and conventional farming – following a conversion period of several years (FAO, 1990).

The process of converting to organic farming can take from two to five or more years. In Denmark, farmers receiving subsidies must convert within a four-year period; in Sweden, conversion grants are available

for three years. Not surprisingly, during the conversion period, yield and returns are normally lower in organic farming than in former conventional farming. A study of Danish farms converting to organic farming, for example, documented crop yield declines of up to 40% initially (Szmedra, 1994). But these organic growers receive lower net earnings because premium prices are not available to them during conversion. In addition, some specialised machinery and other capital investment may be required initially, and production may be more labour-intensive. Nonetheless, eventually farmers may offset these higher costs per unit of output by being able to charge premium prices for their products. In Europe, premium prices range from 5% to 200%, depending on the product, the market channel and the country.

Sales of organically grown foods have risen rapidly in recent years. While at this stage organically produced food represents less than 0.5% of all agricultural sales in the United Kingdom and Germany, its share is growing rapidly from this low base. European producers are often unable to meet the growth in domestic demand. In the United Kingdom, local organic farmers could supply only 40% of the market in the late 1980s, leaving suppliers in Spain, the Netherlands, Israel and the United States to fill the gap. Current domestic demand is also higher than domestic supply in Germany. Nonetheless, substantial changes in farming techniques, the reduction in income during the conversion period, the small market share, and the relatively high marketing costs all present significant obstacles to the expansion of organic farming. To assist the process, Denmark introduced subsidies for conversion to organic farming in the late 1980s. Sweden expanded an already existing set-aside subsidy program to include organic farming in 1990. Later that year, the European Community gave permission for Germany to provide financial aid to farmers converting to organic farming. But this is just agricultural assistance in green guise: genuine

Box 2: *Farmers with attitude*

Information about farmers' attitudes towards the environment is essential when developing and implementing rural environmental policies and sustainable agricultural strategies.
A recent 1993 survey by the Rural Development Centre of the University of New England polled farmers in all Australian states about rural environmental issues such as land degradation and the use of agricultural chemicals, and about various policy instruments to address those issues.

The national study shows that farmers have a relatively high level of awareness of and concern for the environmental impacts of agriculture.

The survey also points out that farmers' concerns for the environment are not necessarily accompanied by agreement or support for conservationists.

Close to 90% of farmers acknowledge that most rural properties have some land degradation and 83% indicate that they have an obligation to look after the land on behalf of the whole community. Eighty-five per cent consider people who knowingly pollute the countryside to be as criminal as people who steal.

While more than half the farmers (59%) say that maximising profits is the most important objective of farming and agree that there is no point in adopting new practices unless they are more profitable, 77% indicate that it is worth putting up with a small decrease in farm profits to protect the environment.

Seventy-nine per cent support financial incentives to encourage soil-improving practices; almost half say that without such assistance farmers can do little to prevent land degradation.
Although most farmers believe that the negative effects of agricultural chemicals, especially pesticides, have been exaggerated, more that half show support for greater testing for and penalties against harmful chemical residues in produce. Over 50% believe that agriculture today depends too heavily on chemical use.

Source: Reeve and Black, 1993.

sustainability requires farmers to supply markets without subsidies, be they organic or otherwise.

Organic food sales are an extremely small portion of the total market in Australia, too. The most recent estimate suggests that 1995 retail sales of organic produce amounted to about $80 billion, or only 0.2% of all retail food sales (DEST, 1996). Organic farmers numbered less than 1,500 in 1990, and organic exports were valued at no more than $1 million that year (Larcombe, 1991). Small though this base is, organic food exports may make a larger contribution in the future, especially as Asian consumer incomes continue to increase. To help farmers to take advantage of Asia's growing demand for fresh foods, animal protein and dairy products, the Australian Government established in 1992 the Clean Food Export Program. The program is aimed at developing a clean and green image for Australian food products in Asia (see Box 3, page 19). The program's objectives are to establish a market preference for specifically Australian fresh and processed foods, based on their high quality and origin from the relatively clean Australian environment.

These developments need to be kept in perspective, though. Two examples help illustrate the point. First, taste preferences can change with incomes in culture-specific ways. Perhaps there is more to be gained by being attuned to those changes than trying to impose, including through advertising, an exotic preference. The campaign to encourage Australian cattle graziers to produce lean beef comes to mind. Marbled rather than less juicy lean beef is the preferred style of beef in the high-priced Japanese market, so Australian beef currently is priced much less per kilogram than

Box 3: *Australia's 'Clean, Green' Promotion Program in Asian food markets*

Australia is one of several countries fighting to secure a place in Asia's burgeoning and increasingly westernised food markets by cultivating the image of a 'clean, green' source of high-quality food products. The Government's Clean Food Export Program was set up in 1992 to help market Australian fresh and processed foods on the basis of their quality and origin from a clean growing and processing environment. This approach could reap substantial rewards for Australian food producers and exporters, as indicated by a successful pilot promotion program in Taiwan. Operated by Clean Food Marketing Australia Limited, a joint venture between the Australian Government, the Grocery Manufacturers of Australia and the National Farmers' Federation, the program is now expanding into other Asian markets, including Hong Kong and Indonesia.

But exporters face several big challenges in encouraging Asian merchants and consumers to open their stores and pantries to 'Clean Australian Foods', not the least being that they are competing with similar campaigns launched by Japan, the United States and New Zealand.

In survey research gathered before and after the Taiwan pilot program, consumers ranked Australia well behind New Zealand as a 'clean, green' food exporter. Furthermore, they placed Australia fourth, after Japan, the United States and New Zealand, in associating the nation with 'high-quality' foods.

There is some evidence suggesting that Australians also need to pay more attention to quality management and customer focus in order to secure their foothold in the Asian food market. A 1995 study undertaken for the Federal Government revealed that Asian buyers' perceptions of the quality, service and value provided by Australian firms falls short of Australian industry's estimates of its own performance and reputation. The Asian consumers polled by the study ranked Australia behind Japan and the United States as the leading suppliers of quality products.

Source: Keniry, 1995.

Box 4: *Healthy food and taste preferences*

Australian farmers and graziers are increasingly finding ways to make the best use of their country's natural comparative advantage in the production of 'clean, green' agricultural products. For example, from Grafton in New South Wales to the far north of Queensland, Australian farmers are currently planting more than 150,000 coffee trees each year. There are no diseases or insects to plague Australia's low-caffeine coffee variety, allowing producers to grow beans without pesticides and receive up to three times the average world price. Australian-produced coffee is now reputedly the third most expensive in the world. Yet production is unable to keep up with the growth in its demand from the world's health-conscious coffee drinkers. The New South Wales Coffee Growers' Association reports that the major constraint facing producers is the lack of a production base, despite the establishment of more than 70 new plantations since the early 1990s.

Australian cattle graziers also are attempting to enhance their position as producers of healthy beef, especially to consumers in Japan. One project in the Lake Eyre Basin has established a herd of 70,000 head of cattle grazing on 6 million hectares. The cattle will not be drenched for internal parasites, nor dipped for external parasites, and no growth promoters will be used. The project has received commercial orders and numerous requests for samples from large Japanese beef importers.

At the same time, a former chairman of the New South Wales Meat Industry Authority, John Carter, warns that promoting 'healthy' lean meat may result in serious marketing problems. Carter claims that consumption of beef in Australia dropped 20% after the Australia Meat and Livestock Corporation began its promotion of lean beef. Taste tests suggest that at least 8% internal fat is needed to provide a 95% chance of a good steak, while more than half of Australia's beef is less than 3% internal fat – providing only a 40% chance of a palatable meal. Since beef from Australian pastures rarely has the flavour achieved by beef that has been grain-fed for its final 100 days, Carter recommends increasing the internal fat for better flavour and then promoting that flavour abroad, particularly in Japan. He also recommends implementing a beef quality rating system in Australia (similar to programs in Canada, Japan and the United States) to allow Australian beef exporters to compete more effectively.

Source: Stapleton, 1996; Carter, 1996.

domestically produced Japanese beef or United States beef in that market (see Box 4, above).

A second example has to do with the level of chemical use in farm production and/or food processing. Fresh food that is organically grown may be no 'safer' than food grown or processed with small amounts of farm or preserving chemicals – and indeed may be less safe (untreated versus pasteurised milk, for example). Because of the relatively low price of its farm land, Australia tends to be a very light user of land-substituting farm chemicals (see Figure 1, page 15), and this is an aspect of its comparative advantage that increasingly will be able to be exploited. Labelling and promoting Australian produce as 'low in chemicals' may continue for some time yet to yield greater net rewards than trying to produce with no chemicals at all.

2.6 Conclusions and implications for Australia

Resource and environmental economists are increasingly stressing the virtues of market-based approaches to sustainable development. This emphasis is driven not so much by economic rationalist theory or ideology as by experiences with inappropriate regulatory policies (political and/or bureaucratic failure being worse than the market failure it was meant to overcome) and

evidence of private market solutions emerging in response to changing needs and preferences. What is required is a careful assessment of each case on its merits, taking into account likely distortions due to special pleading by vested interest groups.

Given the inexorable trend toward 'greener, cleaner' preferences for both products and production processes, it would be wise for Australia to concentrate its research efforts on maintaining its farmers' reputation as low chemical users. Plant variety breeding aimed at building in pesticides using DNA, as is happening with cotton in New South Wales, is but one example. Research on combating potentially imported diseases, including through adapting disease-resistant exotic varieties, also may have a high pay-off in so far as it provides a low-cost alternative to draconian quarantine bans on food imports that may come under challenge at the WTO. Likewise, seeking more efficient ways to use irrigation water, most notably via pricing water more appropriately, also would be wise, both from our own economy's viewpoint and also to avoid being accused of implicitly subsidising agriculture via cheap water charges.

In summary, Australia as an agricultural exporter faces both challenges and opportunities in the changes taking place in international markets and institutions. New opportunities are developing that have the potential to favour our efficient, low-chemical farming industries. But there are numerous ways in which those opportunities could be thwarted by policy responses in food-importing countries. The challenge will be to minimise that latter risk by being vigilant and active in the committees of pertinent international institutions, by maintaining our credibility through not 'sinning' with our own domestic policy choices, and by astute research investment decisions so as to develop appropriate production methods and products that maximise farm profitability in the wake of ever greener preferences of consumers at home and abroad.

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3. Why Markets for Natural Resources Might Fail

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3.1 Introduction

Generally in market economies we expect markets to determine how much output is produced, what inputs are used and the prices at which outputs and inputs are traded. If the inputs used to produce a particular product become scarce, then farmers have an incentive to substitute away from these relatively more expensive inputs by changing their technology. There is concern, however, that the markets for natural resources used in agriculture are failing to value these resources in a way that reflects the wishes of present and future generations, leading to an unsustainable exploitation of some of these resources. This exploitation may take the form of using up a resource such as soil through erosion or degrading the quality of soil through acidification. Agricultural production in Australia has almost trebled in the last 40 years, however, land degradation has also increased. Government reports and individual studies have indicated that land degradation is costing Australia over $2 billion in lost agricultural production each year (Chisholm, 1992). An examination of historic trends in Australian wheat yields concluded that gains in productivity from plant breeding and improved management practices are barely keeping up with declining soil quality (Chisholm, 1992). The 1992–93 Agricultural Census indicated that farmers believed 16.3 million hectares was affected by land degradation including erosion, salinity, acidity, compaction, feral animal invasion and weed infestation (McLennan, 1996). The on-site loss in land values alone in the Murray-Darling Basin as a result of salinity has been estimated by the Dryland Salinity Working Group at $68 million, with the area affected by salinity expected to increase between 2% and 15% per annum (McLennan, 1996).

In this section we seek to review some of the reasons for market failure, with particular reference to the production system in northern New South Wales. More detailed treatment of the economic issues associated with the use of natural resources can be found in texts such as Randall (1987, 1994). A sceptical review of the extent of failure in the markets for natural resources and the need for government intervention can be found in Beckerman (1996).

Important sources of market failure include attenuated property rights to natural resources that lead to externalities; lack of information about the future impact of technology on the environment that leads to farmers appearing to favour short run over a longer run view of wealth maximisation; and inappropriate rural policy by governments in the markets for inputs used in agriculture. These sources are reviewed in turn, but first we describe the production system in northern New South Wales.

3.2 Description of production system

The physical characteristics of agriculture in northern New South Wales illustrate the biological and managerial uncertainties and difficulties faced by farmers, which, in turn, influence the effect of market-based approaches on encouraging sustainable production methods.

The northern inland cropping region of New South Wales receives between 60% and 70% of total rainfall in the period from October to March, with high-intensity storms being common during this period (Holland et al., 1987). Due to the majority of rainfall occurring in summer, the production of winter crops such as wheat is susceptible to water stress. The production system has been characterised by a fallow period (where the area cropped is kept free of active growth) in the summer to store water in the subsoil for a following winter cereal crop. Weeds are often a problem during the fallow period, and tillage to control weeds led to soil erosion since the soil is left bare during the fallow period. Fallow length varies between 5 and 19 months, with 6 months being common before sorghum and wheat. Increasing soil erosion (often observed when high-intensity summer storms occur) of tilled soils then led to a trend towards stubble retention (keeping previous crop residues on or near the surface to reduce erosion) in the last three decades (Holland et al., 1987; Pratley and Rowell, 1987). As with other areas in Australia, there

can be considerable seasonal variability with droughts, late frosts, storms and floods affecting production.

Farmers face constraints and considerable uncertainty of output prices, the costs of purchased inputs, finite supplies of land and labour, as well as physical and biological constraints. This has led to the adoption of high-yield, monoculture farming that is susceptible to increased variability under varying climatic and economic conditions (Farber, 1991).

Modern agriculture in this region is an input-intensive system that is depends on chemical fertilisers, pesticides and herbicides and fossil fuel-driven machinery. Once the majority of the production and infrastructure is depends on the technology, it becomes difficult for other technologies (such as integrated pest management compared to pesticides) to become established (Reeve, 1990). Alternative, knowledge-intensive practices are only likely to be adopted where they can compete with input-intensive practices but, given the nature of an input intensive 'technological monoculture', the alternative practices find it difficult to compete. For example, it is easier for a company to research and produce a new chemical for which the property rights of the manufacturer are definable, enforceable and whose use is convenient for the user, rather than to invest in promoting knowledge-based methods of insect control (such as integrated pest management) for which the property rights are less enforceable and returns are not guaranteed (Reeve, 1990). It is also easier and faster to buy and apply a pesticide rather than spend a substantial amount of time learning new management skills.

3.3 Sources of market failure

Market failure occurs when the forces of competition do not achieve the highest level of welfare possible for society. Resource allocation is inefficient and economic efficiency is not achieved. Resource allocation may be changed to make society (including consumers and/or producers) better off without making anyone worse off; for example, when markets fail to reflect the full social costs of production in the prices of traded inputs and outputs such as the costs of environmental services (Pearce and Warford, 1993).

Failure in the market for natural resources may arise from price-based causes of environmental degradation. The International Institute for Sustainable Development (IISD, 1997) pointed out the following.

1. Externalities: Usually a result of no or ill-defined property rights. Harmful or beneficial effects of production or consumption are imposed on others but can't be traced back to the originator. Hence the perpetrator of the effects can't be liable for the cost of any harmful effect or be reimbursed for beneficial effects.
2. Underpricing: Occurs when all the costs of an input or activity aren't included in the price of an output. Markets generally only make provision for financial costs and not environmental and social costs of production.
3. Lack of information: Gives distorted impression about the scarcity of a resource or the impact of technology.
4. Government policies: Also cause underpricing. Via subsidies, the consumer bears less costs and gains a false impression of the scarcity of the resource. Lower costs will also induce more use of a resource, leading to problems from overuse, such as tax incentives for land clearing which led to excessive clearing in the past.
5. No property rights: Leads to no market for certain goods, services or resources (such as the use of the ocean or atmosphere to receive wastes). Such goods/services/resources are referred to as public goods which are useable by society without payment. Such resources are often difficult to value, hence they tend to be over-exploited.

The Industry Commission (1997a) also mentioned a lack of incentives to preserve intergenerational equity, although this may be grouped with underpricing. Examples of these problems in the context of agriculture include low prices for irrigation water leading to overuse and resulting in salinity, the atmosphere being used to receive gaseous wastes, or the case of dryland salinity, tree clearing on the slopes of catchments leading to rising watertables and salinisation further into the catchment area, often with a time lag of several decades. These market problems result in farmers not receiving price signals which encourage sustainability.

3.3.1 Property rights limitations

Property rights define legally enforceable rights relating to the ownership and use of a resource or commodity. The Industry Commission (1997b) describes the existence of well-defined, secure, exclusive, transferable

and legally enforceable property rights as essential for a market to function effectively.

A common aspect of the literature is a focus on property rights, and that creating markets and property rights may be a way of solving many environmental resource use problems (for example, Reeve 1990; Farber 1991; Zilberman et al., 1997; Ackroyd et al., 1991; Industry Commission, 1997b). Hanna, Folke & Mäler (in Hanna and Munasinghe, 1995) argue that property rights are fundamental to the use of environmental resources and that most environmental problems can be seen as problems of incomplete, inconsistent or unenforced property rights regimes.

There seems to be increasing emphasis in the literature on property rights considerations and institutional structures within which market instruments operate (for example, Hanna and Munasinghe, 1995; Pearce and Warford, 1993; Pearce, 1994; Reeve, 1990; Ackroyd et al., 1991). Taxes have been applied in an environmental context for several years. However, until recently, few had incentive objectives, rather they were intended primarily to raise revenue. Pearce and Warford (1993) advocate the use of market-based instruments over command and control structures, when some form of regulation is required to improve and maintain environmental quality. For tax structures to succeed as incentive schemes, corresponding and appropriate property rights need to be in place. As of 1988, many OECD countries had some kind of tax and charge incentives in place, but they were primarily designed to raise revenue, not alter the behaviour of polluters. User charges such as charges for landfill waste and use of water were widespread in the OECD countries in 1988, but effluent charges were comparatively rare. Sweden introduced the world's first carbon tax in 1991, at a rate of 0.25 Swedish krone per kilo of carbon dioxide, levied primarily on fossil fuels including oil, coal, natural gas, LPG and gasoline (Pearce and Warford, 1993).

Ackroyd et al. (1991) argued that poorly defined property rights are the major cause of abuse of the environment. A key work which illustrated this point was Garrett Hardin's 'The Tragedy of the Commons' article. The example was given of common land in a village, where all local villagers could graze livestock, take hay and gather firewood. But there was no incentive for any individual villager to take steps to ensure the future productivity of the land, because anyone else could come along and make use of it. For one person to leave trees to provide firewood later on was futile because anyone else could come and cut them down. With common land, there was no facility for the users of the land to reap a return on any investment they made in maintaining or improving the productivity of the land. The advent of secure individual title to land, and the accompanying incentives for owners to obtain a return from their efforts, is seen as one of the keys to the Industrial Revolution in Britain (Ackroyd et al., 1991).

Ackroyd et al. (1991) argued for the inclusion of environmental considerations into the economic calculus via assignment of property rights and obligations, if necessary using 'polluter pays' charges and taxes. They argue that research clearly shows the superiority of property rights and incentive-based approaches relative to control and command measures. The 'polluter pays' principle, where the idea is that the polluter should pay for damages caused by pollution, has gained popularity in recent years. However, the problem with this principle is to determine who causes the pollution and, if more than one source, how much each source contributes (Bromley, 1996).

Faeth (1993) pointed out that the notion of sustainability is absent from conventional agricultural accounting systems, which ignores the effects current production has on resources such as soil and water. The depreciation of assets such as building and machinery is accounted for, but there is no accounting system for a decline in productive capacity of soil and water, even though such declines endanger future income. The implication of this is that the most financially rewarding production system for farmers may also generate significant economic losses to both the farmer and the nation as a whole.

Faeth (1993) included natural resource accounting methods in USA case studies, using economic and resource accounting models to integrate information at paddock, farm, regional and national levels. This was done in order to include both the farmers financial perspective and the wider environmental and economic perspectives. A model that simulated the physical changes of the soil due to different agronomic practices and subsequent productivity changes was used to assist in estimating the economic impacts of soil productivity changes. This kind of accounting approach requires a great deal of information on the on- and off-site effects of various crop and pasture management practices, information which is still being researched in detail in Australia. However, it does show that a system of including sustainability in agricultural accounting systems may be possible, once the required information is available.

