workingpaper

Evaluating the Land Dataset

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Sustainable Future Institute Working Paper 2011/2

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About the Resource Project Team

The Resource Project Team comprises of Jessica Prendergast, Nicola Bradshaw, Chris Aitken, Lisa Bazalo, Jean-Charles Perquin, and Steph Versteeg. Each team member has placed a significant amount of time and effort into each Working Paper and the corresponding datasets.

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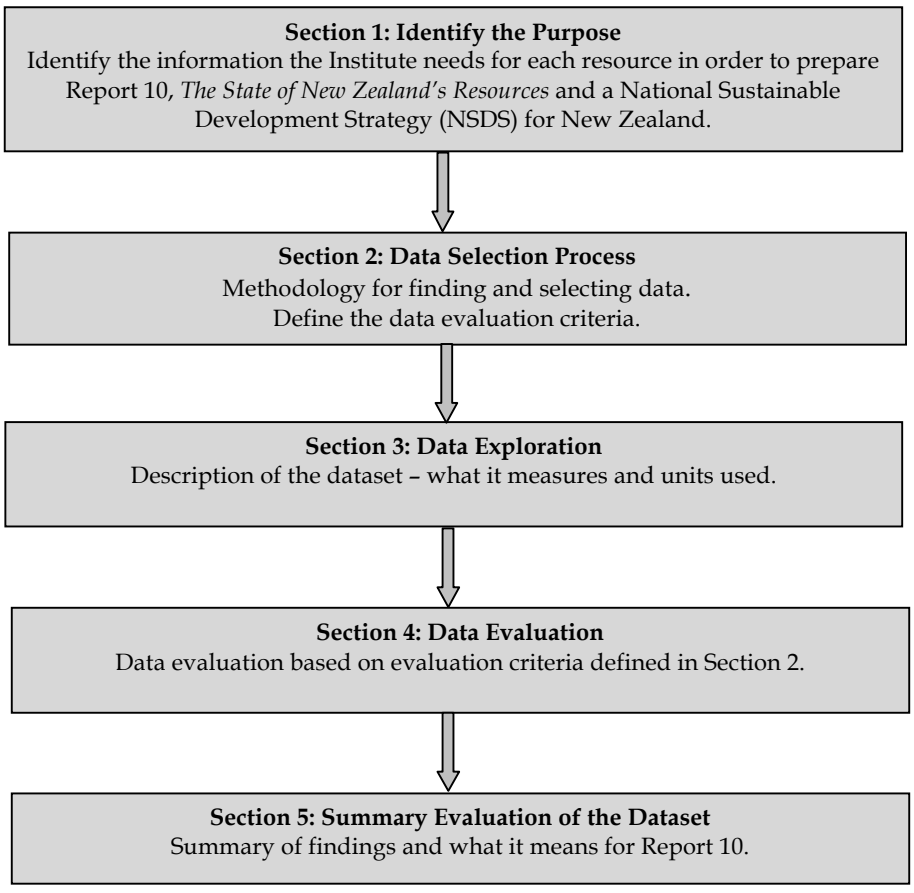
1. Purpose

This Working Paper is one of a series of 11 papers prepared as background to the Sustainable Future Institute's Report 10, *The State of New Zealand's Resources* (SFI, in press). Report 10 aims to provide an overview of available data and information covering a range of resources, and to discuss the use, availability and appropriateness of the data in the preparation of a National Sustainable Development Strategy (NSDS).

The purpose of this Working Paper is to describe the process by which the Institute collected, collated and presented a selection of data on land use, land cover and land ownership in New Zealand. The datasets are summarised and evaluated for completeness, accuracy, relevance, appropriateness of sources and public availability. This paper discusses the purpose for which the data was collected by its custodians, and why the Institute has selected this data for its reporting. The content of the dataset is not interpreted or analysed; rather, our purpose is to evaluate the usefulness of this dataset for the purposes of Report 10.

Following this evaluation any gaps and resulting limitations in using the selected data are assessed, as well as its relevance and reliability in relation to the Institute's purpose of using the comprehensive series of datasets to inform the development of an NSDS for New Zealand.

Figure 1 The Five-step Process for Evaluating the Institute's Datasets



1.1 The Sustainable Future Institute

The Institute is an independently funded think tank based in Wellington, New Zealand. Earlier work by the Institute has indicated that New Zealand is well behind other developed countries on its international obligations to develop and implement a National Sustainable Development Strategy (NSDS) (SFI, 2007). It is hoped that *Project 2058* will help inform ministers, policy analysts and members of the public about key events and trends in New Zealand's past, and alternative strategies for the future. With this in mind, this Working Paper is a step towards the Institute's goal of preparing an NSDS for New Zealand in 2011.

