
Land: Competition for future use

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Land is a finite resource; land use affects the environment and the economy. Despite its importance, decisions on land use are not always being made using science-informed policy. This paper was developed from information presented at the 'Collision of Land Use Forum' in August 2010, and subsequent discussion. Recommendations include the establishment of a national Land Management Forum, a review of current guidelines for land use management, accommodation of natural capital and ecosystem services considerations in land use management processes, education of the importance of soil and land use in terms of economy and environment at all levels, and advocacy and debate to ensure both understanding and that science is the basis for creation of policy.

Introduction

New Zealand is ranked third out of 27 OECD countries, behind Australia and Iceland, yet ahead of Canada and USA, in terms of land availability per capita (The New Zealand Institute, 2010). As population increases, this land area is decreasing. This is a global phenomenon creating ever-increasing opportunities for New Zealand's primary production exports, but, in parallel, greater competition for the better land. The growing food demand is also driving the ongoing intensification of agriculture in New Zealand. Although this is likely to lift outputs and incomes, it will also increase environmental pressures on both landscapes and associated water bodies.

In New Zealand these pressures are being exacerbated by land use changes. Whereas water use and water quality considerations are moving towards a national framework of interest and associated national standards to assist regions and districts to provide guidelines and limits, there is no similar framework for land. Land, unlike water, is not a public utility, but is in private ownership: no single group is responsible for it. As a consequence, the traditional role of stewardship of land use is falling between cracks. Society and government both expect that the primary sectors and, increasingly, Iwi will work towards a sustainable approach to land management. There are, however, no nationally-agreed guidelines, and something approaching an integrated approach to the use of land is missing. The time is fast approaching where this can no longer be left unattended, as the demand for land and its services from competing interests intensifies and the need to assess the wider implications of ongoing land use change on society gathers momentum. The debate on the response local government should take to the encroachment of the urban environment onto high-grade agricultural lands is one element in the need for an integrated approach to future land use in this country. Until this is addressed, advancing the linked issue of a national framework on water use and quality would seem a challenge. Although the Resource Management

Act (RMA) was developed to assist, its implementation has proven to be problematic. In fact, the introduction of the RMA expunged a national directive to protect high-quality agricultural land.

The Local Government Act (2002) does require Councils to take responsibility for sustainable development because of the purpose of the Act (Part 2; 10(b)), which is to promote the social, economic, environment and cultural wellbeing of communities, etc.; this, too, tends to remove the emphasis on the land itself. Further, the words in the legislation around 'life-supporting capacity' are vague and easily by-passed in court hearings.

This paper brings together the discussion on such issues that occurred at a one-day Forum (23 August 2010, Massey University, Palmerston North) under the *aegis* of the Royal Society of New Zealand. This event involved practitioners, industry, and policy makers at regional and national level along with scientists, academics and students to raise debate around soils and land use within New Zealand with a view to establishing a policy for New Zealand land use.

Background

Land that is versatile in terms of use (termed Class 1 land and occupying less than 1% of New Zealand area) is desired, as it has no limitations. Less than 15% of land is in the relatively versatile Classes 1–3. Concern is rising about the potential for a disproportionate amount of risk being applied to the remaining agricultural landscape because our land with little limitation is highly vulnerable to loss to non-food producing uses (Rutledge *et al.* 2010). Note that more than 60% of New Zealand soils have some physical limitations for their use in pastoral agriculture.

Over the last 20 years, agriculture and forestry land has contracted from approximately 4.8 ha per capita to 2.8 ha (The New Zealand Institute 2010). Such a reduction has been caused by losses of productive land and the pressures of population growth. Indeed approximately 730 000 hectares (3%) of New Zealand's total land area is now taken up by urban areas, with a further 160 000 hectares given to transportation networks. Over the past 25 years, the rate of urban expansion has been of the order of 4–5% per year (i.e. 40 000 ha/yr) (Sanson *et al.* 2004). Some areas of lowest risk and highest-producing soils are the most valuable and vulnerable in terms of urban expansion and hence their losses are leading to restriction on land use options (e.g. Auckland to Tauranga). In fact, a disproportionate amount of Class 1 and 2 is being lost from around population centres (Rutledge *et al.* 2010). Already approximately 40% of New Zealand's food is imported. This country must retain its high class soils and capacity for its local food basket and security, whilst maintaining the burgeoning economic performance of our primary sectors.