There have been claims that there is a need to focus on incentives and price signals in understanding (and potentially improving) adoption of sustainable development. IISD (1997) described this aspect succinctly as "Prices are a consequence of the distribution of property rights that underlie market exchange." Chapter 32 of Agenda 21 (negotiated at the Earth Summit in Rio in 1992) is concerned with strengthening the role of farmers in sustainable development. Section 32.6 states that national governments should "Promote pricing mechanisms, trade policies, fiscal incentives and other policy instruments that positively affect individual farmer's decisions about an efficient and sustainable use of natural resources, and take full account of the impact of these decisions on household food security, farm incomes, employment and the environment."

Gretton and Salma (1997) pointed out that at the farm level there are incentives for action to prevent or ameliorate land degradation if the effort and expense yield net benefits to the farmer. However, if the benefits of the efforts of the farmer accrue to society at large, such as the preservation of a rare plant species, there is no direct incentive for the farmer to spend the time and finances on amelioration. In other words, the beneficial effects of a farmer's conservation efforts can't be traced back and so the farmer doesn't receive compensation for the benefits they provide to society as a whole. This is an example of an environmental public good (Industry Commission, 1997b). Milham (1994a) argues that an increased understanding of the linkages between farmers' economic incentives to control soil degradation, productivity decline and future farm productivity is essential for formulation of effective soil management policies.

Any market operates within an institutional framework which includes the political, social and legal structure of a country. Therefore, if the institutional framework changes (for example, a change in property rights), that implies that there will be an automatic change in price signals. Panayotou (1994) commented that "market failures are institutional failures", partly attributable to the nature of certain resources and partly to the failure of governments to establish the conditions for markets to function effectively and to use available instruments to bring inputs and costs into the market that current institutional frameworks fail to internalise. Farber (1991) stated that economic and political institutions have failed to provide incentives for sustaining ecosystems because of a focus on the short term, failures in property rights, concentration of economic and political power, immeasurability and institutional and scientific uncertainty. Kuyvenhoven et al. (1995) pointed out that the potential impact of policy instruments on farm-level resource allocation and sustainability indicators is influenced by prevailing market and institutional arrangements, and that the impact of policy instruments depends on the improvement of the market and institutional environment and overall resource availability.

Hanna, Folke and Mäler (in Hanna & Munasinghe, 1995) state that property rights regimes are a subset of a society's institutions, the organisational structures of a society which mould human interactions. According to Ackroyd et al. (1991), sustainable resource management depends on reforms to the institutional arrangements within which market systems operate, rather than specific policy and planning procedures. For example, they assert that fundamental to the reduction of land degradation are institutional arrangements that secure property rights to land and thereby provide an incentive for the uptake of new knowledge about land resources.

Similarly, Panayotou (1994) argued that government needs only to provide the initial institutional and policy reform necessary to allow markets to function effectively. Market failures don't always mean that there is a need for government institutions to provide market replacement but, rather, policy adjustments are required. For example, correcting interventions such as subsidies on irrigation water, providing the legal foundations of markets such as secure property rights and enforcement, internalising externalities via pricing and financial instruments, and improving the flow of information.

Reeve (1990) also concluded that most of the obstacles to sustainable agriculture are institutional, that the property institutions don't exist that would enable markets to emerge that would reward farmers. He argues that markets are not the answer until institutional reform takes place that can sort out which parts of the ecosystem people can access to pursue economic gain. For example, currently the right to grow wheat also includes the de facto right to allow accessions to the watertable and leaching of chemicals into waterways. Markets can only provide the links once the institutions exist that recognise rights of intervention into the ecosystem. Additionally, the rate of change in institutional arrangements for resource access is a long way behind that occurring in the technology of resource use (I. Reeve, pers. comm., 1995).

3.3.2 Deficiency of information

There are arguments both for and against a lack of information (about the likely or possible impacts of unsustainable land management practices) being a key cause of problems. If lack of adequate information is a cause, there is a case for continued government funding for research, development and information extension activities.

ACIL (1994) found that farmers are not receiving clear messages on new practices and technologies which can improve both profitability and sustainability, claiming this has been due to fragmentation of information coming from different sources, as well as a lack of a whole-farm integrated approach. The ACIL report emphasised the central role of prices and profitability in providing feedback and incentives for adoption of more sustainable practices. It would seem that land management practices advocated in the past (such as fallowing for rainwater conservation) resulted in unforeseen problems (in the case of fallowing, it left the land susceptible to erosion). Consumers do not necessarily know about the origin of the produce they buy and farmers don't have full information about the environmental costs their production system may be causing, and there may not be suitable mechanisms to pass some of those costs on to consumers.

A survey on crop rotation, tillage fertiliser use and weed control was carried out from 1983 to 1985 (Martin et al., 1988) and covered the Shires of Moree, Narrabri, Yallaroi, Gunnedah, Inverell, Quirindi, Parry, Manilla, Bingara and Barraba. The survey found that adoption of new wheat varieties and herbicides was rapid, but adoption of the use of nitrogen fertilisers was slow. The study concluded that the change in crop rotation practices since the 1940s was only marginal, meaning that cropping paddocks were mostly kept in continuous production, particularly in the more western shires. Eighty-one per cent of farmers surveyed cultivated three to five times every year, implying a high cropping intensity. Rotations with pastures or with cereals grown every second year were more common in the eastern part of the surveyed area, which receives more annual rainfall on average. Similarly, Hamblin and Kyneur (1993) observed that crop rotations with pastures, or with a cereal crop every two years, were more common in the higher rainfall areas in the north-east. They concluded that cropping percentages (the ratio of crop area sown to pasture) were excessively high in the northern shires of New South Wales, and that soil organic matter levels are declining.

Hamblin and Kyneur (1993) observed that the rotation of cereal crops with pastures (particularly lucerne) has been perceived for decades as less exploitative and more sustainable, but according to Martin et al. (1988), only 23% of those surveyed grew pastures. Hamblin and Kyneur (1993) suggested that, for many farmers who have a mix of soil types, crop and stock enterprises, the management requirements of cereal crop, pulse crop and pasture rotations may be too complex to be practical. In addition, low wool and cattle prices in recent years are likely to have been a disincentive to increasing improved pasture areas or introducing pasture into a rotation system.

A survey undertaken by Hayman (1995) aimed to ascertain current rotation practices and the main reasons behind crop rotation decisions in order to enable more effective research and technology transfer. This study revisited 49 of the 50 farms surveyed by personal interview in the Martin et al. study (1988). Again, weeds were the most important factor in deciding what crop to plant next. Hayman found that almost all farmers surveyed had decreased the number of tillage operations compared to five years previously. This indicates that there has been a recent change towards operations (such as reduced tillage) that are perceived as more sustainable practices.

The Martin survey could be seen as referring to longer term rotations, while the Hayman survey may refer simply to the next crop. However, the results of both were remarkably similar, particularly in the case of ranking weeds as the main reason for deciding a rotation or what crop to plant next. In the Hayman survey, the results showed that 38% considered price signals (ie. commodity prices) at sowing to be an important factor in deciding what crop to plant next. Price signals at sowing were second to weed control factors (see Table 2, page 29).

It would seem from the Hayman survey results that concern about nitrogen fertility has dropped during the mid-1980s to early 1990s, assuming the two questions mean the same thing, however, the difference could be due to different phrasing of the questions. In the Hayman survey, only 10% responded that soil fertility was one of the major soil problems they faced. This is in spite of publicity about the widespread problem of soil nitrogen and organic matter decline. Erosion was seen as the major soil problem (by 48% of respondents).

A survey of randomly chosen farmer groups (from lists of registered wheat growers from the Australian Wheat Board) by Woog and Kelleher (1993) included

Table 2: *Factors in deciding the next crop to plant*

	Major reason for crop rotation (Martin et al.)	Most important factors in deciding what crop to plant next (Hayman)
Managing weeds	77%	77%
Price signals at sowing	– (not asked)	38%
Nitrogen fertility	30%	23%
Using soil moisture	28%	21%
Managing disease	31%	18%

questions and discussions on the issue of rotations. Many farmers did not see 'alternative' crop options as viable on a large scale or in the long term. The importance of nitrogen and the benefits of pulse rotations in terms of nitrogen was recognised, but farmers had misgivings about the general lack of success with pulse crops and limited markets for the grain. Both the addition of fertiliser nitrogen and increased herbicide use (due to reduced tillage) were seen as expensive options (Woog and Kelleher, 1993).

However, other research indicates that information is available. Surveys across Australia have shown that adoption of agricultural practices is perceived to be more sustainable, with data indicating that more than two-thirds of broadacre farmers used reduced tillage, stubble retention or mulching to minimise land degradation (McLennan, 1996). An Australia-wide survey conducted by Reeve and Black (1993) indicated a high level of awareness of the existence of land degradation (see Box 2, page 18). According to the 1992–93 Agricultural Census, farmers perceived that about 3.9 million hectares of agricultural land in Australia were affected by water and/or wind erosion (McLennan, 1996). Erosion is a problem of concern because soil formation rates in most regions are lower than soil loss rates, and a net loss of soil is likely to have a detrimental effect on agricultural productivity.

Therefore it seems that, although farmers are aware of land degradation problems and in recent years there has been a trend towards tillage practices to alleviate present and prevent further degradation, there still appears to be informational, managerial and profit-based barriers to adopting further 'sustainable' production methods. Also, the management requirements of the production system dictate what operations are feasible (such as requiring a fallow period for water storage), limiting flexibility to change the production system. Often production methods that are thought to be more sustainable are not necessarily fully understood or profitable, or require extensive training in new management methods, which are all disincentives to adoption.

As noted by Pearce and Warford (1993), uncertainty about the future encourages the trend towards productive but unsustainable systems. Agriculture is characterised by the long term 'cost-price squeeze' and various uncertainties such as commodity prices, the cost of purchased inputs, weather (eg. droughts, floods, frosts) and biological variations (eg. pests and diseases). Therefore, encouraging adoption of 'sustainable' agricultural practices requires efforts to reduce the uncertainties faced by farmers. Measures to address uncertainties faced by farmers include research and information provision, such as crop varieties and cropping systems that are better able to stand up to climatic variations.

Conflicting information and lack of coordination from information providers in Australia is another issue of concern. However, this would seem to be being addressed in recent times with the growth in Cooperative Research Centres that often involve many institutions in a research project. In the United States there is less government and more agribusiness involvement in ongoing provision of advice and there is increasing cooperation between the public and private sector (ACIL, 1994). A national symposium in the United States in 1992 identified that economics is driving solutions to land management problems. There is a trend in the United States towards a whole-farm systems approach based on developing profitable

rotations. Soil conservationists as well as agriculturalists are assessing crop rotations for their sustainability (ACIL, 1994).

Milham (1994a) hypothesised that the lack of information about the future impact of technology on the environment, and the inability of the market to reflect the impact of such technology, such as a product whose production methods are environmentally damaging being more expensive, leads farmers to favour short-term income over a longer run view of wealth maximisation. Lack of information about the future impact of technology on the environment may result in environmental resources being underpriced, and may restrict the ability of the consumer sector to select products that may be more sustainably produced.

In the case of dryland salinity in Australia, a lack of information seems to exist about the effects of vegetation clearance and farm management practices; time lags between vegetation clearance and the appearance of salinity; specific costs of dryland salinity and benefits of abatement; and the extent and potential extent of salt scalds and saline seepage. This lack of information results in landholders not making optimal decisions regarding land management practices and distortion of estimated costs and benefits of government intervention to address the externality. It also results in distortion of comparisons between measures to address the problem, such as economic instruments compared to direct regulation, and may constrain the use of some economic instruments (Industry Commission, 1997a). Economic instruments focused on salt outputs cannot be implemented because dryland salinity is a non-point source pollution problem where it is not possible with current technology to discern individual contributions to salinity levels. Rather, only measures that focus on the input side, such as subsidies for revegetation, tradeable permits for vegetation clearance, and cost-sharing for ameliorative works, can be implemented (Industry Commission, 1997a).

3.3.3 Government intervention in input markets

Another source of market failure is inappropriate rural policy by governments in the markets for inputs used in agriculture. A past example of this is the now abolished Commonwealth tax concessions for land clearing which encouraged over-clearing (Industry Commission, 1997b). There are still land tax policies in some States that act as a positive inducement for land clearing (James, 1997). A submission by the Business Council of Australia (BCA) in 1990 to the (Australian) Working Party on Ecologically Sustainable Development identified inappropriate incentives which distort market signals in resource-based industries and encourage an inequitable allocation of resources. Examples cited were underpricing of water on public irrigation schemes resulting in salinity and clearing subsidies which, in turn, result in land degradation. Water supply and pricing reforms have begun to be introduced recently that are aimed at achieving full cost recovery for the infrastructure and delivery systems.

Government may choose between various strategies and instruments to prevent or remedy damage to the environment. Jeanrenaud (1997) listed three main types of approaches:

- Allocating budgetary resources to public anti-pollution investments, such as waste treatment plants. Instruments include investment in public projects and research.
- The application of measures to modify the behaviour causing the damage, by making agents aware of the negative impact of the acts on the environment.

  Instruments: Information and moral suasion – information campaigns, education.

  Direct regulation (command-and-control): standards, permits, specifications, bans, zoning.

  Incentive-based regulation: charges, tradeable permits, deposit refund systems, joint implementation.

  Privatisation: private ownership of resources.
- Government provides a clear definition of property rights, so those responsible for the damage and the victims of the damage may negotiate a reduction in damage voluntarily. Instruments include allocation of property rights and legal liability for damages.

The province of Ontario in Canada has experienced similar environmental degradation problems to Australia, with degradation of watercourses caused by soil erosion. As with Australian agriculture, farmers in Ontario have non-monetary grounds for land degradation control (stewardship ethic, aesthetic or other benefits), however, similarly to Australian farms, economic imperatives often outweigh the non-monetary considerations. Stonehouse and Bohl (1993) found that in the case of cash cropping farms, regulatory limits to soil erosion and taxation of eroded soil would impose significant financial hardships on many farmers. They found that subsidisation of the cost of conservation

tillage equipment or of the costs of producing rotation crops such as lucerne would be more appealing financially for farmers.

In instances where restrictions (such as a ban on clearing) place high costs on those directly involved and the benefits accrue not to the farmer but the public at large, there is an incentive to not report, rather than obey, the restriction. This is a case of externalities where the farmers bear a larger share of the costs than the share of benefits they receive. For example, when legislation in New South Wales (SEPP 46) was expected to ban cultivation of long-term native pasture areas, extensive areas of native grassland were cultivated before the legislation came into force, so that farmers would have the option of using the land for cropland or sown pastures in the future.

The Industry Commission (1997a) states that no economic instruments are currently used to address soil acidification, which appears to be caused by excessive fertiliser use and the introduction of legumes, and soil structural decline, which appears to be caused by cultivation, stubble burning, overgrazing and compaction. However, economic instruments are in place to deal with agricultural problems such as salinity and soil erosion. Soil erosion measures include instruments to encourage retention of vegetation, and revegetation.

Incomplete pricing of inputs such as underpricing of irrigation water has led to overuse of irrigation and associated consequences such as salinisation of irrigation areas. As Tobey (1996) points out, subsidisation of irrigation water for agriculture is a "perverse incentive". Underpricing caused by government subsidisation aimed to encourage increased irrigation has led to overuse of the water supplies. Recent water supply and pricing reforms are aimed at correcting this market failure by increasing the price of irrigation water to achieve full cost-recovery for the infrastructure and delivery systems. However, the effects are likely to be different in different regions.

Some farms have come to rely on low-cost irrigation water, and will face financial difficulties as the price of water increases. An increase in the price of irrigation water may lead to significant changes for most irrigation farms and significant structural adjustment of regional economies. As illustrated by ABARE (1997), the immediate impact of measures which restrict irrigation water availability and increase the price of irrigation water on farm profitability and the resulting socioeconomic impacts on rural regions are likely to vary between regions. The changes on irrigation farms due to increases in water prices may take many aspects, such as improving water use efficiency (for example, increasing water storage, installation of recirculation systems, changing irrigation methods), growing crops that are more profitable per megalitre of water used, to buying more land or selling out altogether.

A survey by ABARE (1997) compared two different regions, the Murrumbidgee Irrigation Area (MIA) and districts in southern New South Wales and the Kerang-Cohuna region in northern Victoria. In the MIA and districts, 52% of irrigation water was used for rice production and 31% for cereals and pasture production in 1995–96. The Kerang-Cohuna region differs from

Table 3: *Possible selected irrigation farm management adjustments, 1996–2001*

Action	MIA and districts	Kerang-Cohuna
Install/increase water storage	25% (22% already have water storage)	0% (17% already have water storage)
Install/increase reuse system	41% (40% already have reuse systems)	33% (44% already have reuse systems)
Install groundwater pump	20% (22% already have groundwater pumps)	3% (10% already have groundwater pumps)
Change water application method	29%	7%
Purchase land	27%	5%
Sell land	29%	38%
No changes	17%	17%

Source: ABARE, 1997.

the MIA in that no rice growing is undertaken, and water use per hectare is lower. Irrigated broadacre agriculture in the latter region is characterised by livestock specialists and mixed farms, with few cropping specialists. Average farm business profit and rate of return on capital were higher in the MIA and districts than for farms in the Kerang-Cohuna region (ABARE, 1997).

The survey found that a significant proportion of irrigation farmers (29% in the MIA and 38% in the Kerang-Cohuna region) would sell land in response to increasing irrigation charges and a decline in the availability of irrigation water over the next five years (see Table 2, page 29). Table 3 (page 31) summarises the changes. The ABARE survey found that it seems likely that the effects of an increase in water prices and declining water availability would have different effects in different regions. In addition, that farm level adjustment will also vary among irrigated farms and it will be influenced by enterprise combinations and management practices.

3.4 Conclusion

The objective in this section has been to review some of the reasons why agriculture in northern New South Wales might fail to use natural resources in a way consistent with the expectations of present and future generations. An important source of environmental degradation has been attenuated property rights to natural resources, leading to externalities for present and future generations. Some degradation has arisen because the long-term effects of some agricultural technologies were unknown at the time the technologies were implemented. Some degradation has arisen because of inappropriate government intervention in the market for water and in tax incentives for land development. It was noted that in some situations it may well be in the interests of both the farmer and the community to 'mine' natural resources to a limited extent.

There are arguments both for and against a lack of information about the likely or possible impacts of unsustainable land management practices being a key cause of problems. Some research observes (eg. ACIL, 1994) that that farmers are not receiving clear messages on new practices and technologies, while others show a high level of awareness of land degradation problems and a trend towards farming practices perceived as more sustainable (eg. Reeve and Black, 1993; Hayman, 1995). The question arises: Is it a lack of information, conflicting information, a lack of communication of existing information, an inability by farmers to adopt more sustainable practices or a combination of all of these factors?

There are many economic incentive instruments available which may be used in environmental management. They work towards correcting market failures due to information failure or externalities, by adjusting the price signals and making property rights clear, securable and tradeable. However, the success of market incentives in moving resource use towards sustainable alternatives will depend on the legal and institutional framework being adaptable and flexible. If the market continues to ignore externalities, then damage to resources could result (Markandya, 1994).

While there are some estimates of the cost of degradation in Australia, these estimates should be used cautiously, as suggested in Gretton and Salma (1996). There is little information to attribute the costs of degradation between the broad causes of degradation that we have identified. There appears to be little information about the extent to which degradation is reversible, nor is there much analysis of whether it is in society's interests to reverse particular instances of degradation.

In the next section some recent approaches to change the incentives for farmers in their use of natural resources are examined. Initially pubic sector initiatives are reviewed, but the focus of the section is on private initiatives aimed to capture the benefits of using 'green' technologies.

4. Market-based Approaches for Sustainability

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4.1 Introduction

In the past the existence of market failure has been seen as a sufficient condition for government intervention. Often this intervention has been in the form of direct regulation of the production of an output, such as pollution of some nature, or of the use of some input. There is now greater appreciation, firstly, that government can also fail in that the costs of intervention are larger than the benefits (Godden, 1997, p. 38) and, secondly, that market-based approaches such as taxes and tradeable permits may achieve the same outcome as direct regulation at lower cost (Industry Commission, 1997a). In this section, market-based approaches by industry and government with the potential to make a significant contribution to overcoming sustainability problems in agriculture are reviewed. The section concludes with a review of attempts at 'niche marketing' based on 'eco-labelling'.

4.2 Government regulation

Market failure has been used to justify government intervention in markets such as water allocations, land use planning and the New South Wales *Native Vegetation Conservation Act 1997* (which has repealed State Environmental Planning Policy 46 – SEPP 46). According to the Industry Commission, (1997a), government intervention to address environmental market failures can take three main forms: direct regulation, suasive measures and economic instruments.

