

Food For Thought: Biodiversity management on farms - links to demand-driven value chains

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Traditionally agricultural production in western countries has been driven by commodity markets, where farmers are price-takers, dependent on market demands. Agricultural intensification combined with the globalisation of markets and declining terms of trade for many farmers have all impacted on farm land management decisions, which in turn had impacts on biodiversity. Globally the production of food and fibre has had detrimental impacts on the environment. Native vegetation clearance and the intensification of agricultural land management in Australia have adversely affected native biodiversity. The pressure on farmers to produce low-cost commodities has a biodiversity cost, one that is driven ultimately by internal and external factors, including consumer demands. This paper discusses the known and potential impacts of food and fibre production on biodiversity, and the consequences of consumer demand for quality, low cost produce.

Introduction

The development of agriculture has been a significant factor in deterioration of Australia's biodiversity and continued degradation of the landscape (Beeton *et al.* 2006). This outcome has received greater attention in recent decades as western consumers have become more environmentally aware (Hartman and Wright 1999, Toyne *et al.* 2004) and Australian farmers have become increasingly concerned about salinity (van Bueren and Price 2004) and soil erosion (Conacher and Conacher 2000). These concerns prompted the formation of farmer-centric environmental programs funded by the Australian Government through groups such as Landcare (Campbell 1994), the Natural Heritage Trust (Bardsley *et al.* 2002) and alliances with agricultural research and development corporations (RDCs) (Price 2009).

Consumers have contributed to change in environmental land management directly through political pressure and indirectly through taxation (Beeton *et al.* 2006). However, we propose that many Australian consumers have limited understanding of their influence on biodiversity outcomes as a result of their demand for food and fibre. This is reflected in commonly perceived images of 'biodiversity' (see discussion below). In this article we will provide an overview of links between consumer demands, land management practices and biodiversity outcomes at paddock, farm and landscape scales. We will:

- a) Define biodiversity and provide examples of biodiversity in agricultural landscapes;
- b) Provide an overview of the external drivers

affecting farm management decisions;

- c) Discuss how a combination of market forces including consumer behaviour and farm management decisions impact on biodiversity; and,
- d) Discuss alternative approaches that may enhance biodiversity management on farms.

Defining biodiversity

Biodiversity has been defined as 'the variety of life, its composition, structure and function at a range of scales' (Freudenberger and Harvey 2003). Personal definitions of biodiversity are value-laden and are strongly correlated with contextual/cultural values (Dettman *et al.* 2000, Williams and Cary 2001). Popular images of biodiversity include natural or semi-natural systems such as rainforests or coral reefs, images that dominate the media (Dettman *et al.* 2000). Less common are images of soil micro-organisms or the abundance of beetles in a pasture. Terrestrial biodiversity in an Australian farming context is commonly represented by woody vegetation and birds (Williams and Cary 2001, Bridle & Price 2009).

In the European Union (EU), environmental policies reflect the multifunctionality of agricultural landscapes for production, biodiversity conservation and aesthetic values (Bennett *et al.* 2004). By contrast, Australian policy makers have generally focused on a subset of the agricultural landscape, patches of native vegetation, for on-farm biodiversity conservation actions (Dettman *et al.* 2000). However, as is the case in Europe, native biodiversity can be found across all land use types commonly associated with farming, and at a range of scales, from paddock to landscape/catchment scale

Examples of Biodiversity within Agricultural Landscapes – Paddock and Farm Scale

Every day land management decisions impact on biodiversity. However, these impacts may not be immediately apparent. For example, recent RDC initiatives focusing on soil health, have promoted shifts in crop preparation techniques from conventional tillage to minimum tillage to enhance the retention of soil carbon. A biodiversity benefit of minimum tillage is an increase in soil faunal activity and diversity (Longstaff *et al.* 1999), which is likely to contribute to a further increase in production.

