

The past and future of agriculture: resolving environmental conflict

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Summary. Australia's most serious environmental problems are largely the consequence of inappropriate agricultural activities. The clearing and fragmentation of native vegetation, the introduction of exotic species, and the mis-use of agricultural chemicals and fertilisers have been major factors in the degradation of terrestrial and aquatic ecosystems and the decline in continental biodiversity. Australian farmers and graziers will need to lead the rest of the nation in the development of environmentally sustainable practices. There should be an immediate end to the clearing of native vegetation and a significant reduction in the use of agricultural chemicals and fertilisers. Any reductions in agricultural production that may eventuate will need to be supported and accepted by all Australians. In the longer term, the restoration of degraded landscapes will ensure agricultural productivity, a viable society and environmental quality.

Introduction

The environmental dilemma that confronts the world is a consequence of the development of agriculture some 10,000 years ago (6). The advent of agriculture not only increased available food supplies, but it produced food that could be both stored and transported. Not only did this encourage the growth of the human population, but it enabled people to come together and form cities. Freed of the need to feed themselves, city dwellers developed the science and technology we associate with modern civilisation. The mis-use of technology coupled with the growth of the human population now threatens global life-support systems.

Twice in the 3.5 billion years of life on Earth, organisms evolved with the potential to change the chemistry of the oceans of air and water that envelop the planet and within which life exists. The first time was when photosynthesis evolved and an oxygen-based life system became possible. The second time dates to the development of modern industry in the 19th century when humans began the massive exploitation of fossil fuels that has resulted in an explosion of the world's population, the thinning of the ozone layer, global deforestation, degradation of the land and sea, and threatens rapid global warming through the greenhouse effect (22,6).

It may be unfair to burden agriculture with the sole responsibility for the destruction of global life support systems. Farmers and graziers are not personally responsible for the development of modern technology or the way that much of it has been used. They have only provided the food. In providing that food, however, agriculture has been responsible for virtually all of the clearing, fragmentation and degradation of native vegetation that threatens global biodiversity with mass extinction (17,20,23). The degradation of soil ecosystems through cultivation and grazing and the mis-use of agricultural chemicals and fertilisers threaten not only the capacity of terrestrial environments to sustain life, but are the primary causes of the degradation of freshwater, estuarine and marine ecosystems.

The conflict between agriculture, as it is currently practised, and ecological sustainability will increasingly dominate political and environmental debate in Australia during the 1990s. Australia's infertile soils and erratic rainfall has made the continent especially sensitive to the impact of Europeans and their agriculture. The capacity of Australia to sustain an expanding human population at a high standard of living and simultaneously maintain environmental quality is open to question. On past performance, the answer is no, it cannot.

In this paper, I briefly review the impact of Australian agriculture on the Australian environment. It is not a pretty story nor one that any person could be proud of. Nonetheless, it is not hopeless and action has already begun to correct past errors. My emphasis, however, is on what needs to be done and how the

community might work together to achieve a sustainable future. Community involvement is the only practical solution to Australia's environmental dilemma (19).

State of the Australian environment

No continent has been as significantly modified by Europeans in as short a time as Australia (1,12,13). This may be surprising given the prevailing view of Australia as a remote and underpopulated continent with vast unused resources. The extinction of species, the loss of biodiversity and the degradation of terrestrial and aquatic ecosystems throughout Australia are primarily the result of agriculture (11,10,14,13,17,19). The effects of forestry, mining and urbanisation are minor by comparison.

Loss of biodiversity

Nearly 300 species or 18% of Australian native terrestrial and freshwater mammals, birds, reptiles and frogs are considered endangered, threatened, vulnerable or rare (9,8,12,14). Sixteen of 79 species of endemic freshwater fish species are also at risk (8). Seventeen mammals, three birds and one lizard are known to have become extinct as a result of European activities since 1788. The extinction rate for mammals is the highest for any continent within historic times. Of the surviving species of mammals, 29 are endangered and 16 are vulnerable (8).