Direct regulation (otherwise known as 'command and control') measures involve a high degree of government intervention. They include direct government ownership of resources, and regulations which define and limit technologies, processes and resource use. 'Command and control' is where the government sets environmental standards and design regulations to ensure the standards are honoured. 'Command and control' involves actions aimed at alteration of available options. Examples include environmental permits, standards, product bans, and restrictions (Jeanrenaud, 1997). The regulation is the 'command' which, for example, sets a specific level of pollution or abatement that must not be exceeded; the 'control' monitors and enforces the standard, and the polluter has to comply or face penalties. However, regulation such as this is generally more expensive than other means, because the regulator must obtain information from the polluter and there is no flexibility for the polluter. Also, the standard must be abided by, even by those whose costs of abatement are higher than those of another (Pearce and Warford, 1993).

However, government intervention may not necessarily be more efficient than imperfect markets. Government intervention may also fail to make markets reflect the full social costs of production. For example, subsidies, price controls and output quotas that result in below free-market-level prices result in excessive or unsustainable use of natural resources (Pearce and Warford, 1993).

Ackroyd et al. (1991) list the main deficiencies of direct regulation as, firstly, that there are inadequate incentives for the search for more cost-effective approaches and, secondly, that they suffer from scarcity of information available to the government planners who formulate the specific decisions, hampering their ability to facilitate efficient resource allocation. The Industry Commission (1997a) lists the main disadvantages of such measures as inflexibility, no incentive to develop innovations to reduce environmental degradation beyond the levels set by law, high administration and enforcement costs, and are therefore not considered to provide the least cost solution of achieving objectives.

Beder (1993) noted that businesses have preferred direct regulation because of concerns that charges would increase their costs. However, there are various legislative measures that do leave leeway for innovation by businesses. For example, by 2003 in California, 10% of the vehicles sold must be electrically powered (Motavalli, 1996). Manufacturers are free to develop their own technologies to meet the legislative requirement.

4.3 Suasive measures

Suasive measures aim to change perceptions and priorities within a businesses decision framework by internalising awareness and responsibility into individual decision-making. Such measures may take the form of education, information provision and training. Suasive measures used to alter attitudes may assist with the success of regulations or economic instruments aimed at altering behaviour. Suasive measures have formed a substantial part of government strategies to address dryland salinity in Australia. Project work under the National Dryland Salinity R,D&E Program managed by LWRRDC is being undertaken in five focus catchments in order to draw a comprehensive picture of the salinity problems and management in those catchments (Industry Commission, 1997a).

With relation to native vegetation retention, suasive measures have been used to foster a conservation ethic on private land, such as awards for achievement in conservation (eg. Landcare awards), participation in community groups, (eg. education and voluntary measures in Landcare), and education of land managers on native vegetation conservation issues (Industry Commission, 1997a).

In September 1997, the Industry Commission released a draft report on ecologically sustainable land management in Australia ('A Full Repairing Lease: Inquiry into ecologically sustainable land management in Australia'). The terms of reference of the inquiry instructed the Commission to report on the ecological sustainability of agricultural and pastoral land use. The inquiry covers both publicly and privately owned land, and includes associated natural resources such as vegetation and water. In the draft report, the Industry Commission has called for an overhaul of environmental laws, warning that the laws are flawed and that the nation's environment is suffering severe stress. The draft report states that "perverse incentives" exist, incentives that encourage extra pressure on the environment (Industry Commission, 1997b).

The Industry Commission has outlined proposals for market-related policies for surface water use, groundwater use, water quality, forestry and rangeland resources. These proposals include:

- establishing preconditions for markets in key natural resources;
- removing obstructions to the operation or development of such markets; and
- using market mechanisms to manage waste and pollution associated with agriculture.

The Commission proposes a reform package to promote conservation and use of natural resources that minimises risk of loss of natural capital. To do this the package aims to create incentives and opportunities for individuals to seek and implement solutions to environmental problems, as well as harness the flexibility of environmental altruism and market-based solutions to environmental problems.

The proposed reform package has three 'pillars':

- Change to the regulatory regime to ensure resource owners take into account the environmental impacts of their decisions.

  This would impose a 'duty of care' for the environment upon natural resource owners and managers. A single unifying statute in each jurisdiction would replace the various statutes currently used to govern natural resources. Voluntary standards and codes would be used to guide duty holders on how to comply with the law, should be able to be developed by local stakeholders, and replace as many mandated standards as possible. Instead of a code of practice, duty holders may comply with their duty of care by implementing a formal environmental management system.

- Create or improve market for natural resources.

  This involves strategies to remove specific obstacles to the creation or expansion of functioning markets for key resources, as well as price reforms to eliminate subsidised resource use. The measures centre on creating better, or better defining, tradeable rights to use the resources.

- Encourage nature conservation on private land.

  This applies specifically to protection of biological diversity and natural heritage.

The draft report claims that the best approach to natural resource management is on a local or regional level, with a comprehensive and integrated package of policy measures to accommodate the complex issues surrounding sustainable management of natural resources in agriculture. It recommends that the voluntary codes of practice to provide guidance to natural resource owners and managers on how to meet their 'duty of care' would be best developed for local application by local stakeholders (Industry Commission, 1997b)).

4.4 Removal of inappropriate policies

In the past, inappropriate government policies have had unexpected adverse effects, such as generous tax concessions for land clearing leading to excess clearing, publicly funded capital works to expand irrigation, and large fertiliser price subsidies. However, in recent years there have been initiatives to correct these problems, such as the removal of tax concessions for land clearing (although some vegetation removal is still tax-deductible), the removal of fertiliser subsidies, and major water reform programs.

In August 1997 the New South Wales Government announced a $117 million package for government to work with the community to implement water reforms and provide support and incentives to agriculture and industry to become more adept in the way they use water, with the aim of improving the management and health of New South Wales rivers and groundwater. The water reform package will affect all New South Wales water supply categories, including metropolitan drinking water (provided by Sydney Water and Hunter Water), non-metropolitan urban (eg. for country town water) and bulk rural. The goals of the water reform package include:

- better balance in sharing water between rivers and groundwater, and water users;
- better clarity of access and use rights for water;
- a fully developed water transfer market; and
- effective community involvement in water management.

Activities of the water reform process include (Department of Land and Water Conservation, NSW, 1997a):

- establishing a framework for community-based planning and management of New South Wales rivers and groundwater;
- strengthening water access and use rights for water users;
- improving the health of rivers and groundwater;
- funding a significant package to encourage industry to use water more efficiently;
- making it easier to buy and sell water to encourage regional development;
- regularly monitoring and auditing the scientific and socioeconomic impacts of the reforms;
- establishing interim river flow and water quality objectives for the State's rivers; and
- establishing a groundwater and weirs policy.

4.4.1 Water pricing aims

In the case of bulk rural water supplies, the aim is to have arrangements to achieve full cost-recovery in place in 2001. The New South Wales Government has asked the New South Wales Independent Pricing and Regulatory Tribunal (IPART) to determine prices for bulk rural water services which reflect the costs of managing surface water and groundwater, and the costs of storage and supply. Prices will be set through an equitable, transparent process which removes cross-subsidies where practical (Department of Land and Water Conservation, NSW, 1997b).

4.4.2 Water market aims

Water transfers have been in place in New South Wales for many years on regulated streams. Temporary transfers for surface water were introduced in 1983. The success of the temporary scheme encouraged the introduction of permanent transfers of surface water volumes in 1989. Within existing markets, work has started on identifying and removing unnecessary barriers to trade, and developing a computer-based trading system (Department of Land and Water Conservation, NSW, 1997c).

The operation of inter-valley transfers is being reviewed and guidelines for future transfers are being developed by the NSW Department of Land and Water Conservation. These guidelines will be considered in the development of transfer rules for individual catchments, which will be documented in river management and groundwater management plans. A separate review of barriers to interstate transfers, such as legislation, definition of water rights, prices and environmental outcomes, is being conducted by a Murray-Darling Basin Commission Working Group. Where no markets currently exist, possible interim arrangements are being investigated and developed (Department of Land and Water Conservation, NSW, 1997c).

In unregulated streams and most groundwater systems, markets do not currently exist. In these systems, water needs must be satisfied through the purchase of land with an existing water licence. In unregulated rivers, water licences must be converted from an area of

irrigation to a volumetric basis prior to the establishment of markets. Plans for stressed systems are expected to be in place by 2000 (Department of Land and Water Conservation, NSW, 1997c).

Assistance measures for water users will include (Department of Land and Water Conservation, NSW, 1997):

- subsidies for investment in efficient irrigation technology;
- capital grants;
- assistance to develop business plans;
- information on best management practices and efficient irrigation technology;
- training; and
- counselling.

4.5 Market-based approaches

Economic instruments are often referred to as 'market-based' instruments, since they work by using market signals (eg. prices) to provide an incentive for decision-makers to consider environmental concerns and bear some or all of the costs imposed on society as a result of their decisions. These affect the relative prices of alternative actions available to businesses (Industry Commission, 1997a). As Tobey (1996) pointed out, market-based incentives can filter though the entire economic system. If the role of government as an independent actor is minimised (Ackroyd et al., 1991), government's role is one of providing and enforcing the rules under which the system operates. James (1997) gives a comprehensive review of economic instruments for environmental management in Australia. Table 4 (page 37) lists different types of economic instruments.

Different economic instruments have different effects on a government budget: they can be revenue-generating, public expenditure or budget neutral (IISD, 1997). These are summarised in Table 5 (page 38). The implementation method of any of the instruments will determine any positive or negative effects on the environment, and their effects may be neutralised by other policies that do not take environmental consequences into account. Some studies have found that economic instruments are the most effective when used in conjunction with regulation (IISD, 1997).

The Industry Commission reported in *Stocktake of Progress in Microeconomic Reform* (1996) that economic instruments have been used sparingly by Australian governments, and there is scope for economic instruments to be used more extensively. The National Commission of Audit also concluded in 1996 that Australian governments should "pursue greater use of economic instruments, such as appropriate valuation and pricing of resources and increased cost recovery, through purchaser/provider agreements."

A submission by the Business Council of Australia in 1990 to the (Australian) Working Party on Ecologically Sustainable Development advocated that the major environmental problems facing Australia could be addressed by a combination of the following economic principles:

1. Removal of unnecessary regulations.
2. Expansion of property rights to encourage accountable use of natural resources.
3. Realistic pricing of resource assets, leading to the full pricing of those assets.
4. Development of market-based approaches to environmental issues (Roberts, 1995).

Tobey (1996) argues that removing or reforming perverse incentives (often a side-effect of policies with other goals) is one of the most cost-effective ways of promoting conservation, since it reduces public expenditure, and perverse incentives often undermine the effectiveness of economic instruments by distorting markets and prices, resulting in conservation of biodiversity being more expensive than it would be otherwise. Similarly to Young et al. (1996), Tobey (1996) mentions that education and awareness campaigns have complementary roles to play with regulatory and incentive-based measures and that evidence suggests people are willing to pay more for conservation when they are aware of what is under threat and why corrective actions are necessary.

Most responsibility for the environment rests with the State and Territory governments. However, the Commonwealth may pursue environmental issues by using its powers in relation to trade (both international and domestic), taxation, corporations and external affairs as well as its funding of programs and role as a landowner. Australia has signed 56 multilateral treaties related to the environment which commit the Commonwealth to protecting Australia's environment in the interests of the global environment. These obligations are reflected in 17 Commonwealth Acts (Industry Commission, 1997b).

Table 4: *Economic instruments*

Type	Characteristics	Advantages	Disadvantages	Application examples
Charges and taxes	Usually revenue-generating, price-based.	– If high enough, incentive for innovations.	– Setting the correct level of charge/tax. Need to monitor effectiveness of charge/tax.	
a. User charges	Payments for use of a resource or service of the resource.	– Incentive to reduce demand for services by truer reflection of costs.	– As above.	– Emissions and effluent charges. – Charges for public waste collection and treatment.
b. Product charges	Applied to products in the manufacturing or consumption phase.	– Incentive for innovations. – Reduce use of products harmful to the environment.	– As above.	– Applied where emission charges not feasible, such as taxing fertilisers rather than charging each farm for run-off. – Used to encourage recycling or discourage disposal.
c. Other charges		– Transparent.		– Administrative charges, clean-up or restoration levies.
Subsidies and tax concessions	Public expenditure.	– Promote desirable activities. – Reduce amount of tax owed to government.	– Distorts tax system. – Net payment by government.	– Section 75D of Tax Act allows full deduction of land degradation control capital expenditure in year of expenditure.
Financial enforcement incentives	– Revenue-generating. – Penalties for non-compliance with standard/regulation vary with environmental damage.			
a. Performance bonds	Ex ante payment to authorities for potential environmental damage.	– Suitable where there is one source of damage which can be reasonably estimated.		– Mine site rehabilitation in Queensland and New South Wales.
b. Non-compliance fees	Levied ex post on producers.			– No current examples in Australia.
Deposit refund systems	Budget-neutral, encourages recycling.	– Reduce waste volume. – Reduce resource use.	– May have higher costs than alternative measures.	– Surcharge in initial price of product is refunded when residual returned for recycling, eg. tyres, glass bottles, aluminium cans.
Property rights and market creation		– Reduce government involvement.	– Not feasible where payment can't be extracted.	
a. Tradeable permit schemes	A limit is established, which is then allocated and traded amongst participants.	– Reduce compliance costs. – Reduce information needs of regulators.	– Need indicators of environmental damage. – Indicators need monitoring.	– Salt credits trading scheme in Murray-Darling system irrigation districts. – Salt discharge trading scheme along the Hunter River, New South Wales.
b. Environmental liability	Polluters made legally liable for environmental damage.			– Victorian lending institutions who finance firms whose activities involve a high degree of pollution are subject to limited liability for cleaning up any environmental spills.

Source: Industry Commission, 1997a.

Table 5: *Budget effects of economic instruments*

Instrument category	Examples	Notes
Revenue-generating	Taxes, charges, fees: tax differentiation on leaded and unleaded petrol, user charges for waste disposal, stumpage fees for timber, depletion taxes on mineral exploitation.	Levels can be too low to affect environmentally damaging behaviour.
Public expenditure	Subsidies, grants, tax allowances: tax allowances for energy conservation, grants for developing technology, price support for recycling.	Provides financial incentive to undertake an activity.
Budget-neutral	Deposit/refund schemes such as deposit/refunds for recycling glass bottles and aluminium cans.	
Budget-neutral	Feebates: producers or consumers pay a certain rate no matter what the legal limit, those who consume or produce less are compensated for restraint.	An example is reforestation rebates on timber stumpage fees.
Budget-neutral	Distributive credits: usually used in waste management where households who recycle their waste are offered a credit against waste collection fees.	The credit should be equal to the savings incurred by not having to collect and process the recycled waste.

Source: IISD, 1997.

In relation to land use, the National Strategy for Ecologically Sustainable Development of 1992 states the Commonwealth's aim to develop an economic and social framework which encourages optimal land management. This includes the aim to establish mechanisms (such as property rights) which encourage the sustainable use of resources; modifying programs and policies to reduce their encouragement of land degradation; improving the operation of social and market systems; and establishing standards and sanctions which discourage or prevent inappropriate land use (Industry Commission, 1997b).

The Commonwealth Government is developing a number of strategies, including (Young et al., 1996):

- National Strategy for Ecologically Sustainable Development
- National Biodiversity Conservation Strategy, developed on a parallel with the international Convention on Biological Diversity. Its goal is to protect biodiversity and maintain ecological processes and systems.
- National Forest Policy Statement
- Draft National Strategy for Rangeland Management
- Draft National Weeds Strategy
- Draft Strategy for Conservation of Australian Species and Ecological Communities Threatened with Extinction. The program examines State and Commonwealth approaches to endangered and vulnerable species and outlines a national program for their protection.

The State and Territory governments administer a substantial number of Acts regarding land management and environmental legislation, accompanied by regulations and by-laws. The legislation covers land use planning, water quality and management, environmental protection, soil conservation, conservation agreements and the protection of biodiversity (Industry Commission, 1997b).

To date, property right and market creation have not been widely used in Australia, however there are permit schemes and environmental liability markets being created.

The Northern Territory Strategy for Conservation through the Sustainable Use of Wildlife outlines management plans and strategies to establish a sustainable market for native species, such as cycads and red-tailed black cockatoos (Parks and Wildlife Commission of the Northern Territory, 1995). It lists the main objectives of the strategy as:

1. develop, test and implement management programs incorporating sustainable use;

2. gather information needed for management programs involving sustainable use;
3. identify species and habitats whose conservation may be enhanced by sustainable use management programs;
4. ensure that Aboriginal people can maintain traditional uses of wildlife;
5. investigate options for enhancing the role of landowners in wildlife management;
6. to make information available to the public on conservation, sustainable use, and the operation of sustainable use management programs.

This is an example of government creating a market and an institutional structure involving property rights and management structures to encourage the sustainable use of the resource.

Several tradeable permit schemes exist in Australia. A salt credits trading scheme is operating between the Murray-Darling system irrigation districts of New South Wales, Victoria and South Australia. It is a part of the Salinity and Drainage Strategy, with the aim of reducing river salinity. Another salt discharge trading scheme is operating along the Hunter River in New South Wales (Industry Commission, 1997a).

The NSW Environmental Protection Authority has set an aggregate limit of phosphorus levels to be emitted from three Sydney Water Corporation plants, which are the main source of phosphorus in the Hawkesbury-Nepean River. The Sydney Water Corporation then allocates the phosphorus emissions levels between the three plants. In Victoria, lending institutions which finance firms whose activities involve a high degree of pollution are subject to limited liability for cleaning up any environmental spills (Industry Commission, 1997a).

The recent Industry Commission report, *Role of Economic Instruments in Managing the Environment* (1997a) found that:

- the use of economic instruments to address environmental problems has progressed in recent years, but there is further scope for them to be used, alone or with other measures;
- economic instruments have advantages over regulations, including least cost solutions, greater flexibility and encouragement of innovation;
- a mix of economic instruments, regulatory and suasive measures are likely to provide the best solutions rather than economic instruments by themselves;
- government has a role in coordinating and implementing environmental policy, providing information and developing mechanisms to ensure industry and community involvement;
- industry and community involvement is needed to provide local knowledge at low cost, and ownership of solutions.

The report found that further research needs included a need for better information about specific environmental problems (to understand external effects and address information failure), development of performance indicators used to monitor and evaluate instruments, and closer investigation of opportunities for economic instruments to be included in strategies. The Industry Commission report suggested a number of criteria to consider when selecting the best, or mix of, instrument(s) to address an environmental problem.

4.5.1 International initiatives

Parry (1996) compares the effectiveness of two policy instruments in the United States – tradeable emissions permits and emissions taxes – in stimulating the development of 'cleaner' production technologies. Using an analytical model, Parry compared the incentives for research and development of 'cleaner' production technologies under either emissions taxes or tradeable emissions permits, and examined the implications of imperfect patent protection and transaction costs in the permit trading market. In emissions trading, coal-burning electric utilities and other industries reduce sulfur dioxide emissions (the primary cause of acid rain) by buying and selling the right to pollute. Emissions taxes are levied against producers of pollution and encourage firms to avoid paying the tax by reducing their emissions to a point where it is cheaper to pay the tax than to make further reductions.

Parry concluded that emissions taxes are likely to be more efficient than emissions permits at stimulating the development of 'cleaner' production technologies because imperfections in the markets for permit trading and technology licensing reduce the returns to innovation under permits. He also found that the incentives to develop major innovations under permits are limited because of their impact on reducing the permit price. A reduction in the permit price reduces the value of the permits a company holds, hence reducing the value of the asset (ie. the permits) the company

holds. There would only be an incentive to invest in production technology if the loss of the asset value is less than the benefit gained by improved production technology.

However, Palmisano (1996) advocates a business-based emissions credit trading program, combined with government in the role of creating, monitoring and enforcing the property rights (see Box 5, below).

Box 5: *Emissions credits*

In 'Establishing a Market in Emissions Credits: A Business Perspective' by John Palmisano, IEA Environment Briefing No. 2, July 1996, the author emphasises the role which businesses can play in controlling emissions – if tradeable emissions credits are vested in firms. Palmisano advocates a business-based emissions credit trading program and also outlines a coordinating role for government: to create, monitor and enforce the rights that flow from creating emission reductions. Palmisano shows that, if a global pollution problem exists, defining property rights in emissions credits and allowing individuals to trade credits in a relatively free market will resolve the problem in a more efficient manner than central command and control models.
(From Press Release on Institute of Economic Affairs (London, United Kingdom) website: http://www.iea.org.uk/press/bp2pr.html)

Marston and Jones-Smith (1991) suggested tools for water management on the lower Colorado River in Texas. These included the local government water authority – the Lower Colorado River Authority – entering the market as a buyer of water rights and promoter of water marketing to provide freshwater inflows for environmental protection purposes, creating conservation investment incentives, including conservation rates in the water pricing structure and reusing more water by constructing decentralised reuse and reclamation systems.