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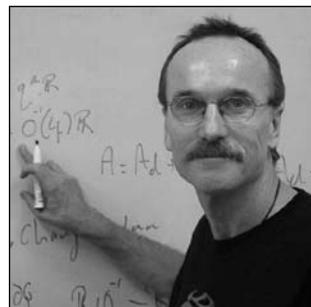
Alec Mackay is a Principal Scientist in the Climate, Land & Environmental section based on the Grasslands campus in Palmerston North. He has a BAgricSci(Hons) and a PhD in Soil Science both from Massey University and is a Fellow of the New Zealand Society of Soil Science and past President. Dr MacKay's research interests include investigations into the impact of intensive pasture agriculture practices on soil organic matter, and pore function and biology as it influences both the soils provisioning and regulating services. A framework for valuing the soils' natural capital and ecosystem services, developed as part of a recent study, provides a new tool in land evaluation and planning. The approach has the potential to add utility to the current suite of soil quality indicators and to replace existing methods for land valuation.

Simon Stokes is Manager of Land Resources for the Eastern area at the Bay of Plenty Regional Council. He has had a 16-year career in resource management in New Zealand working for Manawatu Wanganui Regional Council, Hawke's Bay Regional Council, before his current position. He has also worked with Central Government agencies and non-government agencies, Crown Research Institutes, Iwi and Maori Trusts, and many landowners. He is the Immediate Past-President of the New Zealand Association of Resource Management and led the New Zealand Deer Farmers Association Environmental Awards programme for 4 years. He currently supports the Ministry of Agriculture and Forestry on building resource management capability and capacity under the Hill Country Erosion Programme. Before entering management at the Bay of Plenty Regional Council, he specialised in farm planning, soils and soil conservation, and working with the community.



Mike Penrose is a director and past Chairman of the TelferYoung Group. He is a qualified urban and rural valuer with over 30 year's experience. He specialises within the horticultural, energy, telecommunications, hotel, motel, rest-home, and specialised property sectors. Mike is also a plant and machinery valuer and has experience in business valuations. He has extensive involvement in the telecommunications sector for a range of national clients. He acts as a consultant and valuer to three local authorities and undertakes infrastructural and asset valuations for these. Specialist assignments include rating urban demand and leasehold reviews. Mike is also an associate of the Arbitrators & Mediators Institute, and is experienced as an expert witness and arbitrator.

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Stephen Goldson has been actively involved in pest management and biosecurity research for thirty years. He has worked as AgResearch's Chief Science Strategist and most recently as its Chief Scientist. For ten years prior to this, he was the Science Leader of the Biocontrol and Biosecurity Group, focusing on pest management. He is also Biosecurity Theme Co-leader at the Bio-Protection Research Centre (one of the Centres of Research Excellence) and a Professorial Fellow at Lincoln University. He has been a member of several national science policy advisory groups over the last two decades. In 2005 he was appointed to the Biosecurity Ministerial Advisory Committee and in 2006 joined the National Science Panel. Dr Goldson is a Fellow of the New Zealand Institute of Agricultural Science and was the recipient of the Institute's Jubilee Medal in 2007. He is a Fellow of the Royal Entomological Society of London and a Fellow of the Royal Society of New Zealand. In 2009 he was elected to the Council of the Royal Society of New Zealand as Vice-President, Biological and Life Sciences.

Jacqueline Rowarth CNZM is Professor of Pastoral Agriculture and Director of Massey Agriculture at Massey University. After completing her PhD at Massey, Jacqueline initially took up a research position at DSIR Grasslands, which became AgResearch in 1992. In 1994 she was appointed Senior Lecturer in Plant Physiology at Lincoln University, then from 2000 to 2004 she was Director of Research and Dean of the Graduate School at Unitec New Zealand, becoming Vice-President of Research and Development. She became Associate Professor and Director of the Office for Environmental Programs at Melbourne University in 2005, returning to New Zealand in 2007 to take up the Foundation Chair at her alma mater. Professor Rowarth is a Companion of the Royal Society of New Zealand, and a Fellow and Honorary Member of the New Zealand Institute of Agricultural and Horticultural Science. In 2008 she was appointed a Companion of the New Zealand Order of Merit. She was given the inaugural Agricultural Personality of the Year Award by the Federated Farmers of New Zealand in 2009, and was recognised as the 2010 Agricultural Communicator of the Year by the Guild of Agricultural Journalists and Communicators.