Probably less than 5% of Australian vegetation has been unaffected by European settlement (3). Clearing for agriculture, forestry, grazing by introduced herbivores, changed fire regimes and the spread of exotic plants has meant that little of the continent remains in a pre-European condition. Half of the forests and more than 60% of woodlands have been cleared or are severely degraded (2,16). Much of what remains is fragmented and invaded by exotic weeds. Of more than 22,000 species of native plants, 100 are presumed extinct (4). Another 200 species are endangered, 800 are considered vulnerable, 1,400 are rare and 900 are threatened (4). Over 2,000 species have been naturalised, some with significant consequences for the native vegetation.

Degradation of land and water

It is important to understand that land and water form a single system, an ecosystem. The way we treat and use the land affects the water that drains from it and the streams and rivers in which it flows to the sea.

Examples are of the scale of impact of agriculture on the Australian environment are virtually limitless. More than 50% of Australia's Agricultural and pastoral areas are considered degraded requiring remedial work to restore productivity (2). By one estimate, 72% of New South Wales has been adversely affected by erosion, salinisation, woody weed invasion or a combination of these (15). On a local level, 13% of the agricultural area in the Shire of Tammin in the wheatbelt of Western Australia is affected by salt brought to the surface by a rising water table as a result of the clearing of native vegetation. In the central and northern wheatbelt 90 to 95% of the original vegetation has been cleared and an estimated 25,000 ha of arable land is lost annually to rising salt levels (18,19). The impact on aquatic environments has been no less serious or extensive.

The largest river system on the continent, the Murray-Darling, is salt affected and carries a heavy load of silt from extensive erosion throughout the catchment (2). Even in Western Australia where the population density is much lower than in the eastern states, rivers are affected by saline water draining from agricultural areas and estuaries are being sterilised by nutrients applied to crops and pastures (7).

Increased turbidity and unacceptable colour affects inland waters in southern Queensland, New South Wales and western Victoria (2,5). Associated with increased turbidity and colouration are high nutrient levels which stimulate algal growth and contribute to turbidity and colouration problems and affect the taste of the water. During low water flows, as occurred with the Darling River in 1991, the growth of blue-green algae (Cyanobacteria) may cause the water to become toxic leading to the death of domestic stock

and wildlife and making entire river systems unfit for use by people. Nutrients are also a problem in the south-west.

Contamination by agricultural pesticides is generally considered a local problem, but the presence of pesticides in fish caught off the Australian coast show that the impact is far from localised. High levels of agricultural pesticides have forced the closure of small estuaries near Coffs Harbour in northern New South Wales.

For the remainder of the 20th century, problems with salinity, turbidity, nutrients, algal blooms, colouration and taste are expected to worsen (2). Groundwater will also become saltier and levels of nitrates from fertilisers and from legume agriculture that is promoted by the use of superphosphate will increase.

Resolving environmental conflict

If Australia wants to conserve and manage its land and water resources so that a healthy environment is restored for future generations, there must be a fundamental change in the way land and water are used. A continuation of current land-use practices by Australia's farmers and pastoralists must inevitably result in the extinction (or virtual extinction) of a large part of the continent's native biota. The degradation of aquatic and terrestrial environments with the associated loss of biodiversity not only demeans the quality of life that Australians enjoy, but they threaten the ecological processes and functions of the soil and water ecosystems that sustain agricultural production. At stake is the capacity of the nation to feed itself.

Poor land management

Increased salinity, turbidity and nutrients result from poor land management. Clearing of the native vegetation has allowed water tables to rise bringing salt to the surface where it affects both the soil and the water draining from the land. Irrigation concentrates salt, agricultural chemicals and fertilisers through evaporation. Land clearing, cropping and over-grazing inevitably lead to erosion. Soil washed or carried by the air into rivers, dams and estuaries increases turbidity, decreases productivity and carries with it nutrients and chemicals from the land. Even in the absence of erosion, fertilisers applied to crops and pastures ultimately find their way into streams and rivers and from there to the ocean.