4.5.2 Australian initiatives

In relation to agriculture, the 1997 Industry Commission report, *Role of Economic Instruments in Managing the Environment*, states that no economic instruments are currently used to address soil acidification and soil structural decline. Economic instruments are in place to deal with agricultural problems such as salinity and soil erosion. Measures to address soil erosion include instruments to encourage retention of vegetation and revegetation. Measures to address salinity include:

- cost-sharing for onground works;
- salt credits trading scheme;
- instruments to encourage retention of vegetation and revegetation;
- full cost-pricing and transferable water entitlements, which may also improve wateruse efficiency.

Ackroyd et al. (1991) suggest a number of policy instruments which may induce the change in management practices to reduce salinity:

- polluter pays tax on irrigation and land clearing that lead to salinity;
- subsidies for activities which reduce salinity and waterlogging;
- community engineering works such as pumps, pipelines and evaporation basins;
- transferable quotas for land clearing and irrigation, as well as transferable rights for salinity disposal;
- systems of common property rights; and
- regulations which restrict clearing and irrigation practices, and require drainage.

However, each of the measures has significant problems due to the lack of information about the causes of salinity and implementation difficulties. Lack of information is a market failure that will affect the successful operation of market-based approaches to encourage sustainability.

The New South Wales Biodiversity Strategy is still going through the public consultation phase, however, from the draft document it seems that various economic incentive and legislative measures will be introduced to encourage private landholders to protect native wildlife on their property. Various economic incentives may be introduced, including levies, royalties, environment taxes, non-compliance fees, performance bonds, security

deposits, grants, soft loans, tax allowance and exemptions.

Box 6 (below) outlines the introduction of individual transferable quotas into two Commonwealth fisheries, and some of the problems encountered.

Inefficiencies in land (and capital) markets operations may result from prices which are an incomplete reflection of the current status and productive potential of farms, such as the status of the farm in terms of land degradation. Gretton and Salma (1997) explored the links between agricultural production, farm profitability and land degradation using an empirical study of land degradation in New South Wales. They observed that there is no history of estimation of the statewide effects of additional degradation on production and profits. Their findings suggested that farmers adapt to changing levels of degradation by changing their mix of activities to either minimise losses or maximise profits. A reduction in induced acidity or soil structure decline was projected to increase production and profits. However, they also found in the case of salinity that higher levels of production could be achieved by a shift towards farming activities characterised by higher levels of dryland or irrigation salinity. This is because salinity tends to be isolated to individual points in otherwise productive areas, although the causes may be due to watertables and aquifers on a catchment scale. Hence farmers could still be drawn towards increased clearing and irrigation, as long as the improved profit outweighed any additional degradation. However, there are also incentives to ameliorate degradation where it is most severe.

Box 6: *Transferable quotas and Australian fisheries*

Individual transferable quotas were identified by the Commonwealth Government in 1989 as the preferred management tool to provide incentives for operators in the Australian fisheries industry to restrict investment and effort to levels which maximise the net value of the fishery.

As of 1996, two Commonwealth fisheries – the southern bluefin tuna and South-East fisheries – were managed using individual transferable quotas. However, there were different effects in each sector.

In the bluefin tuna fishery, there was a rapid movement of capital and operators out of the industry. Within two years of the introduction of individual transferable quotas, almost two-thirds of operators with an initial location of over five tonnes had sold their entitlements and left the industry. The south east fishery did not have such a rapid adjustment.

A loophole in the quota system for the south east fishery led to increases in the catch in State waters adjacent to the Commonwealth waters to which individual transferable quotas were applied. Operators also held entitlements to operate in State waters, but there was no legislation for the State waters complementary to the Commonwealth individual transferable quota legislation. This appears to have led to an incentive to misreport catch location, prevented rationalisation of the fishing fleet and may result in long-term losses of productivity due to overfishing. This illustrates that the implementation of economic incentive measures should consider all the implications and other policies in closely related or even the same industries that do not take environmental consequences into account. This is an illustration of Markandya's (1994) point: "There are many cases where (the use of) … markets could result in considerable damage as externalities are ignored. It is a question of the *right* market."

The effectiveness of the individual transferable quotas differed depending on the characteristics of the industry and how the scheme was implemented. This has implications for the applications of similar instruments in other industries. Applying economic instruments of this nature requires caution and analysis of the industry to which it is being applied.

Source: Campbell et al., 1996.

Agricultural land in the Manilla Shire is characterised by serious soil erosion and there are high rates of adoption of recommended soil conservation measures. There have been active campaigns for soil conservation, with the Soil Conservation Service active extension program and the Keepit Project (established in 1971 to reduce soil erosion in the catchment of Keepit Dam), whose goal is to implement farm plans on every farm.

Sinden and King (1990) analysed the trend of high rates of adoption of recommended soil conservation measures to determine what factors are promoting soil conservation. They found that policies to promote farmer perception of erosion problems should be formulated differently to those that aim to promote actual adoption of recommended measures. Perception of the problem depended on the percentage of the farm eroded, and likelihood of adoption of conservation measures depended on the intensity of erosion. Stewardship and personal factors were found to promote perception of an erosion problem, but economic factors were more likely to promote actual adoption of recommended amelioration measures.

Cary and Wilkinson (1997) modified the model used by Sinden and King (1990) and conducted two sets of interviews with farmers in 1988 and 1991 and their findings reinforced those of Sinden and King – that perceived profitability was the most important factor influencing the use of conservation practices. Cary and Wilkinson found that concern for the environment had no observable effect in the decision to plant trees (which is a common land degradation amelioration measure), which suggests that positive attitudes will not translate into pro-environmental behaviour unless there are economic or other benefits associated with it.

In a study to investigate the relationships between land condition (expressed as status of soil conservation works) and farm land value in the Manilla Shire, Sinden and King (1988) aimed to determine whether and by how much changes in land condition affect land prices and to look at whether the benefits of land improvement exceed the costs. They found that the land market does clearly recognise land condition, with higher selling prices for better land. They could find no evidence that this market undervalues conserved land, relative to the costs of recommended conservation works and yield expectations.

In a follow-up study in 1994, King and Sinden aimed to address further issues and develop further land models in the Manilla Shire. They found that education may be preferable to subsidies in achieving soil conservation in the study area, and suggested an educational instrument such as inspection reports by Soil Conservation Service staff being available to seller and potential buyers. Another suggested policy instrument was a program to encourage real estate agents to include information on land condition in advertisements in order to promote more efficient market operation. Factors found to be significant for both buyers and sellers, such as distance from Manilla, agricultural productivity, farm size and the existence of a house are already listed by real estate agents. King and Sinden found that land condition was also a significant factor, and inclusion of land condition on advertisements would promote more efficient market operation.

In 1996, Sinden and King further explored the availability of information on the erosion status of land as a market incentive and the possibility that provision of information on environmental characteristics will lead to improvements in environmental quality. Sinden and King (1996) mention that the idea of a scheme to provide information on the environmental status of land has been coined the "pink slip", analogous to the inspection report required before a car can be registered. It seems that the idea has gained popularity in the 1990s, with newspaper and journal articles referring to the use of satellite information provided by a government soil conservation agency, with costs shared between the agency and the landholder. With assessments of natural capital in place, potential buyers are better informed about the quality of the land. If they perceived that they could earn more from conserved land, they would be prepared to pay more for it and farmers who had undertaken conservation measures would obtain higher prices. Hence such as scheme would provide a market incentive for landholders to undertake conservation measures.

4.5.3 Response to changes in input prices

Generally, the Australian agricultural sector may be described as having many producers who have little influence on the input prices they pay and output prices they receive, but those producers do have the option of varying their input and output mixes (Gretton and Salma, 1997). Since 1960, data have indicated that the average ratio of prices received to prices paid by farms has declined by 2.3% per year. This means that the prices paid for inputs by farmers have been increasing at a faster rate than the prices received by farmers for their

products. This is commonly known as the 'cost-price squeeze.' Chisholm (1992) also observed that there has been a substantial increase in physical productive capacity, with the index of total farm output increasing two and a half times from 1951–52 to 1989–90. Chisholm pointed out that there has also been an upward trend in real total farm costs, but no significant trend in the real gross value of farm production, which translates into a decline in farmers' terms of trade over the last four decades. There has also been a downward trend in the real net value of farm production, which represents the residual return to self-employed farmers' labour and management, unpaid family labour and capital investment in farm land (Chisholm, 1992).

As illustrated in Section 2.4 of this report, chemical fertiliser and pesticide applications are strongly correlated with producer price incentives. A number of reasons in farmers' decision-making tend to lead to increased pesticide use. These include (Reeve, 1990):

- no economic motive for the individual user to consider the long-term effects of pest resistance, as this is a function of regional levels of pesticide use;
- similarly, environmental damage is outside the user's sphere of influence, so that the pesticide type and use level are not influenced by any resultant or potential environmental costs;
- lack of knowledge by individual users about the levels at which infestation will cause an economically significant yield reduction, which leads to unnecessary applications of pesticides;
- risk averse attitudes lower the perceived level at which infestation will cause an economically significant yield reduction.

Variations in the relative prices of inputs encourage input substitution where alternatives are available. Clarke (1992) analysed the effects of price changes on land degradation and found that the relationship depends on the existence of viable soil conservation technologies as well as the complementarity and substitutability between inputs. Clarke observed that if economically feasible technologies for boosting soil productivity do not exist, then soil quality will tend to be negatively related to product price. Hence, in Clarke's view, the key issues for government are the public good issues related to the development of soil conservation and restoration technologies.

LaFrance (1992) used a dynamic economic model to estimate whether commodity prices lead to more or less soil degradation. He concluded that higher profits do not increase the incentives for farmers to take better care of the soil simply because the soil is a more valuable asset. When soil degrading inputs such as irrigation water are subsidised, then it is likely the soil will be exploited more intensively in the short run and the long-run soil stock will decline. When increased profits are due to subsidisation of conservation activities, then it is likely the soil will be exploited less intensively. Therefore, a conservation subsidy, rather than an output price subsidy, is more likely to both increase farm income and create an incentive for farmers to undertake soil conservation measures (LaFrance, 1992). However, Clarke (1992) argues that the opposite is the case, that an increase in product prices raises the value of the marginal product of any input related to soil quality as well as raising the value of the marginal product of investment in soil quality. This would create an incentive for the farmer to use more of the soil quality related input and to take more care in maintaining soil quality. Hence output price subsidies would lead to less long-run land degradation as long as there are viable soil conservation technologies (Clarke, 1992).

As Ward et al. (1987) pointed out, some input prices have risen faster than others, for example, the price of fuel and machinery has risen faster than that of chemicals. This has been one of the primary reasons for a switch in recent decades to chemical weed control from mechanical weed control. This has had benefits in reducing the erosive potential of soils since they are less susceptible to erosion under no-till methods. However, there has also been a trend towards overuse of herbicides, leading to herbicide resistance problems and contamination of soil and groundwater.

Pearce and Warford (1993) observed that if the price of a resource is too low or non-existent, then excessive use will be made of the resource. 'Unpriced' inputs in agriculture include waste disposal (eg. run-off into creeks), environment (air, some aspects of land) and rainfall. Other agricultural inputs are underpriced, for instance, the price of fuel does not include a value for the environmental damage and health costs caused by emissions from burning the fuel.

Ward et al. (1987) observed that "Farmers will adopt a new method of farming only if they are convinced that it will increase profitability or help in the management of the farm." As outlined earlier in Box 2 (page 18), a 1993 Australia-wide survey found that 59% of farmers said that maximising profits is the most important objective of farming and agreed that there is no point in

adopting new practices unless they are more profitable. However, a majority (77%) also said that it was worth putting up with a small decrease in farm profits to protect the environment.

However, there are no in-depth studies on the effect of input prices on environmental degradation. Priced inputs include herbicides, insecticides, land, labour and fuel, but their prices may not reflect their full cost (in terms of environmental damage caused by their use). All of the price-based causes of environmental degradation, externalities, underpricing, lack of information, and public goods affect Australian agriculture, but the magnitude and effect of each problem is uncertain and difficult to measure.

Woog and Kelleher (1993) found that many farmers felt increasing input costs were likely to reduce the viability of wheat growing, even if acceptable yield and protein levels could be maintained. Most farmers at the time saw low world prices and falling yield and protein levels as leaving little room for optimism.

A survey of 100 farmers in the Liverpool Plains was conducted in 1995 by Flavel and McLeish. They found that farmers were willing to assist with catchment scale problems (eg. salinity) but their ability to do so was limited by financial constraints. They also found that the number of cultivation passes had declined, with many farmers using no-till methods. Herbicides were widely used, but there are also significant concerns held by farmers about the toxic effects of herbicides. The farmers surveyed also saw a need for more information on pastures, marketing and groundwater issues.

The input-intensive production system has implications for the effect of economic instruments which influence input prices. The farmers surveyed by Flavel and McLeish preferred incentives that influence input costs, such as direct resource assistance, taxation concessions, interest rate subsidies, low-interest loans and access to machinery and advice for catchment scale problems.

Reeve (1990) pointed out that the problem of 'non-sustainability' in agriculture is based in the way the input and farm sectors interact. As a result of the many uncertainties they face, farmers adopt a sequential decision-making pattern. Given their estimates of various key factors such as market prices and climatic conditions, they make decisions that will affect their production for the next months or years. These decisions are revised constantly as time goes on, conditions change and further information becomes available (Ackroyd et al., 1991). Sudden changes in markets such as a fall in commodity prices or severe drought that reduces production for some time may force farmers to take short-term perspectives to ensure financial survival. For example, pressures to repay loans quickly may lead to practices such as continuous cropping which are detrimental to long-term productivity (McLennan, 1996).

4.6 Differentiation of 'environmentally friendly' products

Achieving sustainable production depends on consumption patterns as well as production methods. The Department of the Environment, Sport and Territories (DEST,1997) claimed that a key element of achieving a sustainable world is changing the consumption patterns of the world's people. In sectors other than agriculture, feedback mechanisms do function via product description/labelling systems which identify and promote key characteristics of the underlying production system through to the final consumer (eg. 'dolphin friendly' seafood products, CFC-free refrigerators). Different eco-labelling programs rely on either single or multiple criteria. Examples of single criterion labels are 'CFC-free', 'dolphin-safe' and 'contains recycled paper', where the label reflects a single environmental friendly attribute of the product. Multi-criteria labelling methods which attempt to quantify various attributes of the product (including manufacture, use and disposal and may involve life cycle analysis) include organic food labelling and certification programs (Erickson and Kramer-LeBlanc, 1997).

Kinsey and Senauer (1996) claim that consumer demand for more convenient products is partly driving the industrialisation of agriculture (at least in the United States). They analysed the consumer trends leading to new store formats in the American retail food market. They examined the impacts of the changes on food processors and agricultural producers "upstream". They observed that the food system is now consumer-driven rather than producer-driven and that "the power in the system is at the retail end because retailers receive information about consumers' preferences first."

A 1994 survey by the NSW Environmental Protection Authority found that 80% of people had chosen household products which they thought were better for the environment (CHOICE, 1996). The Australian Bureau of Statistics (ABS) has found that in

the four years prior to 1996, the number of people reporting that they had environmental concerns has decreased (68% in 1996 as opposed to 75% in 1992). However, the percentage of people stating that they consider environmental protection to be as important as economic growth has remained steady at around 70% since 1992 (ABS, 1996).

A recent study investigated the types of Australian initiatives that have already been undertaken in order to change consumption patterns so as to reduce environmental impact (DEST, 1997). Australia has had guidelines since 1992 regarding environmental claims on products. A very large range of initiatives to promote changes in consumer behaviour so as to reduce environmental impact were found, most involving the production of information materials. Since consumer attitudes towards an issue is in part a function of their understanding of the issue, it was observed that more effective information and awareness programs are more likely to have a substantial impact, particularly if accompanied by some mechanism for encouraging the translation of intentions into action. The study found that there is no present identification in Australia of priority areas for achieving changes in consumption patterns, nor is there a set of indicators with which to measures progress towards sustainable consumption (DEST, 1997).

4.6.1 Government-supported initiatives

ISO 14000 accreditation

Industry initiatives such as voluntary environmental management standards and eco-labels are a way for producers to differentiate their products and gain a larger market share or supply a market niche. Government may still have a role, however, in setting and monitoring such standards.

The International Standards Organisation (ISO) has set up the ISO 14000 set of standards for environmental management systems. Compliance with ISO 14000 standards are voluntary (Schwartzman and Kingston, 1997). The ISO 14000 guidelines will require organisations to establish an environmental policy and to set targets and objectives for environmental performance. ISO 14001 is the core standard and ISO 14004 lists the practical guidelines for implementation of the standard. ISO 14000 aims to create voluntary agreement worldwide on environmental management systems and provides tools for businesses to boost efficiency.

The ISO was founded in 1947 to promote the development of manufacturing, product and communication standards. Each country member (there are over 120 members) is represented by an official member body. However, compliance with ISO 14000 doesn't indicate any particular level of environmental performance or suggest any environmental improvement. Still, there are potential incentives (in reduced costs and/or improved returns) for companies to comply with ISO 14000 standards, including:

- reduced environmental management costs;
- fewer violations and penalties;
- improved management of environmental risks (possibly leading to reduced insurance premiums); and
- improved public image.

The ISO will adopt international standards for environmental labelling (ISO 14020, 14021, 14022 and 14023) as part of the broader set of standards on environmental management systems and environmental audits under ISO 14000. The draft guidelines state that the development of environmental labels should take into consideration the life cycle of the product or service, where the life cycle of the product is defined to range from raw material extraction to final disposal (van Ravenswaay, 1996). An eco-label identifies environmentally preferable products based on an environmental impact assessment of the product compared to other products in the same category (van Ravenswaay and Blend, 1997).

It has been claimed that Australian grazing industries will need to develop best practices which conform to ISO 14000 quality assurance guidelines in order to gain a competitive advantage on world markets (Francis, 1996). So far in Australia, one farm has gained ISO 14001 accreditation. The farm concerned is a 'conventional' cotton farm located near Narrabri in northern New South Wales (Lyon, 1997) (see Box 7, page 46).

Eco-labelling

Several countries and the European Community have initiated programs that award approval of the environmental 'friendliness' to consumer products. The main aim of eco-labelling programs is to reduce environmental impacts over the entire life cycle of the product as well as preventing deceptive environmental advertising by providing objective expert assessment on the environmental effects of a product. Eco-labels are

believed to change consumer purchasing behaviour, thus creating incentives for producers to produce less environmentally harmful products and to develop less polluting technologies (van Ravenswaay, 1996).

An example of this is the European ANPED (Alliance of Northern People for Environment and Development) pilot project, the 'Sustainable Product Campaign', which aims to increase environmental awareness of consumers and stimulate the shift in consumer attitudes. It aims to achieve this by providing consumers with a 'life cycle analysis' of a small number of selected everyday products. The arguments will be summarised in leaflets and other campaign materials. The project is based in Europe and began on 1 February 1996. The project aims to correct the market failure that occurs when consumers do not have all of the relevant information they need. ANPED is a network of environmental, development, solidarity, women's and other citizen's organisations in Europe and North America.

In the United States, increasing consumer demand for 'environmentally friendly' products and services has led to an increase in manufacturers making voluntary claims about the 'environmental friendliness' of their products. A study for the United States Environmental Protection Authority found that the percentage of new products with voluntary environmental labelling increased from 5.9% in 1989 to 11.4% in the first half of 1992 (van Ravenswaay, 1996). Concern about the potential for deceptive eco-labels by private companies has prompted the introduction of legislation on eco-labelling in federal Congress. In 1992, the United States Federal Trade Commission produced a guide for the use of voluntary environmental marketing claims. However, the guide doesn't have the force of legislation behind it and is limited to resolving the issue of what constitutes a truthful or deceptive environmental claim (Section 5 of the United States Federal Trade Commission Act makes deceptive acts and practices in or affecting commerce unlawful) (van Ravenswaay, 1996).