Approximately 70 000 ha of New Zealand are used intensively by the horticultural industry, which contributes \$5 billion p.a. to the economy. By 2020, this industry plans to have increased its contribution to \$10 billion p.a. Industry predicts that along with productivity gains this will require 10% more horticultural land.

The huge demand for increased dairy production driven by strong commodity prices is resulting in increased conversion of land to dairy grazing. Cow and heifer number are predicted to increase from 4.35 million in 2009 to 4.49 million by 2013 (Ministry of Agriculture and Forestry 2009).

Expansion of these three sources of demand comes at the expense of the sheep and beef and forestry sectors, which are being relegated to less versatile land and landscapes of lower resilience. Such influences will result in the reduction in the size, stability, and future vitality of these industries and ultimately on performance and quantity of produce. What is remarkable is that the sheep and beef sector has been able to sustain productivity gains despite greater exposure to the more challenging landscapes and climates less suited to intensive rearing and finishing operations. This is also creating further complexity to sheep and beef enterprises, as the traditional rearing operation in the hills and selling of store animals for finishing properties on higher-class land has broken down.

There are landscapes in New Zealand where centre-pivot irrigation, barns and dairy cows have suddenly appeared. This creates arguments beyond just the provision of ecosystem services for primary production and sustaining associated water bodies; it creates debate beyond the housing of animals, to include cultural and social values of community and their expectation of landscape services. As well, the economically-important tourism industry is predicated on many tourists who have expectation of what they might expect to observe and what they do not want to see. Recent government investment in the film industry, which relies on the bucolic landscape in the Waikato, and the rugged beauty of the un-intensified South Island high country, shows the importance of considering more than direct income from primary production. These 'additional cultural services' should be captured, quantified and valued.

'Natural Capital' is an economics-based concept incorporating the supply of nutrients, mineral resources, combined with the filtration and reservoir functions and maintenance of biodiversity. This emerging science provides a basis for valuing land and impact on the wider environment into the future. Using this concept, marginal land is effectively land with compromised natural capital that requires additional capital inputs (e.g. fertiliser, irrigation, drainage, animal feed pads, and herd homes). However, this is not entirely the point. There are also cultural, heritage, and spiritual services provided by land. These are particularly important to Iwi and to the tourism industry and must also be considered in any decision on land use and land use change.

Issues

On a global scale, meeting the requirements for extra food production to satisfy the global population increases means either intensifying agriculture using new technologies, and producing more food on an existing area of agricultural land, or putting more, currently non-agricultural land, into production.

Professor David Tilman, an ecologist at the University of Minnesota in St Paul, estimates that on current production levels, at least an additional billion hectares of land will be needed in order to feed the population predicted for 2050 (Tilman *et al.* 2001). That land is also vital for the other ecosystem services it provides.

Professor Vaclav Smil, from the University of Manitoba, calculates that in the 50 years between 1900 and 1950, when population increased from 1.7 to 2.5 billion (a 47% increase), the land area put into production increased 14% but yield increased by 75% (Smil 2008). Further, more people were better fed. In the following 50 years, population increased to 6.1 billion (an increase of 244%), land area in production increased 22%, but yield increased by 276%. Technology, particularly the Green Revolution involving new cultivars of cereals, plus intensive use of fertiliser, pesticides and irrigation, made this possible.

Such intensification between 1961 and 2005 also increased greenhouse gas emissions arising from developments such as fertiliser production and application. Nonetheless, the net effect of higher yields per hectare meant emissions of up to 161 gigatons of carbon (GtC) (590 GtCO₂e) were avoided (Burney *et al.* 2010).

All-in-all, the weight of public opinion is guiding land use and developments through the regional councils (at least in part because New Zealand, unlike Europe, is still developing land in colonial fashion), despite the fact that 'the public' have little knowledge of the issues. For instance, decisions are being made on high-risk market-driven initiatives (such as the Mackenzie Basin dairy proposal) without considering extant fundamental knowledge of soils, which, if taken into account, might suggest that the future viability of tracts of land could be compromised. An awareness of future possibilities is becoming increasingly important and consideration of costs of the risks of the collapse in ecosystem services is becoming paramount. Although science has provided answers in the past in terms of intensification, new imperatives require new research to inform policy development. This in turn requires development of institutional capacity in both local and national policy-setting bodies.