RDCs have funded extensive research on grazing management in Australian native and sown pastures with an aim to influence production and environmental outcomes. The traditional approach of continuous grazing has been shown to be detrimental to long-term pasture management and to livestock production (Lodge *et al.* 2003). At a landscape scale, Leonard and Kirkpatrick (2004) demonstrated that resting native pastures at different times of the year results in different species mixes within the pastures. Periodic resting of pastures at critical times (during flowering and seed set) may increase the perenniality of the pasture base, while overgrazing results in a decrease in vegetation cover and increased soil erosion (Greenwood and McKenzie, 2001).

Vegetation structure and pasture inputs influence invertebrate populations which may have beneficial effects on agricultural production. The re-introduction of native grass tussocks to provide habitat for predatory invertebrates was an important outcome of an integrated pest management (IPM) project in Victoria, where farmers aimed to reduce reliance on costly pesticides by utilising the naturally occurring predators to prey on crop and pasture pests (Nicholson 2008).

Landscape effects on biodiversity – the farming context

Approaches to biodiversity conservation on Australian farms generally follow the pattern of retain, repair, recreate. Many programs have targeted the fencing of 'remnant' vegetation on farms as a means of retaining local biodiversity, using a combination of stewardship payments and the prospect of production gains (shelter for stock, clean water) to facilitate participation. This focus on protecting remnant native vegetation patches retains existing ecological assets and is likely to promote the greatest (native) diversity for the farm (Bridle *et al.* 2009).

The proportion of cropping to pasture to native vegetation, and the size, shape and connectivity of native vegetation patches may impact significantly on the abundance and composition of many taxa (Weibull

et al. 2003, Cole *et al.* 2005, Wretenberg *et al.* 2010). Australian ecologists have proposed thresholds for the retention of native vegetation to maintain native populations. McIntyre *et al.* (2000) proposed that no more than 30% of the SE Queensland grassy woodland landscape should be under intensive agriculture (cropping and sown pastures), while at least 30% should be under native woody vegetation cover. Similarly, Radford *et al.* (2005) recommended the retention of at least 10% native vegetation in the landscape to maintain bird species diversity.

In highly fragmented environments, the addition of woody species provides habitat for mobile species such as birds and bats (Law and Chidel 2006) as well as production benefits. Oil mallee plantations in the Western Australian wheat-belt have been shown to provide habitat for birds (Smith 2009) and small mammals (Short *et al.* 2009), while saltbush plantings have been used extensively in southern Australia to reclaim production value in saline lands. The 'win-win' benefits of saltbush plantings include the provision of alternative fodder sources for livestock and diversification of habitat for native fauna (Seddon *et al.* 2009).

External drivers affecting farm management decisions

Farming is a socio-cultural practice (Vanclay 2004) that is increasingly subject to the influence of events and attitudes in Australian society. While many farmers express a desire to maintain the natural resource base that they rely on to make a living (see Table 1-page 33), their farm management decisions are also influenced by their exposure to external factors, and their perception of what is a public or a private good. For example Dickinson (2008) decided to log an area of native forest of low conservation value (considered to be of little public benefit) on his property. He reasoned that the transformation from native forest to plantation timber provided wider private and public benefits such as riparian fencing and enhanced water quality, in addition to greater economic returns on farm.

Farming – Interactions with sustainable practices

Foskey (2005) identified four aspects of farm life that interact to influence decision making - farm work as a central component of identity, the farm as home, the psychological attachment to the farm as a valued place, and the farm as a business and source of income.