An American examination of the potential of eco-labelling to create economic incentives for adoption of environmental technologies in agriculture observed that, in the majority of cases, growing produce under eco-label standards is more expensive than using 'conventional' production methods. The extra costs include labelling fees, record-keeping costs, potential yield losses, marketing costs, added input costs (with the

Box 7: *ISO 14000 certified cotton*

Currently, one farm in Australia has gained ISO 14001 accreditation in recognition of its compliance with best practice principles for environmental management. ISO 14001 is the core standard for best practice principle for environmental management, set down by the International Standards Organisation (ISO). The farm is 'Oakville', located in the Narrabri district and owned by Mike Logan. Cotton production is 2,600 bales of non-organic cotton per year. Initially Mr Logan considered growing organic cotton, and the consultant he engaged to investigate market opportunities found that while consumers wanted cotton clothing that was of good quality, was Australian, and had environmental or organic certification, they were not prepared to pay a premium for it. Given the lack of premiums for organic cotton, Mr Logan decided to pursue the development of an environmental management strategy which satisfied the ISO 14000 accreditation requirements. This included operating an integrated pest management strategy, reducing chemical usage, introducing a controlled traffic farming system, retaining irrigation tailwater on-farm, and constructing earthworks to reduce run-off from the farm. Once obtained, the accreditation was then used as part of a marketing strategy. The cotton is spun into yarn in Indonesian mills and sold to knitters and weavers in Australia and New Zealand, with the intention of selling to Europe as well (Lyon, 1997). The product differentiation afforded by the accreditation only allowed access to the international market at the current price, with no premium. The accreditation requires annual assessments of the environmental management program by Quality Assurance Services auditors (Lyon, 1997).
This illustrates that farmers cannot necessarily pass on the increased costs of measures undertaken to ensure sustainability.

level of extra costs varying with each crop type), as well as transaction costs in finding new suppliers and lost productivity from equipment that cannot be used under label standards (van Ravenswaay and Blend, 1997). It was also observed that for consumers to value an eco-label they must be affected by negative externalities from production, for example, perceive that they suffer from harm due to the adverse impact of wastes from 'conventional' production systems on the environment. However, current technology cannot measure the environmental impacts of production with a great deal of precision, and most eco-label standards are expressed in terms of the implementation of best management practices, rather than by an assessment of their environmental impacts. This inability to fully measure the environmental impacts of a production method increases the difficulty of explaining the value of the eco-label to consumers (van Ravenswaay and Blend, 1997).

Schwartzman and Kingston (1997) examined a means of timber consumption in the United States, the timber trade and global deforestation and analysed the links between the timber trade and deforestation. They recommended timber labelling as cost-effective progress towards encouraging investment in sustainability. Those that favour certification "argue that increased prices or market share for verifiably sustainable timber will signal producers to invest in sustainable management, providing a market incentive for the shift to sustainability." In addition, they claimed that:

> Mandatory labelling of timber and wood products by country of origin and species, to the extent it would apply to all products equally, should not constitute restraint of trade or discrimination under World Trade Organisation (WTO) rules, and could be done at a small fraction of the cost of certification. Labelling would catalyse effective consumer education on the links between consumption and deforestation. It would thus help to reduce demand for the most notoriously unsustainable timber and wood products, while increasing demand for sustainably produced wood. A verifiable consumer information label in the US would help to meet existing consumer demand for information on the environmental effects of market options. Perhaps most importantly, an informational label, in conjunction with consumer education campaigns, can increase consumers' confidence in their ability to make informed judgments with positive environmental consequences.

The ECO-O.K. Certification Program, launched in 1992 and focused on the Latin American region, aims to reduce the negative environmental impact of growing tropical agricultural products, such as bananas and coffee. The program aims to do this by creating market incentives for producers to grow and harvest their crops with minimal impact on the environment. Details of the program are described in Box 8 (page 48).

The idea of economic incentives to encourage less environmentally damaging farming was first introduced into United Kingdom legislation by the 1981 Wildlife and Countryside Act, which allowed compensation to farmers for reducing activities damaging to the environment. However, the scheme was hampered by various factors. Details and other schemes that followed it are discussed in Box 9 (page 49).

4.6.2 Australian industry initiatives

The Australian organic industry is an example of an industry with labelling methods and is often perceived as more sustainable than 'conventional' agriculture (Evans, 1995).

Industry organisation

The Organic Producers Advisory Council oversees and produces the organic standards for Australia. It was formed in 1990 in response to increasing world demand for organically grown produce and recognition of the organic farming industry as a significant part of the overall agricultural sector. The Australian Quarantine and Inspection Service provides the chair and secretariat for the council. The Organic Producers Advisory Council is made up of representatives from national organic organisations as well as the National Farmers' Federation, the Australian Federation of Consumer Organisations, the National Food Authority and the Standing Committee on Agriculture and Resource Management.

In 1992, the Organic Producers Advisory Council defined a set of national export standards for organic and biodynamic produce in order to (Biological Farmers of Australia, 1994):

- protect consumers against deception and fraud in the marketplace;
- protect and enhance the credibility of the organic farming industry;
- enhance Australia's reputation as a supplier of certified organic produce and facilitate exports; and
- form the basis of negotiations with overseas trading partners.

Box 8: *The ECO-O.K. Certification Program*

The ECO-O.K. Certification Program works to reduce the negative environmental impact of tropical agricultural products. Launched by the Rainforest Alliance in 1992, the program develops feasible ways for growers of crops, such as bananas and coffee, to do business without doing damage to workers, rainforests and other natural environments. The program is a joint collaboration between the Rainforest Alliance and a network of Latin American partner organisations.

The problem

While commercial tropical agriculture, such as growing bananas and coffee, contributes to the world's food basket and provides jobs, revenue and foreign exchange in producing countries, current commodity agricultural production methods take a heavy toll on the people and wildlife of tropical countries, which are home to ecologically rich and rapidly diminishing tropical ecosystems.

In many instances, rainforests have been cleared (growing one product only), resulting in loss of habitat to flora, fauna and people. Much monoculture production also results in soil erosion, water pollution and siltation of rivers and streams, mismanagement of agrochemicals, and worker safety and health risks. There has been growing concern on the part of consumers and producers about ensuring the sustainability and social equity of agricultural production.

The solution

Create market incentives for producers to grow and harvest their products with minimal impact on the environment. ECO-O.K. rewards growers who meet the comprehensive ECO-O.K. environmental and social standards and aims to transform tropical commodity export production so that its impact on the environment is minimised without sacrificing quality, supply or economic opportunities. Certification inspections are made farm-by-farm, and recommendations are made by a scientific team on how to bring the farm up to the standard.

Once a farm reaches the standards of the program, it may then use the ECO-O.K. seal on the product and in advertising. In addition to this, a public information campaign in the United States, Canada and Europe aims to educate consumers about the environmental effects of tropical production, and to develop demand and marketing channels for certified ECO-O.K. products.

The results

The ECO-O.K. Certification Program, a joint collaboration between the Rainforest Alliance and a network of Latin American partner organisations that includes Fundacion Ambio in Costa Rica, the Fundacion Interamericana de Investigacion Tropical (FIIT) in Guatemala, and the Corporacion de Conservacion y Desarrollo (CCD) in Ecuador, has certified nearly 16% of Costa Rica's banana production and is working with banana producers in Ecuador and Panama. The program has also begun certifying oranges (Costa Rica) and shade coffee (Guatemala), and has developed guidelines for cocoa, vanilla, and non-timber forest products such as Brazil nuts.

The ECO-O.K. Certification Program is a large-scale working partnership between environmentalists, consumers and industry; it is a model of market-driven conservation aiming to prove that commercial agriculture can thrive while conserving the natural systems that make it sustainable. The program won the prestigious 1995 Peter F. Drucker Award for Nonprofit Innovation.

From project website at http://www.rainforest-alliance.org/okm.html

Box 9: *The United Kingdom: Subsidies in return for conservation practices*

Subsidy payments to farmers in designated areas of special biological, landscape or historical interest. Farmers voluntarily agree to farm less intensively or undertake prescribed conservation practices in exchange for a fixed annual per hectare payment.

The 1981 Wildlife and Countryside Act in the United Kingdom allowed compensation to farmers for reducing activities damaging to the environment. However, the management agreement scheme was hampered by unclear responsibilities for its financing, a lack of funds at the Department of the Environment, and negotiation difficulties with farmers.

An alternative, three-year experimental scheme was introduced in May, 1985 – the Broads Grazing Marshes Conservation Scheme (BGMCS). Unlike the previous Act, the BGMCS was financed by the Ministry of Agriculture, Fisheries and Food and the Countryside Commission, rather than the Department of the Environment. The BGMCS also provided income support to farmers for applying traditional methods such as grazing by beef cattle, thereby reducing pressure to drain the land for conversion to arable farming. The scheme proved highly popular: it enjoyed a 90% participation rate across its initial area of introduction.

In 1985 the then European Community also gave authorisation to a broader application of the Environmentally Sensitive Areas (ESA) idea through Article 19 of the structural regulation (EC 797/85), permitting member states to pay aid to farmers in suitably designated areas of high conservation value. The aim was to encourage better farming practices. The ESA scheme was subsequently written into United Kingdom legislation with the 1986 Agriculture Act, giving the Ministry of Agriculture, Fisheries and Food full responsibility for the ESA payments.

ESA agreements initially designated two tiers of management and payment. Payment rates vary between the different ESAs, but each takes account of the actual and potential profits that farmers in the ESA lose by following the prescribed management scheme, as well as the extra work that the scheme entails. Each ESA agreement regulates drainage, grazing and fertiliser use, and stipulates the maintenance of conservation features such as hedges and traditional barns. The Ministry of Agriculture, Fisheries and Food reserves the right to monitor each ESA with aerial photos and ground inspections. Following monitoring and evaluation reports in 1991 and 1993, three additional tiers were added, and new management options arose, such as 10-year agreements and capital grants for conservation plans, the latter including the protection of historical features, the restoration of marshes, the construction of water penning structures and the planting of trees. The grants usually cover 60% to 80% of capital costs and are paid if the work is carried out within two years, subject to proof of payment and inspection by the Ministry of Agriculture, Fisheries and Food.

Source: IISD, 1997.

The Organic Producers Advisory Council has also produced a definition of 'organic':

> produced in soils of enhanced biological activity, determined by the humus level, crumb structure and feeder root development, such that plants are fed through the soil ecosystem and not primarily through soluble fertilisers added to the soil. Plants grown in such systems take up essential soluble salts that are released slowly from humus colloids, at a rate governed by warmth. In this system, the metabolism of the plant and its ability to assimilate nutrients is not over stretched by excessive uptake of soluble salts in the soil water (such as nitrates). Organic farming systems rely to the maximum extent feasible upon crop rotations, crop residues, animal manures, legumes, green manures, mechanical cultivation, approved mineral bearing rocks and aspects of biological pest control to maintain soil productivity and tilth, to supply plant nutrients and to control insects, weeds and other pests.

Organic farms have to be certified as such by approved certification organisation inspectors, and are subject to routine inspections to maintain their certification. There are currently four Australian Quarantine and Inspection Service approved organic industry certification organisations:

- National Association for Sustainable Agriculture (established in 1986;
- Biological Farmers of Australia;
- Bio-Dynamic Research Institute; and
- Organic Herb Growers of Australia.

Tasmanian Organic-Dynamic Producers and the Organic Vignerons Association are waiting for their certification (RIRDC, 1997). Certification organisations currently have their own labelling systems, there being no overall national standard.

Production characteristics

A survey in late 1989 to early 1990 focused on organic certification organisations estimated that 1,300 farms could be classified as commercial organic producers. A commercial organic producer was defined as a producer who sold $5,000 or more of organic produce per year (Hassall and Associates, 1996).

In 1995, 1% to 2% (approximately 335,000 hectares) of all Australian agricultural land was under organic farming. This represented an increase of 45% per year since 1990. Some 69% of the area was devoted to broadacre production and 8% to horticulture. The number of growers in the same period increased from an estimated 991 in 1990 to 1,462 certified growers in 1995, an annual increase of 3% per year. Tables 6 to 8 (page 51) show the areas and types of production and numbers of organic farms.

A survey (408 respondents, with 374 indicating that they were certified organic growers) showed that the reduction in input costs or the possibility of price premiums were not the primary reasons for entering into organic production. The reasons respondents gave for becoming organic producers were, in order (Hassall and Associates, 1996):

1. concern for the environment;
2. concern for family health;
3. to secure long-term viability of their properties;
4. lifestyle reasons;
5. to reduce input prices;
6. because conventional farming systems were not working; and
7. the possibility of price premiums.

It is expected that the growth in the domestic industry will continue to be strong, but not at the exceptional rate experienced to date. However, this growth may be further improved if the apparent export opportunities are realised (RIRDC, 1997).

Cost structures

In the Hassall and Associates (1996) study, most organic farmers reported lower costs of production than those of conventional farmers. The exception was organic poultry farmers, whose cost increases may have been due to the higher cost of the organic feeds they use. The difference in costs was highest for cereal and fibre producers. Labour requirements were higher for organic producers (except meat producers).

In regards to price premiums, poultry producers required the highest price premiums (50% to 75%) to return an income equivalent to that of conventional producers. Meat and poultry producers indicated that they were not receiving price premiums needed to provide an income equivalent to conventional production. Most other producers were nearly or barely receiving sufficient premiums for equivalent income.

Thirty-five per cent of respondents to the survey indicated that marketing costs were higher than for conventional production. Also, there are still problems with distribution, such as limited availability of suitable storage and handling facilities for bulk organic grain (Hassall and Associates, 1996).

Yields and output prices

As Hassall and Associates (1996) pointed out, it is often assumed that yield (ie. production per hectare) suffers under organic farming systems. A late 1980s study which surveyed eight cereal-livestock organic farms did not find a statistical difference between yields of conventional and organic systems on cereal-livestock farms. Yields in the dairy industry have been the most widely studied, with indications that milk yields fall by 30%. However, there were also significant decreases in the input of feed concentrates. No data were available for other industries within Australia (Hassall and Associates, 1996).

Hassall and Associates (1996) found that only 15% of the respondents believed that they did not need a price premium in order to have a similar income as under 'conventional' management. Some 45% of

Table 6: *Areas and broad categories of organic industries*

	% or total farmers	Organic land area	% of organic certified land
Horticulture	75	6,948	8
Broadacre	12	59,764	69
Livestock	10	14,675	17
Other	3	4,914	6

Source: Hassall and Associates, 1996.

Table 7: *Number of organic farms, 1993–94*

	NSW	Vic	Qld	SA	WA	Tas	NT	ACT	Australia
Certified producers	271	187	141	101	68	26	1	2	795
Seeking certification	275	204	205	109	83	34	1	0	911
Total	544	391	346	210	151	60	2	2	1,706

Source: Australian Bureau of Statistics, based on the 1993–94 Agricultural Census.

Table 8: *Number of organic farms, 1995*

	NSW	Vic	Qld	SA	WA	Tas	NT	Australia
Certified producers	331	81	162	144	30	61	3	862

Source: Hassall and Associates, 1996.

respondents required a premium of between 10% and 20% to bring their income to a similar level as under 'conventional' management.

Market size and consumer attitudes

Hassall and Associates (1996) observed that the value of organic agricultural production has grown from $28 million in 1990 to $80.5 million in 1995. As a proportion of total food sales in Australia (ignoring on-farm transactions, barter and, with an average expenditure of nine cents per person per week.

Victoria has the largest State market for organic produce, with sales estimated at $30.8 million in 1995. New South Wales was second to this with estimated sales of $24 million, followed by Queensland with $14.5 million.

A survey on consumer attitudes, perceptions and behaviour with respect to chemicals in fresh food was undertaken by Parigi and Clarke (Agriculture Victoria) in 1994. It found that consumers are concerned about the use of chemicals in fresh food and feel too little is being done to safeguard food. Also, current non-purchasers are less likely to purchase organic food in the near future due to lack of availability, quality and price, although price was a more prominent reason for non-purchase than availability (Hassall and Associates, 1996). However, the reasons why consumers are concerned about the use of chemicals in fresh food is still unclear. It is likely that immediate personal health concerns are one of the primary factors, while concern for the health of the environment and the sustainability of agriculture may be of secondary concern to the majority of consumers.

A survey by Evans (1995), using the Victorian market for organic breakfast cereals as an example, found that consumer confidence in organic certification labels was low, and that a large proportion of consumers did not recognise the labels of the three major certification organisations. The survey also found that consumer ignorance of certification scheme requirements inhibited demand for organic products. Box 10 describes why one retailer has withdrawn from the organic breakfast cereal market.

The Evans (1995) and other studies (eg. Sriskandarajah and Dignam, 1992; Hassall and Associates, 1996) have concluded that organised promotion, market information, market development, a single national labelling system and logo, consistency in supply, identification of markets and organisation of efficient distribution systems are required.

Hassall and Associates (1996) found that while there is demand for organic vegetables, grains and organic animal products, the production of organic fibre products was very small, with only six organic cotton producers and four sources of wool supply. Organic cotton producers have been badly affected in recent years by lack of water supply, since the crop is irrigated, and with the low and variable volume of the crop, processors are unwilling to commit resources until a critical production volume is reached. Box 11 (page 53) outlines supply problems in the organic cotton industry in Australia, and describes the experiences of one American company during its switch to organic cotton products and the consumer attitudes observed.

Box 10: *Organic breakfast cereals*

A survey of consumers in Victoria (Evans, 1995) focused on organic breakfast cereals. The results showed that consumer confidence in the claims about organic breakfast cereals were high, but knowledge about the certification organisations and recognition of certification labels were low.

The Uncle Toby's company marketed Organic Vita Brits® over the past five years, but ceased production in early 1997. This decision was based on market research findings and operational factors. The main problems faced by the company were as follows.

- Price premiums required by organic growers to cover production requirements were rising.
- The riskiness of supply in poor seasons. The company's requirements were for large lots (more than 500 tonnes, a total of 10,000 tonnes per year was required) of consistent quality wheat of a particular variety. The limited number of growers who were providing the grain meant that sufficient supplies were not guaranteed.
- The division in the organic industry, with some grower organisations not recognising other certification schemes, meant the company had to pay some growers for dual membership.
- Market research showed that target consumers showed low awareness or comprehension of 'organic' and that the major product attribute of Vita Brits® valued by consumers was instead, 'No Added Sugar'.

The Evans (1995) survey observed that the Uncle Toby's Organic Vita Brits® labelling was well recognised by consumers and received a high confidence rating in regards to believability of its organic claim. However, no information on sales levels was available. From the available evidence, it would seem that the majority of the problem was on the production side.

Box 11: *Organic cotton*

The Maud 'n' Lil company in Sydney designs and retails organic cotton clothing made from certified organic Australian cotton. The company started three and a half years ago, and sales have proved strong, with the company entering a contract with David Jones to supply various clothing and toy items. Originally the cotton was sourced directly from the farmers, however, currently an agent handles the buying of supplies. There is some uncertainty of supply of organic cotton in the coming season, and if no Australian organic cotton is available, yarn will have to be sourced from the United States, which will be much more expensive (V. Watson, pers. comm., 1997).

Greenpeace has ceased operation of its retail section, which included the sale of organic cotton clothing. This will leave the Maud 'n' Lil company as the only retailer of Australian organic cotton clothing in Australia.

Health concerns seem to be a key concern to customers who buy organic cotton, due to allergies to conventionally produced and processed cotton, rather than a concern for the sustainability of the cotton farming system.

Organic cotton producers contacted during the Hassall and Associates (1996) survey indicated that Australian processors are interested in sourcing organic product, but are unwilling to commit to purchase when supply is not assured. The survey found that the underdeveloped marketing channels for organic cotton are more a function of short supply, rather than a lack of processor and consumer demand. The experiences of switching to organic cotton fabrics by an American apparel company, Patagonia, are described below.

Patagonia's switch to organic cotton products

The United States-based company, Patagonia, which manufactures clothing and equipment for outdoor sports, decided to use only organically grown cotton for its cotton products as of early 1996. The company found that initial sales of the organic cotton products met or exceeded expectations, but they also observed that customers bought the products for quality, fit, styling and brand, with environmental concerns of less importance (Chouinard and Brown, 1997).

When initially considering the decision to switch to organic cotton, the company was concerned whether consumers would perceive sufficient value in higher priced cotton products. Also, initially the company did not know where and how the cotton they were using was grown, and had little knowledge about the production process and associated potential environmental problems. The process of switching to organic cotton required a lot of staff training, developing new fabrics of sufficient quality, creating linkages along the entire supply chain (which was found to be complex), finding organic cotton sources and educating customers. The company found that customers knew little about agricultural issues and found it difficult to link what they did know to the clothing they bought. The company found that the price increases they had to apply to the products (between 15% and 40%) did not have a significant impact. They have found it difficult to maintain product quality, and have observed little interest in organic cotton from other companies in the apparel industry (Chouinard and Brown, 1997).

Switching to organic cotton products was not a high-risk option for the company, since their sales of cotton products overall was small in relation to the total products sold. The overall "financial health" of the company would not be a risk, even if they lost "every single sales dollar" from cotton produce. However, this company had an extra incentive for switching to organic cotton, over and above what other companies may experience. This extra incentive was that the company's self-imposed mission was "maximum attention to product quality" while "striving to do no harm" to the environment, as well as supporting environmental causes, and this was part of their public profile that they wished to maintain (Chouinard and Brown, 1997).