Main problems

Problem 1: The encroachment of the urban environment onto high-grade agricultural lands

Urbanisation often leads to a loss of the ecosystem services from high-class agricultural lands through disruption of soil ecology and drainage patterns. In this context the market has a major role in defining land values (Figure 1), and this is affected by the exchange rate.

As seen in Figure 1, because of its relative cheapness, rural land on the periphery of urban areas possesses inherent potential related to future demand and opportunity for urban development. As distance from the urban areas increases, land values tend to decrease, dependent upon the best-use options. Such options are directly related to productive capabilities and potential. Alternative land uses compete in terms of price with the most profitable activity able to justify the highest land value. The upsurge in rural residential subdivision has distorted land values in some localities. This has led to and contributed to the breakup of larger rural holdings into smaller 'hobby' farms, predominately on high-class lands.

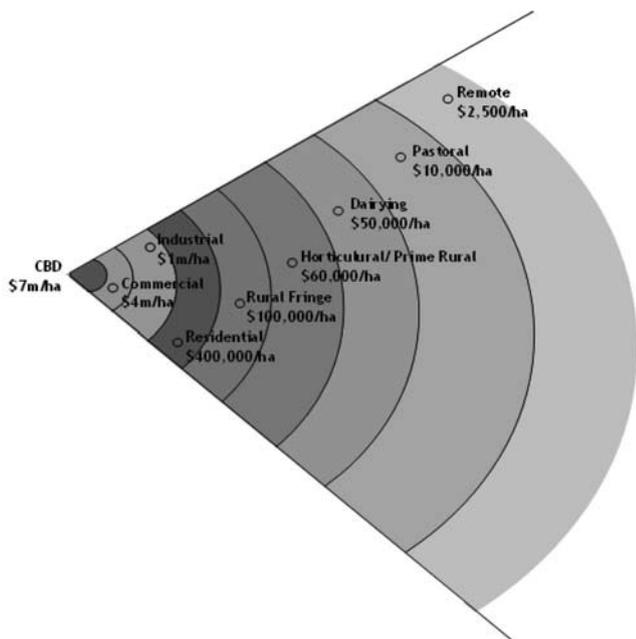


Figure 1. Reduction in land values in the Hawke's Bay as distance increases from the CBD (Central Business District) and land use changes.

The burgeoning loss of small parcels of peri-urban land is through a 'death by a thousand cuts'. As part of the legal process considering this insidious peri-urban creep, independent Hearings Commissioners were appointed by the Hastings District Council (24 July 2009) to assess an application by a company to build a megastore on prime horticultural land on the outskirts of the city. Their decision to decline the application was based on the HDC's district plan for the Rural Resource Strategy and the Plains Zone, which refers to the life-supporting capacities of the soils of the Heretaunga Plains. The decision also appeared to reflect contemporary national and international themes in relation to maintaining natural capital assets and sustaining the provision of ecosystem services. The Commissioners rejected the request to use this valuable productive land for retail purposes, even though just '... a small amount of land will be lost, [for they found] it should not be considered an insignificant departure from the policy. If these soils are as valuable as described by the witnesses, their loss should be avoided.' They added that '... they had formed the view that the productive potential of the land on the Heretaunga Plains was being realised to a greater degree as time passed'. This is admirable. Their decision has, however, been appealed.

From this perspective, urban-design planning and regulation are important components in land-use collision processes. In order to resolve land-use allocation issues, there needs to be a shift in urban design thinking away from lifestyle blocks to more intensive urban planning and in-filling. This will be achieved only through smart urban design offering a sense of community within the urban environment.

Problem 2: Rural competition for available finite resources

New Zealand should be undergoing a transition from a sector-based approach to land use on farms to a systems-based approach that considers natural capital values and ecosystem services. Decisions are being made about land use considering financial exchange rates and food demand, which are already

changing. Nonetheless large amounts of capital infrastructure have been and continue to be invested onsite. This severely restricts the flexibility of future land use by locking in financial capital to local natural capital stocks.