Dams, irrigation systems and flood mitigation programs change stream flow, alter the pattern of flooding and reduce the amount of fresh water entering estuaries. As many of Australia's native fish require access to the sea or a particular pattern of flooding to spawn, their survival is threatened by these changes.

What needs to be done?

Increasingly there is recognition within the farming community of the impact of agriculture on the environment, the long-term social and economic consequences of these impacts, and of the responsibility of the agricultural community in resolving these problems and restoring the environment. This is evident by the actions of individuals in restoring native vegetation, promoting wildlife conservation, and seeking assistance from scientists and environmentalists in achieving their goals. It is also evident by the willingness of national organisations, such as the National Farmers Federation, to work with the Australian Conservation Foundation and other environmental groups to promote national programs to conserve and restore native vegetation, as well as soil and water ecosystems. Although these are important initiatives, and at a local level are often highly successful, much more *is* required.

The clearing and fragmentation of native vegetation should be stopped and the conservation reserve system extended. Land bordering conservation reserves should be managed to buffer the effects of agriculture, intensive forestry, recreation and urbanisation on the reserves. To allow for long-term climatic change, including greenhouse effects, a system of corridors broadly linking major conservation reserves should be mapped and managed to allow the movement of biota between reserves. Areas that might be

included in conservation reserves, as reserve boundaries shift with change in climate, will require special management.

Programs, such as Landcare, will not only improve the quality of the land but they will benefit aquatic environments by reducing salt levels and turbidity. However, there must be specific programs for protecting and restoring water quality. The use of agricultural chemicals and fertilisers should be scaled down and their application restricted to areas where their impact on aquatic systems can be minimised. Perhaps the single most important conservation initiative that an individual landowner can take is to re-establish native vegetation along creeks and streams (21). Ideally this buffer of vegetation will be at least 20 m in width to either side of the waterway, but even narrower plantings will significantly assist in controlling siltation, erosion of banks, and in moderating water temperatures. It will also significantly improve wildlife habitat.

Whatever the form, function or objective of restoration undertaken, a primary goal must be sustainability. That is, after the initial and necessary input of human resources leading to the addition and deletion of species, the restored landscape must be self-sustaining in the sense that ecological processes and functions continue without human intervention.

Better is defined as increased productivity, better retention of nutrients, reduced amplitude between extremes of local climate, regulated water flow, improved water quality, and reduced rates of extinction among others. These attributes are deemed better because they increase or enhance human values by increasing the financial return on capital and labour and by improving quality of life through the conservation of native wildlife and maintaining an aesthetically pleasing environment. They also facilitate return toward the original state of the environment, and they increase the stability and resilience of communities. Stability and resilience are essential properties of the environment required to achieve sustainability in agriculture. They are also necessary to sustain a greater diversity of organisms including those of the original biota which in turn are necessary to ensure stability, resilience and productivity. An ecosystem, whether agricultural or natural, is comprised of many interacting parts; no part can be lost without the whole being affected.

Although much of the damage to the Australian environment occurred in ignorance of the fragility of the Australian landscape and its biota, Australia's farmers and graziers need to assume greater responsibility for their actions. As the managers of our continent's soil and water, our most precious resources, they need to lead the rest of the nation in developing and implementing ecologically sustainable practices. At least through the first decades of the next century, Australian agriculture will need to divert significant resources into the restoration of degraded landscapes (21). They will require the support of all Australians to do this, but the primary responsibility is theirs.

Acknowledgements

Preparation of this paper was made easier by the many discussions I have had with Pat Hutchings, Leon Lim, Dan Lunney, John Pickard and Denis Saunders about the role of agriculture in the Australian environment and its effects on wildlife. Keith Hutchinson provided very helpful and constructive comments on the manuscript for which I am particularly grateful.

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