Interest in organic wool from Japan and Europe is high. The Hassall and Associates (1996) study found that there is only one certified scouring plant for organic wool in Australia, operating in Launceston, Tasmania. Organic wool for the plant is sourced by a single agent who has four separate sources of supply. In any year, only one of the four growers is contracted to supply the plant, while the other three growers must sell their wool via the conventional market. Selling production via the conventional market eliminates any opportunity for price premiums for organic product. There is also only one commercial knitter of organic wool, located in Adelaide.

However, interest from overseas in Australian organic wool is high, with enquiries from Japan and Western Europe. So it would appear that there is a market for Australian organic wool, but supplies and processing capacity are inadequate to meet demand.

Regulatory effects

Two types of regulations which hindered the development of organic marketing were identified by Hassall and Associates (1996). Firstly, there were those that related to the control of diseases and pests. There are restrictions on intra- and inter-state trade on products which have unacceptable levels of blemish or risk of insect infestation. Secondly, regulated marketing arrangements caused difficulties in the distribution of wheat and rice on a national basis. Regulated marketing arrangements made it difficult to segregate products, price pooling hindered payments of premiums for organic produce, and suitable handling and processing was not available. However, since the Australian Wheat Board no longer has compulsory acquisition powers, growers find it easier to obtain price premiums (Hassall and Associates, 1996).

Recent developments in the Australian organic farming industry

A national strategy for organic agriculture was developed following the National Symposium on Organic Agriculture in Australia held in July 1996. As a result of the symposium, the Interim Organic Industry Council of Australia was established. The council was charged with establishing a peak industry body and providing a foundation for unification for the organic agriculture industry.

The Rural Industries Research and Development Corporation (RIRDC) commissioned a report on the organic agriculture industry in Australia, 'From Farmer to Consumer: the Future for Organic Agriculture in Australia', which was published in April 1997. The report found that a top priority of the industry should be national coordination so that it can take advantage of growing international market opportunities.

As a result of the RIRDC report, an industry workshop was held in mid-June 1997 at which the Australian organic farming industry agreed to form an industry federation. The federation is intended to have a 'whole industry' focus, with representation from producers, certifiers, wholesalers, retailers and customers (RIRDC, 1997). Work to achieve the formation of the federation is ongoing, with a major meeting expected to be held in September 1997. (P. Peterson, pers. comm., 1997). The Organic Federation of Australia, an Organic R&D Advisory Committee, was formed in November 1997. The advisory committee involves members of the industry with specialist skills and has broad industry coverage. The principal activities of the advisory committee are the management of existing research programs, the implementation of new research and development for the industry, and the development of a five-year R&D plan for the organic industry of Australia (RIRDC, 1998).

Information on the market for organic foods is quite limited, with few consumer studies being undertaken. It has been observed in the United States that an increase in price premiums beyond that which consumers were willing to pay for organic produce did suppress demand. Applying environmental labelling to agricultural produce will not be easy, since the effects of various practices and technologies vary across different regions. Chemical use risks vary with location and practice, and nutrient use and recycling have adverse impacts in some areas but not in others (Erickson and Kramer-LeBlanc, 1997).

4.7 Conclusion

In this section, government and industry approaches to achieving better environmental outcomes have been reviewed. Government has traditionally relied on regulation, but is now exploring suasive and market-based approaches. Until recently, economic instruments have been used sparingly, but some recent major government initiatives include creation of property rights such as tradeable permit schemes. Tradeable permit schemes are most relevant to point source (ie. of an identifiable and measurable source) pollution. But non-point source pollution problems, where the source is difficult to identify and monitor (ie. no observable

point source), are pervasive in agriculture. Examples include surface water contamination from erosion that enters waterways over a dispersed area or salinity of waterways caused by excess irrigation and rising saline watertables upstream. Cost-sharing for onground works to address salinity is one Australian method of addressing non-point source pollution, and there is heavy government involvement in R&D to ameliorate the environmental impacts of agricultural technologies. Government in Australia is also achieving better environmental outcomes by withdrawing from input subsidies which encouraged inefficient wateruse and excessive land development. The current progress of water reform in New South Wales is an important example of this withdrawal.

At an industry level, an eco-label identifies environmentally preferable products, ideally based on an environmental impact assessment of the product compared to other products in the same category (van Ravenswaay and Blend, 1997). However, current technology cannot measure the environmental impacts of production with a great deal of precision, which leads to problems assessing production systems and informing consumers about the impacts of production. Since many eco-labels are voluntary, there have been problems with deceptive labelling in the past, resulting in the introduction of legislation in the United States and lack of consumer confidence in Australia in the truthfulness of produce claimed to be organic, which has caused problems for the organic food industry. The organic industry in Australia has also faced problems stemming from small production amounts being vulnerable to seasonal conditions, regulatory effects hindering the development of marketing, and lack of coordination to take advantage of international marketing opportunities.

The Department of the Environment, Sport and Territories (DEST, 1997) noted that there is no present identification in Australia of priority areas for achieving changes in consumption patterns, nor is there a set of indicators with which to measures progress towards sustainable consumption. Yet the pattern of consumption is a key influence on sustainability. A number of current government strategies on ecologically sustainable development, greenhouse gases and urban development have direct bearing on consumption pattern priorities and indicators to measure progress (DEST, 1997).

For prices to function as sustainability incentives, information must be provided to consumers linking prices to sustainability. The organic industry is an example of an industry that is perceived by consumers as more sustainable. It seems that strong price premiums for organic produce are not being paid at present, partly because consumers have difficulty identifying organic produce and partly because they are unwilling to pay large premiums for such products. The experience of the organic industry in Australia seems to show that there is a lack of consumer awareness of organic labelling systems in Australia, and that those systems lack credibility for many consumers.

Surveys have found that consumers tend to use organic food and products more as a result of personal health concerns rather than as a direct manifestation of concern for the environment (eg. Evans, 1995). Concerns about the environmental sustainability of the production systems which make the food and clothing they buy seem to be of secondary importance to consumers, with health, quality and price concerns apparently of more importance. The efficiency with which commodity prices can provide incentives to encourage primary producers to adopt practices that are sustainable will depend heavily on the effectiveness with which sustainability (being a credence attribute of products) is communicated to consumers. The next section describes the conditions under which price signals passing between consumers and agricultural producers can act effectively as incentives to promote the adoption of sustainable practices by agricultural producers.

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5. Market Signals and Sustainability

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Executive summary

The objective in this work was to describe the conditions under which price signals passing between consumers and agricultural producers can act effectively as incentives for agricultural producers to adopt sustainable practices. The effectiveness with which such signals may act as incentives depends on many factors. The most critical are:

- the degree to which consumer beliefs about sustainability are linked to price incentives; and
- the extent to which price signals passing between producers and consumers are modified by the processing sector.

Market signals are transmitted between the agricultural producer and the consumer via the marketing and processing chain. The transmission of consumer preferences about sustainability depends on the profitability of servicing those preferences. Profitability will depend on:

- the size of segments;
- differences in scale between farming and processing operations;
- the ease with which desirable practices and techniques can be integrated into existing farming operations;
- the extent to which the attributes which processors value in a commodity as an input coincide with the attributes which consumers value in the retail product; and
- how precisely consumer preferences are defined.

The purchasing behaviour of consumers is driven to a large degree by their interest or involvement in an issue. Many consumers have strong concerns about issues such as health (chemicals in food), children's safety (allergies to additives) and animal welfare (free-range eggs). The more directly consumers link a product with an issue which concerns them, the less sensitive they will be to increases in the price of the product relative to substitutes. This means:

- With regard to products which are not linked to issues that concern consumers, brands that are offered at higher prices are unlikely to compete successfully with lower priced brands. Therefore, brands that are offered at a higher price because the sustainable practices used in their manufacture entails an increase in production costs are unlikely to be widely accepted. To compete, the supplier or processor must be willing to accept a lower margin. In short, price signals alone are more likely to act as disincentives in these circumstances.

The disincentive that higher prices represent for such products may be offset if sustainability is, or can be made, an issue that concerns consumers. If consumers are sufficiently well disposed towards sustainability then they may reject lower priced brands in favour of the higher priced 'sustainable' brand. Hence, for prices to function as sustainability incentives, information must be communicated to consumers linking prices to sustainability.

- With regard to products which are linked to issues that concern consumers, price tends to play a less important role. These products are purchased on the basis of a set of product attributes, which may or may not include price, that are important to the consumer. Typically, the set of attributes, which form the criteria for choosing between brands, is generally small.

For consumers to select brands of these products that promote sustainability they must already believe, or be persuaded, that sustainability is an important purchasing criterion. However, even though the consumer may rate sustainability as an important purchase criterion, actual purchase behaviour will depend on the importance of this criterion relative to the consumer's other purchase criteria. If a brand that is manufactured using sustainable practices does not meet the consumer's other purchase criteria as well as some other brands, then the other brands may still be

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preferred (unless the consumer is convinced that sustainability is a particularly important purchase criterion).

The potential for sustainability to influence consumers' purchase decisions depends then on the extent to which sustainability is an issue that concerns consumers. Given the vagueness of sustainability as a concept, and given the social distance between the urban consumer and the countryside, sustainability is unlikely to be an involving issue *per se*. This means that education and awareness-raising campaigns are generally unlikely, by themselves, to create widespread changes in consumers' purchase behaviour.

The following strategies might be more effective.

- First, the evidence is that health and safety concerns are the primary motivations for consumers who purchase 'organic' food. This suggests that consumers are more likely to be interested in the adoption of a sustainable practice if that practice can be linked to issues that are of concern to them such as health and safety (eg. concerns about chemicals in food).
- Second, consumers are more likely to respond to sustainability if the concept can be presented as consisting of specific techniques, practices or standards. In other words, if a particular farm practice such as integrated pest management can be credibly linked in consumers' minds with an issue such as their health and safety (eg. chemical-free), then consumers may be more inclined to purchase brands manufactured from produce grown using these methods.
- Third, there may be some role for governments in facilitating the development of accreditation schemes to assist consumers in more easily identifying goods and services that rely on sustainable agricultural methods.

If the concept of agricultural sustainability remains vague for consumers, then they may well find other more convenient and more tangible ways to express their concern for the environment (eg. recycling schemes).

The potential for signals from foreign consumer markets to provide incentives to farmers to adopt sustainable farming practices appears as limited as is the case with domestic consumers. This is especially so considering the diversity of foreign markets that are buyers of our agricultural commodities. However, to the degree that foreign consumers' concerns about issues such as food safety encourage the international harmonisation of standards and environmental practices, current trends in international trade forums encourage the adoption of sustainable practices.

5.1 Introduction

A farming enterprise can be viewed as a business where inputs of various forms such as fertiliser, fuel, land and labour are transformed into various commodities such as wheat, wool and meat. In managing this business the agricultural producer faces two different sets of prices – input costs and commodity prices. Changes in either the cost of inputs or the prices of commodities will alter the relative profitability of commodities. This can lead to changes in the volume and mix of both inputs and commodities produced.

There are two general ways in which commodity and input prices can create incentives for agricultural producers to adopt sustainable practices. Commodity prices can create an incentive to adopt sustainable agricultural practices if agricultural commodities produced using such practices are more profitable than those that are produced in other ways. This might occur if, for example, consumers are willing to pay a sufficiently high premium for commodities produced using sustainable practices. Input costs can promote the adoption of sustainable agricultural practices if, *ceteris paribus*, the costs of production are lower when such practices are employed.

The objective in this section is to describe the conditions under which commodity prices and input costs can act effectively as incentives to promote the adoption of sustainable practices by agricultural producers. The effectiveness with which commodity and input prices may act as incentives to promote the adoption of sustainable agricultural practices depends on many factors. The most critical factors, in my view, are:

- the degree to which the producer behaviour caused by price incentives correlates with the producer behaviour needed to maintain ecosystem health;
- the degree to which price incentives are linked to claims about sustainability in the minds of consumers; and
- the extent to which price incentives are modified in transmission between producers and consumers by the processing sector.

Each of these factors is considered in detail in the following discussion.

5.2 Ecosystem coupling

The first factor identified as critical to the effectiveness of prices as incentives for sustainability was the degree to which producer behaviour caused by prices (both input and output) correlates with the behaviour needed to maintain the health of the ecosystem. This idea can be given some precision as follows. The environment can be thought of as supplying inputs to, and assimilating by-products of, industrial and agricultural processes (Common, 1992). The capacity of the environment to supply inputs and assimilate by-products will vary over time, depending on the dynamic behaviour of ecosystems and the way in which this behaviour is affected by economic activity (Reeve and Kaine, 1992). Assuming ecosystems are hierarchically stable (Kaine et al., 1992a), ecosystems do have a limited dynamic capacity to supply inputs and assimilate by-products without fundamental changes occurring in their dynamic behaviour. When this capacity is exceeded, and the fundamental dynamic behaviour of ecosystems changes, irreversible degradation is likely to occur.

A system is hierarchically stable if the dynamic behaviour of a sub-system at one level in the hierarchy is only weakly linked to the dynamic behaviour of the higher and lower order sub-systems (Simon, 1973). The limited interaction between the different levels in the hierarchy permits stable assemblies of sub-systems to develop whose dynamic behaviour has no effect on the development of the hierarchical structure as a whole (Koestler, 1968). The limited interaction between levels in the hierarchy means that there is potential to alter the dynamic behaviour of a sub-system without fundamentally altering the dynamic behaviour of the hierarchy as a whole. In other words, if ecosystems are hierarchically stable, then the behaviour of sub-systems at some level within an ecosystem can be altered without permanently changing the overall dynamic behaviour of the ecosystem.

The foregoing means that, at some scale, ecosystems do have a limited dynamic capacity to supply inputs and assimilate by-products without fundamental changes occurring in their dynamic behaviour. Provided the volume of inputs used in agricultural and industrial activities, and the volume of by-products delivered into the environment by these activities, does not exceed this capacity then, in principle, the interaction between economic activity and the environment is sustainable (Kaine et al., 1992a; Reeve and Kaine, 1992). In other words, ecosystems could have some ability to supply resources to, and absorb by-products from, agriculture and industry before their dynamic behaviour is disrupted. If economic activity remains within the boundaries set by the behaviour of the ecosystem, then it is sustainable. However, once economic activity reaches the point where it disrupts the fundamental dynamic behaviour of the ecosystem, degradation occurs and economic activity is no longer sustainable.

Various regulatory, market and other mechanisms might be employed to constrain the volume of inputs drawn from the environment to the supply of inputs and to constrain the volume of by-products delivered into the environment to the assimilative capacity of the environment (ABARE 1993; Bohm and Russell 1985; Common et al., 1990; Freebairn 1991; James 1993; Kaine et al., 1992a; Kaine et al., 1992b; Nicolaisen et al., 1991; Tietenberg 1990; Young et al., 1996). Such mechanisms would be most effective when the allowable volume of inputs or by-products is directly linked or coupled to dynamic variations in the productive and assimilative capacity of the ecosystem respectively. Hence, one condition for prices to act effectively as incentives to the adoption of sustainable practices is that they vary appropriately with changes in the productive and assimilative capacity of ecosystems.

This condition requires that the productive and assimilative capacities of the ecosystem be priced inputs into agricultural and industrial processes. And some efforts have been made to move in this direction. See Kaine and Reeve (undated) and Kaine and colleagues (1991) for instance. The weaker the link between a price and variations in productive or assimilative capacity, the less effective the incentive created by the price. For instance, the incentives created by the higher prices that consumers might pay for 'chemical-free' products are attenuated by the fact that the impact of 'chemical-free' farming practices on the assimilative capacity of the ecosystem is apparently positive but unquantified. Furthermore, the prices for 'chemical-free' products do not vary in line with changes in assimilative capacity of the environment over time.

In conclusion, the more directly variations in the productive or assimilative capacity of the environment are represented in prices for agricultural inputs and commodities, the more effective these prices will be in promoting sustainability.

5.3 Consumer behaviour

The second factor that is critical to the effectiveness with which prices may act as incentives is the degree to which price incentives are linked to claims about sustainability in the minds of consumers.

A basic tenet of the theory of perfect competition is 'perfect information', which means that all buyers and sellers in the market have complete information on the prices in the market. However, perfect information does not exist in the real world. Consumers are not perfectly informed about products, production processes and markets. As a result, the myriad of reasons which cause product prices to change are rarely known to consumers. Consumers may be willing to pay a higher price for products that are produced using sustainable methods. However, consumers cannot infer that sustainable agricultural practices have been adopted simply on the basis of being charged a higher price. The higher price must be accompanied by signals (such as an accreditation scheme label with which consumers are familiar) indicating that the higher charge stems from the adoption of a sustainable practice. To understand how such signalling operates and the effects it can have, an understanding of consumer purchasing behaviour is necessary.

5.3.1 Purchase behaviour

Consumers' purchases are influenced by cultural, social, personal and psychological factors (Kotler, 1984). Cultural factors are the most fundamental determinants of a person's wants and behaviour (Assael, 1984). Our culture imbues us with a set of values and behavioural norms and these cultural values and norms set the boundaries within which social factors influence our behaviour. Social factors include reference groups, family, social class and status. Interacting with these social factors are personal factors such as age, occupation, economic circumstances and lifestyle.

The last category of factors that determine the choices made by people are psychological factors. The four major psychological factors are motivation, perception, learning, and beliefs and attitudes (Kotler, 1984, p. 136). Motives may be physical or psychological. A motive is a need that is sufficiently pressing to direct a person to seek satisfaction of the need. A motivated person is ready to act. The way in which they act depends on their perceptions of a situation, what they learn about the situation and their beliefs and attitudes. A belief is a descriptive thought that a person holds about something. An attitude is a person's enduring favourable or unfavourable cognitive evaluation towards an object or idea (Kotler, 1984, p. 141). In other words, an attitude is a person's favourable or unfavourable judgement about an object or idea. For example, a person may believe that recycling promotes sustainability. If they think that sustainability is a good thing, then they will probably have a favourable attitude toward recycling. Attitudes involve judgments which depend in some way on cultural, social and personal factors. Since attitudes tend to be enduring, they lead people to behave in relatively consistent ways towards similar objects and ideas. Returning to the example of the person who thinks that sustainability is a good thing, they are likely to have favourable attitudes towards most practices that they believe promote sustainability.[7]

As outlined above, the purchasing behaviour of consumers is the result of the complex interplay of cultural, social, personal and psychological factors. Understanding these factors can provide clues as to how to develop, price and promote products. However, the roles performed by these factors in conditioning consumer choices vary for different types of buying behaviour.

Low involvement buying behaviour

Assael (1984) classified buying behaviours into four basic types on the basis of consumer involvement and degree of brand difference. The purchasing of most products involves 'low involvement' buying behaviour. Commonly, low involvement purchases involve products which are low-cost and frequently purchased. Consumers have weak, or neutral, attitudes towards low involvement products. Many household goods such as groceries, laundry products and basic toiletries are low involvement products. With low involvement products the consumer forms beliefs about products by passive learning, and product evaluation occurs after purchase (if at all).

There are two forms of this behaviour, 'habitual' and 'variety seeking'. Where involvement is low and brand differences are insignificant, buying behaviour is habitual. Cordials, frozen vegetables and paper towels are examples of products involving habitual purchase. Consumers purchase the same brand of product out of habit rather than brand loyalty. They do not form an attitude about a brand but select it because it is familiar. The low involvement of the consumer means that brand

[7] This view of consumer behaviour is consistent with Stern and Dietz's (1994) social psychology model of attitude formation.

switching can be initiated relatively easily through price discounts as the consumer is not highly committed to any brand (Assael, 1984, p. 89).

Variety seeking behaviour occurs where there are significant differences between brands but consumer involvement is low. In this case, consumers tend to switch frequently between brands that are perceived to be different. This switching is motivated by a desire for change or novelty rather than dissatisfaction with the original product. Biscuits, frozen meals, take-away meals and toothpastes are examples of products involving purchasing behaviour of the variety seeking type.

Low involvement buyer behaviour has important implications for the role of prices in promoting sustainability. As mentioned previously, price discounts are likely to trigger brand switching with low involvement purchases. Hence, brands of low involvement products that are offered at higher prices are unlikely to compete successfully with lower priced brands. Therefore, brands that are offered at a higher price because the sustainable practices used in their manufacture entails an increase in production costs are unlikely to be widely accepted. To compete, the supplier must be willing to accept a lower margin. In short, price signals alone are more likely to act as disincentives when consumer involvement in products is low. For example, Hassall and Associates (1996) quote Parigi and Clarke's (1994) finding that price is a major factor preventing people who do not presently purchase organic food from doing so.