Investigation into opportunities for more efficient use of current land use, including intensification options, through effective farm planning is now an imperative. Although discussions around intensive farming options, such as the use of herd homes, have started, the focus has tended to be on emotive issues like animal health and iconic landscapes rather than the land use and associated impacts on surface water quality. Ironically, housing animals is considered the norm in winter months in Europe and the value of landscape is a concept of shifting values.

This brings in a second finite resource – water: there is a finite ability of receiving water bodies to assimilate nutrients, before they are compromised, maybe irreparably.

The Way Forward

Central guidance, yet with flexibility for specific local conditions is required in order to provide parameters for Regional Councils on policy development that governs land-use change. This requires land-use data collection and co-ordination to provide a values-based foundation for consideration in decision making. The Environment Court will then be able to consider and understand that continuing piece-meal losses of small parcels of land will lead inexorably to a substantial loss on the inventory value of New Zealand's natural capital assets.

Such an approach has just been achieved it seems, through the Land and Water Forum (2010) for water. Little has appeared from this agreement with respect to land, however, even though it is land use that affects water quality in most circumstances.

Decisions on land use need to be based on long-term impacts rather than short-term finances. Clearly this will require careful handling, as interfering with market forces results in skewed behaviour and unintended consequences.

Finding solutions will require communication, cooperation and commitment between the urban and rural sectors as well as competing components of the rural environment. All require education.

Conclusions

Land is a critical part of New Zealand's future and it is a finite resource. This must be recognised in any policy and regulatory decisions that are likely to affect its use. Policy development and judicial processes must be based on rigorous scientific research.

Those who understand the physical resource and its natural capital value, including the agricultural and forestry sectors, have major roles to play in providing this knowledge and understanding. An important step change from the past is needed. Hitherto, land use development has been mostly about overcoming limitations. In the future it will be focused on increasing the natural capital of soil and enhancing ecosystem services from the land.

Would it be possible, for instance, to move from Class 2 to Class 1 land by improving ecosystem services? Such remediation-based development would require not only serious investment in land-based services to enhance ecological

infrastructures, but also a significant investment in new and emerging research themes.

It will also require a champion.

Whereas water has such bodies as the Environmental Defence Society, Fish and Game, and Irrigation NZ to make statements about quality and bring concerns to the fore about what is effectively a public utility, land, which is associated with private ownership and property rights, has no champion as yet.

Recommendations

- New Zealand establishes a forum along the lines of the Land and Water Forum (noting that this forum focused on water), to identify a champion to develop guidelines and policy on land use to assist districts and cities in policy development at local and regional level.
- An analysis of guidelines in current regional policy statements and the mechanisms that are in district and city plans currently in use to effect land use is instigated.
- The land management processes (through the guidelines, plans and policies, including the RMA) are modified to accommodate statements on the natural capital value of land and its ecosystem services.
- Practitioner agricultural and forestry knowledge is included in all collaborative groups; it is the farmers and growers who have direct experience of managing land productively, economically and efficiently.
- An increased understanding of the importance of soil, agriculture and forestry for national sustainability – environment and economy – is promoted. This will take a national initiative.
- Science must be the foundation of assistance and change. It is already known that marginal land faces greater risk of damage than versatile land when put to productive use; research is required to mitigate such risks and offer options for future use flexibility. Hence science must have an increased role in contributing to providing solutions which will assist in minimising potential damage. (Note that science already supports some high-risk operations on productive landscapes, thereby minimising impact.) Such an approach is more efficient in terms of yield than trying to support unproductive areas.
- Advocacy and debate is required throughout the science, education and productive sectors to assist policy makers, planners and governing bodies. Science provides the wherewithal for the creation of good policy, and requires policy makers to have understanding and to trust the science provided. Independent scientific research is therefore imperative.

The proposed approach is an advance on the concept of matching land use with land capability and still needs research to design systems that reflect limitations and militate against mistakes; this requires foresight. Such an approach would allow New Zealand to move from sectoral understanding to a systems approach with the robustness and foresight that is so badly needed. The goal for science will be to expand the potential of certain classes of land without causing irreversible damage, whilst building the inventory value of our natural capital stocks.

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