Over the past 60 years, increased mechanisation, a reliance on chemicals to promote growth and control pests and diseases, and rapidly evolving techniques for genetically modifying plants have all become features of the conventional agricultural landscape in western countries. There are also continuing trends towards

State	Population	Sample	Degradation key concern	No money to address degradation	Farm for long term productivity	Would leave industry	Major risk to change the way I farm
	(farms)	(farms)	(%)	(%)	(%)	(%)	(%)
Australia	35990	604	60	24	82	14	27
NSW	9332	136	58	18	92	14	34
QLD	4779	83	49	33	81	14	31
SA	3128	89	60	32	90	6	27
TAS	1705	85	50	32	84	21	39
VIC	15011	152	61	21	75	15	22
WA	2035	59	83	33	76	11	20

Table 1 Land degradation statistics across the high rainfall zone for broad acre and dairy farms. Source ABARE Resource Management Survey Database 2001-2002 <http://www.abare.gov.au/ame/lrm2/lrmalt.asp>, accessed 21/01/10

large-scale enterprises, lower margins and reduced labour inputs to increase financial efficiency (Productivity Commission 2005). However, whilst there is an association between scale and profitability, most farm operations are still relatively small and have low gross incomes (Australian Bureau of Statistics 2007). Fenton *et al.* (2000) and Cary *et al.* (2001) concluded that the implementation of sustainable practices was influenced by gross farm income, debt levels, farm diversification, farm size and farm ownership. Beal (1997) directly linked the general decline in the agricultural terms of trade since the 1950s, reduced producer margins and lower net income to the degradation of the land resource base, as farmers sought to maintain minimum net incomes and standards of living. Ultimately, the homogenisation of landscapes that generally accompanied these financial trends has had significant effects on biodiversity.

Rise of consumer and investor power

The globalisation of agricultural and food markets and the liberalisation of world trade is creating a new competitive environment for primary producers, food manufacturers and retailers (Kotzab *et al.* 2009). The supplier dominance of the past has given way to retail control of the agri-food value chain and subsequent influence on consumer choice. In place of simply supplying produce and competition based on price, supermarkets are now working on the development of product value (including non-utilitarian values such as ecologically and socially responsible production) for which consumers will ideally pay a premium (Wright and Lund 2003, Feller *et al.* 2006). The creation of this value is innovation-driven and often requires substantial resources and collaboration to succeed (Bonney *et al.* 2007, Gulati *et al.* 2005). This approach aims to translate consumer demand for premium value attributes into higher prices that may be transferred through the chain to the producer of the raw materials (Smith 2006). However, despite expressed intentions to support non-utilitarian values, consumers are largely price-oriented in their actual behaviour, i.e. these values have yet to translate into a premium price for farmers.

Concentration of retail power

Global hyper-competition on price, low margins on agri-food products and the removal of restraints on trade have contributed to the development of large, multi-national retailers. Australia is now the most concentrated market in the world with two major supermarkets having, in broad terms, about 55-60% of the total agri-food market, although individual categories may be much higher. This market is price-focused whilst still demanding broad extrinsic and intrinsic value attributes (Australian Competition and Consumer Commission 2008, Spencer 2004).

Unprecedented power is placed in the hands of a few, often multinational companies. Their capacity to exert that power, and their access to time, resources and expertise, far exceeds that of individual farmers, farmer cooperatives or even the agri-political associations that represent them. This power can either be expressed for the benefit of everyone in the chain, including the consumer, or for self-interest (Cox 2001; Tallontire and Vorley 2005). Ultimately, however, these companies will only prosper by delivering the value that consumers demand (Stephens 2006). Retailers (and the value chains that supply them) will only have the capacity and the reason to focus on the product attributes that positively impact on biodiversity if consumers are willing to pay for them.

Commodity production vs. innovation – potential impacts on biodiversity

The majority of farmers produce undifferentiated commodities for large national or global markets. This has significant implications for both the farm business and biodiversity. The production of commodities is a choice to compete on price and to commit to innovation that achieves scale and efficiency (Albers *et al.* 2003). Farmers are then 'price-takers' because their products are no different from similar products produced anywhere else: the competition is a race to be the least-cost competitor (Clay *et al.* 2005). In this case business strategies aim to achieve scale and efficiency

which frequently leads to large-scale production, mechanisation, monocultures and intensified use of the landscape.