The disincentive that higher prices represent for low involvement products may be offset if sustainability is an 'involving' issue. An involving issue is one that consumers have attitudes towards. If consumers have favourable attitudes towards sustainability, and the brand can be linked to this issue, then consumer involvement will be heightened. In essence, the involving issue widens the latitude or grounds for rejecting competitive brands (Assael, 1984, p. 99). If consumers are sufficiently well disposed towards sustainability, then they may reject lower priced brands in favour of the higher priced 'sustainable' brand. Hence for prices to function as sustainability incentives, information must be communicated to consumers linking prices to sustainability.

High involvement buying behaviour

Quite different decision processes are followed when consumers are making high involvement purchases. Typically, high involvement occurs when products are expensive, bought infrequently, are risky and are highly expressive (of self-identity). The consumer may not be well informed about the product category and may have much to learn. The purchase process is characterised by active learning by the consumer who evaluates products and brands prior to purchase. There are two forms of high involvement purchase behaviour, 'complex' and 'dissonance reducing' (Kotler, 1984, pp. 143–144).

Complex buying behaviour occurs when involvement is high and significant differences are perceived across brands. Complex buying occurs in the purchase of products such as personal computers, motor vehicles and cosmetics. With complex buying a person first develops beliefs about products by actively seeking information and learning about them. Products are evaluated and attitudes (ie. favourable or unfavourable judgments) about products and brands are then formed. Once the evaluations are completed, a deliberate choice is made about which product and brand to purchase. Often there is a re-evaluation of the product following purchase.

With complex buying behaviour, product price is likely to be only one of many product features under consideration. Strategies for increasing sales need to centre on identifying which product attributes are important to consumers and the relative importance of these attributes. Such strategies also seek to promote brand loyalty. Brand loyalty represents a favourable attitude towards and consistent purchase of a single brand over time (Assael, 1984, p. 70). Risk is an important factor in high involvement purchases. Once a particularly satisfactory brand has been identified, then the risk entailed in any future purchases can be reduced by repeatedly purchasing the same brand. In other words, the consumer shifts to a habitual purchase behaviour to minimise risk.

The other form of high involvement process is dissonance reducing buyer behaviour. This type of behaviour occurs when differences between brands are perceived to be insignificant. Again, the product to be purchased is likely to be expensive, bought infrequently, and risky. Examples where this type of behaviour may apply include whitegoods, lawnmowers and carpets. Because the consumer sees little difference between the various brands, the actual purchase is often made quickly, without any firm belief in the merits of the chosen brand compared to other brands. As a result, any information received after purchase suggesting that the chosen brand is inferior to another raises doubts in the consumer's mind about their choice (Assael, 1984, p. 85). Consumers will

seek to reduce the dissonance or internal conflict they experience in these circumstances by seeking positive evidence justifying their choice. Hence, beliefs about the product and attitudes towards it are formed after purchase.

Implications of buying behaviour

With high involvement purchases, price tends to play a less important role than in low involvement purchases. Complex purchases are made on the basis of a set of complex product attributes, which may include price, that are important to the consumer. Typically, the set of attributes which form the criteria for choosing between brands is generally small. For consumers to select brands that promote sustainability, they must already believe, or be persuaded, that sustainability is an important purchasing criterion.

Even though the consumer may rate sustainability as an important purchase criterion, actual purchase behaviour will depend on the importance of this criterion relative to the consumer's other purchase criteria. If a brand that is manufactured using sustainable practices does not meet the consumer's other purchase criteria as well as some other brands, then the other brands may still be preferred (unless the consumer is convinced that sustainability is a particularly important purchase criterion). Similarly, if other brands meet a consumer's needs equally well but are offered at a substantial discount, then the consumer may well prefer the other brands unless they are convinced that sustainability is an instrumental purchase criterion.

With respect to dissonance reducing buying behaviour, the purchase of brands that are manufactured using sustainable practices may be promoted by using sustainability as a differentiating attribute at point of purchase, and by communicating reassuring messages to consumers that they have made the 'right' choice by purchasing such brands (Assael, 1984, p. 86).

In conclusion, the role that product prices can play in promoting sustainability depends on the type of buying behaviour that consumers adopt when they purchase products (see Table 9, below). For low involvement purchases, higher prices for socially desirable brands may be made more acceptable to consumers if sustainability is an involving issue and brands can be linked to this issue. For high involvement purchases, consumers must be persuaded that sustainability should be an important purchasing criterion.

Table 9: *Consumer involvement and purchase behaviour*

Buying behaviour	Description	Implications for price signals and sustainability
Low Involvement	• Products which are low cost and frequently purchased • Brand switching initiated relatively easily (habitual) • Consumers tend to switch frequently between brands (variety seeking)	High priced brands (due to sustainable prices used in their manufacture entailing an increase in production costs) are unlikely to be widely accepted. But if consumers are sufficiently well disposed towards sustainability then they may purchase the higher priced 'sustainable' brand. For prices to function as sustainability incentives, information must be communicated to consumers linking prices to sustainability.
High Involvement	• Product purchased likely to be expensive, bought infrequently and risky • Purchases are made on the basis of a set of product attributes that are important to the consumer • Significant differences perceived across brand (complex) • Differences between brnads are perceived to be insignificant (dissonance reducing)	• Other brands will be preferred unless the consumer is convinced that the sustainability is an important purchase criterion • Purchase of brands that are manufactured using sustainable practices may be promoted by using sustainability as a differentiating attribute (complex) and by communication reassuring messages to consumers that they have made the 'right' choice by purchasing such brands (dissonance reducing)

5.3.2 Purchase criteria

The way in which sustainability can be promoted to consumers as an important product attribute depends on how consumers formulate purchase criteria. When we buy a product our decision to purchase a particular brand is based on a set of purchase criteria. This is especially so when we have a high involvement with the product. There are a number of ways these criteria can be usefully classified. One way is to categorise purchase criteria into experiential and credence criteria.

Experiential purchase criteria

Experiential criteria are those attributes of a product that arise from the actual experience of using the product. For example, if ease of care is an important factor when we purchase clothing, then our experience in caring for different types of fabrics and styles will have an important influence on our purchasing decision. Importantly, perceptions of experiential attributes are difficult to alter unless the product itself is modified. This is because such perceptions are rooted in actual experience.

Credence purchase criteria

Credence criteria are attributes that cannot be inferred simply from experience of the product. Reference to some arbiter outside the product itself is necessary to form a judgment about how well the product performs on credence criteria. For example, if fashion and style are important factors when we purchase clothing, then our judgment as to whether a particular article of clothing is fashionable and stylish will depend on the opinion of those who we regard as arbiters of fashion and style (for example, celebrities, famous models and fashion designers). Perceptions of credence attributes can be modified without altering the product itself (by influencing the opinions of arbiters, for instance).

Implications of different purchase criteria

The distinction between experience and credence criteria raises important issues regarding the signalling of 'sustainability' to consumers (see Table 10, below). One is the credibility of arbiters or claimants (DEST, 1997). Consumers cannot know that a product has been manufactured using a sustainable process simply on the basis of their experience of the product. Instead, they must form their judgments about the 'sustainability' on the basis of claims made for the product by others. The more credence given to the opinions of these others by the consumer, the stronger the claim. Hence the degree to which consumers may be willing to pay more for products that are sustainable will depend on the credibility in consumers' minds of those who claim a product is sustainable. Lonergan (1995, p. 8) notes that consumers, being aware that many products are marketed as being environmentally friendly yet have minimal or superficial environmental benefit, are increasingly sceptical about claims that products are 'green'.

A second issue concerns the nature of the claims themselves. At present, and for the foreseeable future, our knowledge of what is sustainable is imprecise (Wills, 1992). Therefore, an empirically verifiable claim cannot be made that a product or process is sustainable. Instead, claims can be made that particular processes or methods are believed to be sustainable. This means that the extent to which consumers may be willing to pay more for a product because a particular method has been used in

Table 10: *Sustainability and purchase criteria*

Purchase criteria	Description	Implications for sustainability
Experiential	Attributes of a product which influence consumers' purchasing decisions that arise from the actual experience of using the product.	Consumers do not have sufficient information to judge for themselves whether or not a mode of production is sustainable.
Credence	Attributes that cannot be inferred simply from experience of the product. Reference is made by the consumer to some outside arbiter to form a judgment.	The degree to which consumers may be willing to pay more for products that are sustainable will depend on the credibility of those who claim a product, or the method used in its production, is sustainable.

the manufacture of that product will depend on the degree to which the method is associated with sustainability in consumers' minds.

Consumers do not have sufficient information to judge for themselves whether or not a mode of production is sustainable. They must rely on claims made by credible others to make this judgment. Such claims are signals to the consumer that a product or process holds potential value for them because it is sustainable (a use criterion which cannot easily be verified). The conclusion to be drawn from this discussion is that the efficiency with which commodity prices can provide incentives to encourage primary producers to adopt practices that are sustainable will depend heavily on the effectiveness with which sustainability (being a credence attribute of products) is communicated to consumers.

5.3.3 Involvement, claims and credibility

The potential for sustainability to influence consumers' decisions for low involvement products depends on the extent to which sustainability is an involving issue for consumers. The potential to promote sustainability as an important purchase criterion for high involvement products also depends on whether sustainability is an involving issue for consumers. DEST (1997) notes that initiatives intended to change consumer behaviour have not succeeded where the issue is socially distant from the target groups, or the consequences of not changing are distant in time. Given the vagueness of sustainability as a concept, and given the social distance between the urban consumer and the countryside, sustainability is unlikely to be an involving issue *per se*. This means that education and awareness-raising campaigns are generally unlikely, by themselves, to create widespread changes in consumer purchase behaviour. This is supported by recent findings with respect to organic food and 'green' superannuation funds (DEST, 1997) and consumer response to nutrition education campaigns (Lonergan, 1995, p. 5).

A survey by Lampkin (1990) shows that health and safety concerns are the primary motivations for consumers who purchase 'organic' food. Saulwick-Age/Herald and University of Melbourne (RIRDC, 1989) found that the majority of people would prefer food without chemicals, while CSIRO (1993) found that approximately one in two people believe additives and pesticides are a problem in food. Crawford and colleagues (1983) reported similar findings. This has two important implications for promoting sustainability to consumers. First, consumers are more likely to be interested in the adoption of a sustainable practice if that practice can be linked to involving issues such as health and safety, convenience or cost. For example, 'organic' products are linked to food safety and health, highly involving issues (Lonergan, 1995; Evans, 1995). Similarly, manufacturers of breakfast cereals employ the concerns of parents for the health concerns of their children to promote their brands of cereals. Consumer concerns about the safety of chemicals (together with concerns about animal welfare) are sufficiently strong for many to pay substantial premiums for 'free-range' eggs. Equally, consumer concerns about animal welfare are sufficiently strong for the creation of 'dolphin-safe' fish products.

Second, consumers are more likely to respond to sustainability if the concept can be presented as consisting of specific techniques, practices or standards. In other words, if a particular farm practice such as integrated pest management can be credibly linked in consumers' minds with an involving issue such as their health or safety (such as chemical-free) then consumers may be more inclined to purchase brands manufactured from produce grown using these methods. If the concept of agricultural sustainability remains vague, then consumers may well find other, more convenient and tangible ways to express their concern for the environment. For example, consumers might engage in glass and plastic recycling schemes or purchase phosphate-free washing powders. In other words, there are a range of apparently environmentally friendly behaviours being promoted to consumers and it is important to recognise that these behaviours are, to some degree, substitutes for each other.

Presenting sustainability as a set of specific and concrete techniques, practices and standards facilitates claim making. The greater the opportunity to verify that a practice or standard is actually followed in growing the produce used in the manufacture of a brand, the stronger the claim linking the brand, the practice and the involving issue. The strength of such claims will be enhanced if verification is undertaken by independent parties with certification authority. Note that certification may involve more than just the inspection and monitoring of manufacturers, some claims may well entail certification of farm enterprises. See Wynen (1989) for a description of the mechanics of certification for 'organic' farming and Dumaresq, Greene and van Kerkhoff (1997) for a discussion of the issues involved.

Verification and certification procedures provide the basis for confidently claiming a link between a desirable practice or technique and a brand name. However, it is also necessary to establish a claim linking the desirable practice or technique in consumers' minds with an involving issue. The question then is identifying who can make such claims. Independent experts, public figures, government and consumer advocates may all have a role to play in establishing links with an involving issue. For example, the linking of breakfast cereals with health has been achieved by using sports, sports medicine or sportspeople with high public profiles in cereal advertising (eg. Kelloggs Nutrigrain®, Kelloggs Sustain®, Uncle Toby's Vita Brits®).

It is important to distinguish between certification and the use of brand names as signalling devices. The number of brands under which a product is sold generally reflects the variety in consumer segments (or needs) for that product and the intensity of competition within and across segments. Brand names are used to send a variety of messages to consumers. Brands communicate to consumers differences in product characteristics such as quality, service, price, reliability and so on. In other words, brands provide the consumer with a convenient means of judging the relative merits of products. In contrast, certification sends a single message to the consumer. Namely, it signifies that certain standards have been met in the provision of the product. Consequently, certification marks or logos should be easily recognisable and reliable. Consumers may become confused, or more likely, frustrated, if there are a number of certification agencies, with different logos and marks, verifying standards that appear the same to consumers (Dumaresq and Greene 1997; Wynen, 1997).

The role that product prices can play in promoting sustainability depends on the type of buying behaviour that consumers adopt when they purchase products. For low involvement purchases, higher prices for socially desirable brands may be made more acceptable to consumers if sustainability is an involving issue and brands can be linked to this issue. For high involvement purchases, consumers need to be persuaded that they should rank sustainability as an important purchase criterion.

In conclusion, the degree to which prices can provide incentives promoting sustainable agricultural methods and practices depends on the extent to which the employment of these methods and practices can be linked to issues that are involving for consumers. Once this has been achieved, establishing consumer confidence in verification and certification processes becomes important.

5.4 Processor behaviour

Market signals are transmitted between the agricultural producer and the consumer via the marketing and processing chain. This chain varies in length and complexity. Sometimes the marketing chain can be quite short, as is sometimes the case with fresh vegetables. More often, marketing and processing chains involve many stages, as is the case for wool products and convenience meals. The transmission of market signals through the processing chain will depend, in the first instance, on the degree to which similarities in consumer purchase criteria enable the identification of profitable market segments. The market signals transmitted to producers will also depend on the purchase criteria of consumers, and the degree to which the attributes of the retail product depend on the attributes of the commodity inputs used in the manufacturing process.

5.4.1 Strategy and segments

As already discussed, purchase criteria are the attributes of a product that consumers use in deciding which brand of a product to purchase. Market segments arise when different groups of consumers use different sets of purchase criteria in their purchase decisions. Consider the purchase of clothing, for example. Some consumers may place a great deal of importance on fashion and style. For others, comfort may be paramount. Yet another group may be most concerned about ease of care and price. The greater the variety in the purchase criteria used by different segments of consumers, the greater the opportunity for firms to offer differentiated products or brands that are designed to meet the particular purchase criteria of each segment.

In markets where purchase criteria differ in only one or two dimensions across large groups of consumers, firms may pursue one of two strategies. A firm may attempt to follow a cost leader strategy by offering a standardised product to all consumers and relying on economies of scale to keep prices as low as possible (Porter, 1985, pp. 12–14). Alternatively, a firm can pursue a differentiation strategy by offering a more expensive product that better satisfies the purchase criteria of a large proportion of consumers (Porter, 1985, p. 14). In markets where purchase criteria differ in many dimensions across large groups of consumers, firms can

pursue one of two forms of focus strategies (Porter, 1985, p. 15). Firms can follow a focus differentiation strategy by offering a high-priced product that is specially tailored to meet the particular requirements of a market segment. Alternatively, a firm can adopt a focus cost strategy by offering a specialised product to a segment and relying on specialist production techniques to keep costs and prices lower than those of their rivals.

Consider, then, a market in which a sizeable group of consumers begin to rate sustainability as an important purchase criteria. This group of consumers constitutes a new, developing segment and present a new opportunity for product differentiation. If the market in question is one where sustainability appeals to a broad range of consumers, then a differentiation strategy based on offering a more expensive product that better meets the sustainability criterion used by consumers may be feasible. If the market is one where sustainability appeals to only a small segment of consumers or specialised inputs or manufacturing processes are required to produce appropriate products for different segments, then a focus strategy may be feasible.

The feasibility of these strategies depends on the size of the market segments of interest. For a differentiation strategy to be feasible, the differentiated product must be manufactured for a price that is proximal to a comparable standard product (Porter, 1985, p. 14). In other words, the cost of producing the differentiated product must be such that the differentiated product can be offered at a price that is low enough to tempt consumers in the target segment away from the standard product. The cost of differentiation will depend on the cost of the differentiating inputs and technologies and the absolute size of the target segment. The larger the segment the greater the scope for lowering costs by taking advantages of economies of size.

The fact that differentiation must be profitable means that consumer preferences are not fully reflected in the range of products and brands on offer. If only a small segment of consumers in a market rate sustainability as an important purchase criteria, and the cost of offering a differentiated product that meets the needs of these consumers is greater than the premium they are willing to pay, then specific products tailored to the needs of the segment will not be produced. Hence the preferences of these consumers with respect to sustainability will not be fully satisfied.

A critical factor affecting the cost of differentiation when the quality of the final product is sensitive to the quality of the input will be the reliability and timeliness of the supply of input. Obtaining reliable and timely access to supplies of agricultural products that meet specific quality standards can be difficult, especially given the differences in the scale at which farms, processing and distribution firms operate (Dumaresq and Greene, 1997; Hassall and Associates, 1990). Often, the scale of a single processing firm may be several orders of magnitude larger than individual farms. According to their manufacturing manager, Uncle Toby's has ceased marketing Vita Brits® as organic partly because of the difficulty of consistently obtaining acceptable supplies of organic wheat (Pensini, pers. comm., 1997).

Lampkin (1990, p. 459) suggested that the premiums for organic fruit and vegetables reflected the higher costs to large-scale retailers of dealing in organic produce. The higher costs of organic produce relate to the relatively small volumes of product, the shorter shelf-life of much organic produce, and the unreliability of supply. In addition, much organic produce is of poor appearance and resembles rejected outgrades, being deformed and of small size (Hassall and Associates, 1990).

Historically, agribusiness companies have tended to rely on the aggregation of supply from many individual farms at auction markets to provide them with reasonably secure access to the volume of product they need (Kaine, 1990; Kaine, Tozer and Grace, 1994). Provided adequate supplies of an appropriate quality can be obtained at little risk through open market mechanisms such as auctions (or from 'single desk' sellers), there is little incentive for processors to enter into specific contractual arrangements with individual producers or groups of producers. However, such arrangements become more attractive the more sensitive the processor's product is to variations in the quality of a commodity input. The greater the need to ensure reliable access to input supplies which consistently meet specification standards, the greater the incentive for processors to secure supplies by vertically integrating, either by contract or by ownership (Porter, 1980).

The need to ensure access to supplies, coupled with differences in the scale of farming and processing operations, has a number of implications for the transmission of market signals (see Table 11, page 70). Assume that sustainability is defined, in terms of consumer purchase criteria, as the employment of a particular practice or technique in the production of an agricultural commodity. If the market segment for the resulting product is relatively small, and specialised farming systems are required to implement the practice,

Table 11: *Sustainability and segment size*

	Small segment	Large segment
Highly specialised techniques	Focus differentiation strategy. Limited adoption in agriculture. High premiums.	Focus differentiation strategy. Gradual adoption in agriculture. Premiums decline over time.
Less specialised techniques	Focus differentiation or broad differentiation strategy. Gradual to widespread adoption. Low premiums.	Broad differentiation strategy. Widespread adoption in agriculture. Low premiums.

then a focus differentiation strategy is feasible for a small group of specialist producers and for processors. In this case, consumers in the target segment must be prepared to pay a substantial premium. Note that the desired farming practice or technique will only be adopted by a relatively small group of specialist producers.

If the market segment for the product is relatively large but specialised farming systems are required to implement the practice then a focus differentiation strategy is still feasible for a small group of specialist producers and processors. In this case only consumers who are willing to pay the highest premiums will purchase the product in the short term. These high premiums are likely to encourage further development and modification of the relevant practice or technique, leading to broader adoption in the long term.

If the market segment for the product is relatively large and the practice can be easily integrated into most farming systems, then a broad-scale differentiation strategy is feasible for processors. In this case, consumers in the target segments may pay a substantial premium in the short term but expect to have to pay only a small premium in the longer term. There is the potential for rapid, widespread adoption of the desired farming practice or technique. If the market segment for the product is relatively small but the practice can be easily integrated into most farming systems, then processors following broad-scale differentiation strategies might service this segment, offering 'sustainability' as a bonus to other segments in the market. In this case, consumers in the target segments may expect to pay a minimal premium and there is the potential for rapid, widespread adoption of the desired farming practice or technique. Alternatively, a processor following a focus differentiation strategy might service the segment. This might occur if the consumers in the segment share a specialised need with one or two other small segments in the market. In this case, consumers in the target segments may pay a relatively small premium. The potential for widespread adoption of the desired farming practice or technique seems limited in this instance.