This reduction in crop diversity and increased intensification has resulted in an overall reduction in biodiversity, particularly at the farm and paddock scale. In both Europe and Australia, increased agricultural intensification has been linked to a decline in bird species richness (Donald *et al.* 2006, Bridle *et al.* 2009), while increased nutrient inputs across crops and pastures has been linked to a decline in plant species richness (Dorrough and Scroggie 2008, Kleijn *et al.* 2009). However, at a farm scale, intensification of part of the farm may result in a biodiversity gain through the process of setting-aside unproductive areas for conservation purposes (Wretenberg *et al.* 2010). This potential gain would depend on the landscape context, the degree of fragmentation and management of native vegetation on and surrounding the farm (Radford and Bennett 2007).

The alternative to commodity production is to find new business models based on innovation to provide product differentiation and a more sustainable form of competitive advantage. If primary producers choose to move into innovative, high value, niche markets then they need new, flexible business models, new ways of working and a new set of skills (Fisher 1997). That choice also has significant implications for the sustainability of the farming business and the approach to managing biodiversity.

Barriers to innovation

Many farmers admit that it is difficult to change practices on farm to deal with environmental degradation. For example, they may not have the financial resources to address environmental problems (Table 1). Social networks, media and access to agricultural extension staff provide much of the background knowledge farmers use to make decisions (Pannell *et al.* 2006, Vanclay 2004). The process of choosing to maintain the status quo or to change is complex and is influenced by factors such as farmers' age, education, role models, societal ageism, independent attitudes, commodity and land prices, and personal economic circumstances Foskey (2005).

The increase in global sourcing by supermarkets may constitute a threat to Australia's long-term food security (Foskey 2005). Imports in the food, grocery and beverage sector have increased 40% in the last five years (Australian Food and Grocery Council, KPMG 2009) almost negating the very significant food export performance (38% of manufacturing and 11% of all exports), and potentially outsourcing environmental degradation. This increase in imports reinforces the pressures on farmers to compete in global markets

with unknown consequences for land management and biodiversity. However, it also provides farmers with opportunities re-assess their approach to farming, and choices about how to create value to achieve a more sustainable competitive advantage and exercise stewardship of the land for the future (Merrilees and Miller 2001).

Value-adding - trialing innovative approaches: Responses from consumers

Local food movement

Increasing competition in international markets has led local producers to call for country-of-origin labeling on produce so that consumers can make an informed choice to support local farmers. In 2005, the Tasmanian 'Fair Dinkum' food campaign called for label of origin on all processed vegetables. Farmers argued that label of origin would allow consumers to choose between supporting Australian produce and buying imported goods.

In response, an advisor to the Tasmanian State Government at the time noted that when he:

...looked at the vegetable-growing industry in Tasmania in 1995, one of the most obvious problems it needed to address immediately was that farms were small and therefore economies of scale could not be sustained. Today this issue remains largely untouched. Where it takes 450 Tasmanian farms to produce 80,000 tonnes of potatoes, 13 New Zealand farms can produce the same amount.' (Greg Barns reported in *The Age*, July 19th 2005).

The efficiency of New Zealand farmers may be related to lower input costs (irrigation), paddock and farm size and organisation of the farm business (corporate versus family farms). It is not known what the environmental or biodiversity impact of off-shore investment in agricultural production would be, and importantly, do consumers care?

Many farmers believe that the issue of Australian or regional provenance will confer premium prices on their commodities. However, the issue is not well understood (Fearne *et al.* 2008) and is one that is difficult to research because of the differences between stated consumer intention and their actual purchasing behaviour. Food is a low engagement purchase (except for gourmet lines and wine). Generally, most consumers would prefer to buy Australian or local products but they are not willing to pay a premium. They recognise that we live in a global market but there is little understanding of Australia's lack of competitiveness in that arena.

Niche markets

Selling direct to the consumer

The growth of farmer's markets in the UK (Dixon 2007) and Australia (Lyons 2007) has created a niche market for local producers, selling to informed consumers. The growth of such markets is in its infancy in Australia and includes local initiatives such as brochures advertising regional farm gate sales (e.g. Fruit Growers Tasmania Inc. 2009). These markets provide a direct communication link between producer and consumer that is generally lacking in the traditional supply chain model. The long-term success of producer to consumer sales will rely on this communication link, and the ability of farmers to respond to the consumers' needs. However, positive biodiversity outcomes are not guaranteed, but may be more likely if 'sustainability' attributes are explicitly used in marketing and producers have a commitment to product integrity.