The transmission of consumers' preferences about sustainability will be strongly influenced by the degree to which such preferences are expressed in terms of specific practices and techniques. The more generalised consumers' concept of sustainability is, the greater the opportunity for processors to offer other, less costly environmentally friendly options to consumers in place of agricultural sustainability. For example, processors might satisfy consumers' desire to act in an environmentally friendly way by offering products in which only 'natural' food additives or colourings are used, or by switching from plastic to recycled paper packaging.

In summary, the transmission of consumers' preferences about sustainability depends on the profitability of servicing those preferences. Profitability will depend on the size of segments, differences in scale between farming and processing operations, the ease with which desirable practices and techniques can be integrated into existing farming operations, and how precisely preferences are defined. When segments are large enough for differentiation to be profitable, then market signals are transmitted between stages in the processing chain by means of the purchase criteria that are employed by firms.

5.4.2 Use and signalling criteria

Like consumers, firms select supplies on the basis of purchase criteria. Porter (1985) states that the criteria that govern a firm's choice of which product to buy as an input stem from the way in which inputs either lower costs or raise performance by enhancing the capacity for differentiation. There are two types of purchase criteria that firms use – use criteria and signalling criteria. Use

criteria are specific measures of what creates value for the buying firm (Porter, 1985, p. 142). They may include factors such as price, product features, delivery time and product reliability.

Signalling criteria are purchase criteria that stem from the means used by buyers to make inferences about the use value of a product. Signalling criteria are measures of how buyers perceive the presence of value (Porter, 1985, p. 142). They may include such factors as advertising, the attractiveness of facilities, and reputation. Signalling criteria are most important when a product is purchased infrequently or when it is difficult for buyers to directly assess product performance. For example, when the performance of the product is difficult to assess prior to purchase. Signalling criteria can be identified by understanding the process a buyer uses to form judgments about the potential of a firm, or its product, to meet use criteria (Porter, 1985, p. 147). In many ways, signalling criteria are like credence criteria. Both types of criteria represent claims made on behalf of a product or service by the supplier. In both cases, an important aspect of claim making is establishing credibility.

Use and signalling criteria are complementary. On one hand, buyers may undervalue a firm's product if that firm pays insufficient attention to signalling criteria. On the other hand, while attention to signalling can create an impression of value in the buyer's mind, in the long term a product will not sell if the product fails to perform adequately in terms of use criteria.

5.4.3 Transmission of consumer preferences

The degree to which consumer preferences are translated into specific preferences on the part of processors with regard to a commodity input depends on the extent to which the attributes of the retail product are influenced by the attributes of the commodity. In other words, the purchase criteria used by a firm when sourcing commodity supplies will more directly reflect the purchase criteria of consumers, the more direct the link between the attributes of the commodity input and the attributes of the retail product. If the quality or price of the commodity input has a major influence on the quality or price of the final product, then the processor will be sensitive to variations in the supply of the commodity and the more directly the processor's behaviour towards the commodity will reflect consumer preferences.

For example, if consumers are unable to detect, or are tolerant of, variations in the quality of fresh meat, then price may be much more important than meat quality in consumers' purchasing of meat. Consequently, in this instance, retail suppliers of fresh meat are likely to be much more sensitive to factors affecting costs, such as carcase size, than they are to factors affecting quality. Hence they are unlikely to pay premiums for higher quality carcases (see Mullen 1995). In contrast, consumers may be particularly sensitive to the visual quality of fresh vegetables. Hence suppliers of fresh vegetables may be much more willing to offer premiums for higher quality produce (and willing to pay extra for rapid and reliable shipment).

This leads to the proposition that commodity prices are more likely to create incentives promoting sustainability the more precisely consumer preferences regarding sustainability are defined in terms of the production of the commodities themselves. If the sustainability criteria used by consumers in a particular segment are defined in terms of the practices and techniques employed in the production of commodity inputs, then, by definition, the attributes of the final product depend on the attributes of the commodity input. This means that a firm wishing to supply a differentiated product that meets the requirements of consumers in such a segment must be willing to pay a premium to secure the necessary supplies of the commodity. For example, a consumer segment for a product might place great importance on products being 'chemical-free'. A firm supplying such a segment will seek to source input supplies from producers who use 'chemical-free' production methods. In short, because consumer preferences are clearly defined, the use of 'chemical-free' production methods is an important purchase criterion for the processor as well as the consumer.

A firm following a differentiation strategy will be particularly sensitive about correctly sourcing inputs when the quality of those inputs has a direct impact on the quality of the final product it produces. Firms, like consumers, will seek assurance that claims made by suppliers are true. Hence a firm purchasing inputs produced under 'chemical-free' conditions will require some verification from commodity suppliers that this is true. Hence, as was the case for consumers, verification and certification procedures become critical for firms. The strength of suppliers' claims will be enhanced if verification is undertaken by independent parties with certification authority. Note that certification may involve more than just the inspection and monitoring of farm enterprises. To correctly signal the potential value

the commodity produced by the farm enterprise offers to the processor, the farm manager may need to offer guarantees. Guarantees may be required in terms of quality, and the reliability and timeliness of supply.

In conclusion, the transmission of consumer preferences to producers depends on many factors. The profitability to processors and producers of meeting these preferences will depend on the size of consumer segments, differences in scale between farming and processing operations, and the ease with which desirable practices and techniques can be integrated into existing farming operations. The transmission of market signals will also depend on the extent to which consumer preferences about sustainability relate specifically to the commodity inputs used by processors.

5.5 Farmer behaviour

In the preceding discussion the ease with which desirable practices and techniques can be integrated into existing farming operations was mentioned as a factor influencing market signals. Farmers manage complex production systems which are complicated further by uncertainties relating to weather conditions, input costs and commodity prices. The introduction of apparently simple changes in practices or technology into such complex systems can have repercussions throughout the system.

The ease with which a new practice or technology can be introduced depends on whether the existing farming system already does or can easily incorporate the prerequisite practices and techniques that are required for the new practice to function successfully. See Kaine and Lees (1994) and Kaine, Lees and Sandall (1994) for detailed discussions of practice change in farming. The greater the dislocation involved in changing a practice or technique, the lower the likelihood that farmers will adopt the change. Hence sustainable practices that entail substantial changes to the existing farm system, such as shifting from conventional to certified 'organic' farming, will only be adopted on a limited scale even though premiums may be substantial.

A final point is that independence and self-reliance are attributes that many farmers value highly. Those farmers who do place a high value on these attributes may not welcome the idea of accreditation. Such farmers may find the need for on-site monitoring or annual farm inspections too intrusive, disruptive and annoying to contemplate.

5.6 Discussion

Typically, most agricultural products are low involvement purchases for consumers, although some clothing purchases are highly involving for consumers. This means, on the one hand, consumers are likely to be easily persuaded to switch to purchasing brands that are manufactured from commodities that have been produced using sustainable farming practices. On the other hand, low involvement also means that the premium most consumers are likely to be willing to pay for such brands is unlikely to be substantial. Further, these brands must be easily identifiable and widely available, otherwise most consumers will be unwilling to spend much time seeking them out.

Consumers' willingness to purchase, and pay premiums for, brands manufactured from commodities produced using sustainable farming methods may be increased if low involvement products can be linked to issues that are highly involving for consumers, such as their health, children's safety or animal welfare. Generally speaking, sustainability *per se* is not a highly involving issue for most consumers. Consumer interest in organic products, for example, is driven more by fear of chemical contaminants and allergies than by concern for the environmental effects of pesticides and weedicides (motivations that do not bode well for raising consumer enthusiasm about farming methods such as conservation tillage). Interestingly, Uncle Toby's has recently ceased marketing organic Vita Brits®, partly because market research has found that the marketplace for such cereal is largely driven by price and that the key product attribute for most consumers of Vita Brits® is that the cereal contains 'no added sugar'. Organic Vita Brits® were on the market for five years, but very few consumers were aware of, or understood, the organic nature of Vita Brits® (Pensini, pers. comm., 1997).

With respect to high involvement purchases, sustainability must either be an involving issue for consumers or linked to a highly involving issue in order for consumers to place a higher priority on sustainability than on other product features. Whereas price proximity needs to be maintained for low involvement purchases, feature comparability needs to be maintained with high involvement purchases. In other words, the performance of the brand manufactured from sustainably produced inputs must be compared with the performance of other brands. Consumers will be unwilling to switch brands if the performance of the alternative brand is below par on influential purchase criteria.

Another particularly important aspect of the market for many Australian agricultural commodities is that many consumers are overseas. If foreign consumers are concerned about the environment, they may be more likely to be concerned about the environment in their country rather than the environment in Australia. It may be particularly difficult to identify involving issues for these consumers that can be linked to the employment of sustainable farming practices in this country. Of course, the market segments for 'organic' food and fibre products in other countries may provide opportunities for the export of commodities which are differentiated through the use of sustainable farming practices (Lampkin, 1990, pp. 463–464). There have been enquiries from Japan and Western Europe regarding the supply of Australian organic wool (Hassall and Associates, 1996).

Determining which practices are sustainable and under what conditions poses particular difficulties. A practice may promote sustainability in one industry or locality, yet be inappropriate or counterproductive in another industry or locality. In other words, which practices or technologies are sustainable and which are not depends on the production context. This means that standards may be difficult to set, and claims to sustainability may be difficult to legitimise on the one hand, or difficult to refute on the other.

Consumers are likely to find it easier to understand and respond to manufacturers' claims to environmentally friendly practices (such as 'CFC-free' or 'phosphate-free'). Such practices are easily verified and universally acknowledged as contributing to sustainability. When faced with highly qualified or apparently conflicting claims as to what constitutes environmentally friendly in agriculture, consumers may seek alternative ways to express their concern for the environment. They may, for example, express their commitment to the environment by engaging in 'household recycling' or they may purchase products that manufacturers claim are environmentally friendly when this is possible. These types of behaviours would allow consumers to be environmentally friendly in some way, while avoiding the inconvenience of dealing with complex and confusing claims about sustainable agriculture.

Differences in the scale of farming enterprises, food or fibre processing enterprises and retail businesses create problems in transmitting the preferences of small consumer segments to agricultural producers (and vice versa). If the market segments for 'organic' food are small, major food chains will face substantial costs in attempting to service them. Small segments are only likely to reach an economical size in major urban concentrations. This means that food chains, or differentiated food stores specialising in organically produced food, are much more likely to occur in metropolitan areas. Furthermore, if the number of producers interested in producing organic produce is relatively small, and scattered, major chains and specialty stores are likely to experience problems securing reliable supplies. This adds further to the costs of supplying these small market segments. Because producers are scattered, and the consumer segment is small, specialist wholesale distributors of organic foods may not be viable.

Where farms are located near urban concentrations they may retail direct to the public provided they can ensure some continuity of supply. This could be achieved through favourable environmental conditions (eg. horticultural production on fertile coastal soils) or by processing and storing produce (eg. cheeses and other processed milk products). The opportunities for similar operations distant from population centres to operate profitably seems limited.

The final issue I would like to turn to is ecosystem coupling. Ideally, the volume of inputs agriculture draws from the environment and the volume of by-products delivered into the environment should be directly linked to changes in the supply of inputs, and the supply of assimilative capacity, generated by the environment. This direct link does not occur when the spread of a sustainable practice is governed by consumer preferences. There is no reason to expect consumer preferences to correlate well, at least in the short term, with changes in the regenerative and assimilative capacities of the environment.

5.7 Conclusion

Broadly speaking, most consumers do not find sustainability a highly involving issue. This means that most consumers' commitment to changing their purchasing behaviour to favour sustainability will be limited. Consumers will change their purchasing behaviour in favour of sustainability when either of two circumstances are present. First, consumers will change their purchasing behaviour if the employment of a particular environmentally friendly practice is linked to a strongly involving issue such as personal health or safety. Second, consumers will change their purchasing

behaviour when acting in an environmentally friendly fashion is relatively inexpensive and easy. In other words, when being environmentally friendly is packaged in a convenient, inexpensive fashion. This suggests that the scope for consumer preferences to create strong price incentives for producers to adopt sustainable practices is limited.

The scope for consumer preferences to create strong price incentives for producers to adopt sustainable practices is further limited by the difficulties involved in equating agricultural sustainability with a few easily identifiable practices and techniques. These difficulties are likely to be compounded by the tension between farmers' desire to preserve their autonomy and independence and the need for monitoring and verification by third parties required for reputable accreditation.

There may be some role for governments in facilitating the development of accreditation schemes. Governments are in a position to create organisations with the authority and power to independently establish standards and manage accreditation. Whether governments should create such organisations depends on the degree to which voluntary accreditation schemes are not regarded as credible by consumers. In regards to the organic industry, a symposium in mid-1996 created an interim organic industry council whose express task is to establish a peak industry body and provide a foundation for unification for the Australian organic agriculture industry. An industry workshop was held in mid-June 1997 at which the organic farming industry agreed to form an industry federation, and work to achieve the formation of the federation is ongoing (RIRDC, 1997a; 1997b).

The potential, then, for commodity prices to provide incentives to farmers to adopt sustainable farming practices appears limited. This is especially so considering that foreign markets are the major buyers of many of our agricultural commodities. This does not mean that there is some form of market 'failure' and that governments need intervene in commodity markets. It does mean that there may be an important role for government in redefining rights to environmental resources and assimilative capacities. By redefining rights, the environmental effects of production can become costs directly borne by the producer and passed on to consumers. If rights to ecosystem resources are redefined so that access varies in accord with changes in the productive and assimilative capacities of the environment over time, agricultural production may be placed on a more sustainable footing without necessarily prescribing which farming practices are sustainable and which are not. The resulting flexibility in technology choice and resource allocation is generally accepted, at least among economists, as resulting in more efficient outcomes in the longer term.

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Market Signals and Sustainability: Checklist

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Introduction

The following list of questions is intended to encourage consideration of the issues raised in the accompanying paper. They provide an indication of the issues that need to be covered when assessing the potential for market signals to create incentives for producers to adopt sustainable production methods.

1. Ecosystem coupling

How closely is the production of the commodity coupled to the ecosystem? Does the production system respond quickly to dynamic changes in the capacity of the ecosystem to deliver inputs or absorb by-products?

2. High or low involvement

Are the products manufactured from the commodity high or low involvement purchases for consumers? Are the products inexpensive and purchased routinely? Are the products expensive, purchased infrequently or important in defining personal identity?

3. Linkages to involving issues

For low involvement products, does the move to sustainability (eg. change in practice) entail a substantial premium for the move to be profitable? If so, can the change in the production system be linked to an involving issue for consumers? For instance, does the change involve less reliance on chemicals and can this be linked to consumer concerns about product safety?

For high involvement products, does the move to sustainability (eg. change in practice) entail a substantial premium for the move to be profitable? Does the move to sustainability entail a reduction in product performance for an attribute that is highly valued by consumers? If so, can the change in the production system be linked to an involving issue for consumers so that the increase in cost or reduction in performance is outweighed by other concerns? For example, does the change involve a reduction in animal testing and can this be linked to consumer concerns about animal welfare?

4. Specific practice or technique

Is the change in production method a particular practice or technique? Is it legitimate to claim that this practice or technique contributes to sustainability or is environmentally friendly? Does this claim apply universally or only for a subset of the industries or regions that might use it? In other words, is it always the case that existing techniques or practices are less sustainable than the technique or practice being promoted?

5. Verification and certification

Do procedures exist for certifying that producers are using the recommended practice or technique? Is failure to use the technique or practice detectable through monitoring of commodity or product during processing and are there adequate trace-back procedures? Are property inspections required and, if so, on what time frame?

6. Adoption and scale differences

Is the sustainable practice or technology easy to integrate into existing farming systems? If it is, is the market segment that is concerned about sustainability (or the relevant involving issue) large? If the practice or technology is not easily integrated into existing farming systems, are the potential adopters highly scattered geographically or are they likely to be concentrated in specific regions? Is the market segment of interest large? Are members of the segment geographically concentrated or scattered? Are potential adopters scattered but distributed around urban populations?

7. Market structure

What proportion of the market for the products made from the agricultural commodity consists of institutional buyers, government buyers or foreign buyers? How concerned about sustainability are each of these types of buyers? Are there involving issues for these buyers that can be linked to the use of the sustainable practice? What options are available to processors for improving the environmental image of their products by changing their practices or technologies?

1. Ecosystem coupling

	Organic cereals	Organic cotton
How closely is the production of the commodity coupled to the ecosystem?	Unknown	Unknown
Does the production system respond quickly to dynamic changes in the capacity of the ecosystem to deliver inputs or absorb by-products?	Unknown	Unknown

2. High or low involvement

	Organic cereals	Organic cotton
Are the products manufactured from the commodity high or low involvement purchases for consumers?	High involvement for small segment (for those with allergies or sensitivity to artificial chemicals), low involvement for most segments	High involvement for small segment (for those with allergies or sensitivity to artificial chemicals), low involvement for most segments
Are the products inexpensive and purchased routinely?	Yes	Yes
Are the products expensive, purchased infrequently or important in defining personal identity?	No	Depends on clothing item, but usually no

3. Linkages to involving issues

	Organic cereals	Organic cotton
Is a substantial premium required for adoption to be profitable?	Yes	Yes
Is it legitimate to link this practice to an involving issue for consumers?	Yes, for small segment (reduced use of chemicals and food safety)	Possibly, for small segment (reduced use of chemicals less damaging to environment)

4. Specific practice or technique

	Organic cereals	Organic cotton
Is the change in production method a particular practice or technique?	Yes	Yes
Is it legitimate to claim that this practice or technique contributes to sustainability or is environmentally friendly?	Yes	Yes
Does this claim apply universally or only for a subset of the industries or regions that might use it? In other words, is it always the case that existing techniques or practices are less sustainable than the technique or practice being promoted?	Unknown	Unknown

5. Verification and certification

	Organic cereals	Organic cotton
Do procedures exist for certifying that producers are using the recommended practice or technique?	Yes	Yes
Is failure to use the technique or practice detectable through monitoring of commodity or product during processing and are there adequate trace-back procedures?	Detectable and traceable, NASAA has standards for both growers and processors with labelling procedures.	Detectable and traceable, NASAA has standards for both growers and processors with labelling procedures.
Are property inspections required and, if so, on what time frame?	Yes, annually	Yes, annually

6. Adoption and scale differences

	Organic cereals	Organic cotton
Is the sustainable practice or technology easy to integrate into existing farming systems?	No, organic certification requires at least three years of artificial chemical-free operation before certification is granted	No, organic certification requires at least three years of artificial chemical-free operation before certification is granted
If it is, is the market segment that is concerned about sustainability (or the relevant involving issue) large?	–	–
If the practice or technology is not easily integrated into existing farming systems, are the potential adopters highly scattered geographically or are they likely to be concentrated in specific regions?	Scattered	Regional (northern New South Wales and Queensland)
Is the market segment of interest large?	No	No
Are members of the segment geographically concentrated or scattered?	Scattered	Scattered
Are potential adopters scattered but distributed around urban populations?	Yes	Yes

7. Market structure

	Organic cereals	Organic cotton
What proportion of the market for the products made from the agricultural commodity consists of institutional buyers, government buyers or foreign buyers?	High proportion of buyers are government buyers	
How concerned about sustainability are each of these types of buyers?	Generally low	Generally low
Are there involving issues for these buyers that can be linked to the use of the sustainable practice?	Maybe (eg. chemical residues)	None apparent
What options are available to processors for improving the environmental image of their products by changing their practices or technologies?	Probably some (eg. recycled packaging materials)	None apparent

8. Conclusion

The potential for market signals to create incentives for producers to adopt organic cereal and cotton farming methods appears quite limited. On the one hand, the methods involve specific techniques which are recognised by many as more sustainable than conventional farming. Also, monitoring procedures are operating. On the other hand, the products made from cotton and cereals, in particular, are low involvement consumer products. Also, adoption is not simple (eg. different management skills must be learned), takes time (eg. for NASAA certification, organic farming standards must be adhered to for three years before licensing as organic is approved) and may require a substantial premium to be profitable or equivalent to 'conventional' profit levels. There are market segments willing to pay substantial premiums for organic cereal and cotton products. These consumers are concerned about issues such as food safety or the environment generally. However, these consumers represent small segments in the market. Hence the potential for prices for consumer products to act as incentives promoting organic cereal and cotton production is limited.