Farmers' markets, organic produce and direct farm-to-consumer/retailer marketing or internet sales are unlikely to pose a major threat to conventional food retailing, though organic lines are now more prevalent in supermarkets (Lockie *et al.* 2002).

Selling the environment

An initiative to provide a point of sale difference for 'clean, green' wool produced on environmentally sustainable farms has been implemented in Tasmania. A collaborative effort involving research ecologists, industry groups, research and development corporations, state government employees and interested farmers developed a system by which wool could be accredited by an independent auditor and marketed as environmentally sustainable (Kirkpatrick *et al.* 2007). Whether this accreditation system produces a price premium for wool producers depends on enduring consumer support.

Buying the environment - increasing stewardship payments for biodiversity

Consumers contribute to biodiversity on farms indirectly through taxation, a small proportion of which is spent on land stewardship payments. Such payments are common in both the EU and the US, and are increasing in Australia (Hajkowicz 2009). Australian models focus on components of the landscape (traditionally native vegetation) while the EU model focuses on landscapes and ecosystem services. For example the retention of grassy field margins and hedgerows are a feature of stewardship payments in the UK (Natural England 2010) providing habitat heterogeneity across the agricultural landscape.

Very little attention has been given to farming landscape design in Australia, particularly the manipulation of paddock boundaries for biodiversity gains (e.g. IPM Nicolson 2008). In Australia a subset of ecosystem services deemed 'duty of care' is seen to be the responsibility of the land manager, covering issues such as the prevention of soil erosion, weeds and water quality. Recently, calls have been made for Australian policy to address multifunctional landscapes rather than focusing on the location and connectivity of native vegetation patches (Maron and Fitzsimons 2007, Attwood *et al.* 2009). Adopting a broader ecological services approach may be justified in highly fragmented landscapes, particularly if production and biodiversity benefits are demonstrated (Seddon *et al.* 2009).

The Caring for Our Country Initiative has begun to address broadscale environmental stewardship issues such as soil erosion (Commonwealth of Australia 2010). However, it is likely that biodiversity conservation agreements will remain focused on native ecosystems, particularly threatened species and communities.

Summary

Stewardship payments by government are likely to be the most successful mechanism in delivering change to farming practices in the near future. However a broad-based change in consumer behaviour is also required, using all components of the value chain to develop markets that recognise and reward sustainable agricultural practices.

Large corporations dominate the marketplace, with many producers focusing on efficiency as a means to stay in business. Intensification of agricultural landscapes occurs at a cost to biodiversity. To date, ecosystem services and biodiversity assets are not easily valued or costed in the market place, and products that are 'biodiversity friendly' are few and usually relate to a particular species, e.g. 'dolphin-friendly' tuna.

Alternative strategies that value-add to products rely on information exchanges between producers and consumers, and support given to the public good services provided by producers. Consumers subsidise agriculture through environmental stewardship payments. The Australian government spent \$10.3 billion during 2001-2005 on environmental problems (Beeton *et al.* 2006). The environment subsidises production with markets accepting or ignoring land degradation and biodiversity loss as a component of production. The concept of a multi-functioning landscape is common in Europe and includes stewardship payments to maintain the social, cultural and aesthetic components of our rural landscapes in addition to delivering environmental outcomes (Meerburg *et al.* 2009).

We can encourage or challenge farmers to deliver environmental and biodiversity gains on farms, but we must first understand and acknowledge our own role as consumers in creating environmental problems. We need to challenge current models to avoid a band-aid approach to conserving our environment. Do consumers want to be pro-active or remain reactive? Are we ready to take some responsibility for the impact of our demands on the land?

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