1.2 Project 2058

The strategic aim of *Project 2058* is to promote integrated long-term thinking, leadership and capacity building so that Aotearoa/New Zealand can effectively seek and create opportunities, and explore and manage risks over the next 50 years. In order to achieve this aim, the *Project 2058* team is working to:

1. Develop a detailed understanding of the current national planning landscape, and in particular the government's ability to deliver long-term strategic sustainability thinking;
2. Develop a good working relationship with all parties that are working for and thinking about the 'long-term view';
3. Recognise the goals of iwi and hapū, and acknowledge te Tiriti o Waitangi;
4. Assess key aspects of New Zealand's society, asset base and economy in order to understand how they may shape the country's long-term future, such as government-funded science, natural and human-generated resources, the state sector and infrastructure;
5. Develop a set of four scenarios to explore and map possible futures for New Zealand;
6. Identify and analyse both New Zealand's future strengths and weaknesses, and potential international opportunities and threats;
7. Develop and describe a desirable sustainable future in detail, and
8. Prepare a *Project 2058* National Sustainable Development Strategy. (SFI, 2009: 3)

The culmination of *Project 2058*, the development of a National Sustainable Development Strategy (NSDS), depends on having an accurate assessment of key aspects of New Zealand society. Earlier reports have dealt in particular with points 1, 3, 5 and 6 above,[1] and this Working Paper is designed to help progress the fourth point: 'Assess key aspects of New Zealand's society, asset base and economy in order to understand how they may shape the country's long-term future…'

[1] For a detailed list of published and upcoming reports, see *Project 2058 Methodology: Version 3* (SFI, 2009: 7).

1.3 Land Resources within an NSDS

Below we ask six strategic questions that drive this research. These are then expanded upon to discuss the use, availability and appropriateness of the data in the preparation of an NSDS. Without accurate, comprehensive, relevant and accessible data to answer the following questions, it will be difficult to develop and execute an informed NSDS for New Zealand.

- **What** are the issues facing land and land use in New Zealand? Are New Zealanders clear on exactly what these issues are? Does New Zealand have quality data and information to enable us to understand these issues to their full extent? Are New Zealanders able to establish an informed understanding of the priorities?

- **Why** does New Zealand need to confront issues affecting our land? Are there improvements that can be achieved; or practices that need to change? Are current indicators relevant and meaningful to benchmark changes over-time? What is the purpose and the benefit in taking action?

- **When** should New Zealand start to address issues which impact on New Zealand's land? Is now the right time? Are current economic, social and environmental conditions conducive? Would it be beneficial to wait and monitor events as they evolve? Are current measures and indicators appropriate to monitor developments? Is there a risk of rushing into short-term action when a long-term approach is needed?

- **Where** do New Zealanders most need to concentrate their efforts to address New Zealand's land issues? Which aspects of the issue should be focused on first? Where should New Zealanders begin to ensure the most beneficial and sustainable outcome? Does New Zealand have sufficient knowledge, based on accurate and appropriate data, to assess outcomes?

- **Who** must be engaged to effectively address issues facing land in New Zealand? Who needs to be involved if New Zealand is going to successfully tackle these issues? Is data on land in New Zealand accessible and transparent to allow those interested to be accurately informed? Are data ownership issues affecting public involvement?

- **How** should New Zealand ensure we have effective management of our land? What is the best approach? What skills or techniques are needed? Does New Zealand have comprehensive and accurate information to enable effective management? How can New Zealand learn from international experience to assist in maximising effective and sustainable land use?

This working paper does not attempt to answer the above overarching questions. These overarching questions do however inform our purpose for Report 10 and in progressing an NSDS. Data collected for inclusion within this dataset has enabled us to understand the level of accuracy, relevance, comprehensiveness and issues of ownership that exist surrounding publicly available data in New Zealand. The above questions function as a bridge between the dataset, this Working Paper and Report 10; specific questions pertaining to how the selected Institute's dataset will inform the development of an NSDS are outlined in Table 1.

2. Data Selection Process

2.1 Methodology

Report 10a *Designing a Framework to Monitor New Zealand's Resources* (SFI, 2010a) outlined the process through which the Institute developed the framework for collecting and presenting the data. With this framework in place, the steps towards the completion of Report 10 are: (i) building the datasets for the eleven resource types studied, (ii) evaluating the selected datasets, and (iii) reporting on the findings in relation to the Institute's aim of defining an NSDS for New Zealand. The datasets developed in Step (i) are available on our website.[2] This Working Paper is one of 11 that form Step (ii), the data evaluation. Step (iii) will be published in Report 10.

The source data for the Institute's Land Dataset was selected from a variety of static tables, particularly the Land Use Maps (LUM) extracted from the Land Use and Carbon Analysis System (LUCAS) and Land Cover Database (LCDB) available on the Ministry for the Environment (MfE) website. The tables used are listed on the Institute's website under Project 2058 Publications and State of New Zealand's Resources. The Institute has taken the original data and reformatted it in Excel spreadsheets to facilitate use and analysis. The original data values have been preserved.

2.2 Sources of Data

The Institute supports the free availability of data relating to environmental statistics. With this in mind, we deliberately used only openly accessible data so that we were able to report on its availability and identify potential gaps. This enables us to report on the implications of using only freely available data, and to evaluate the information that can be extracted from these data sources.

We acknowledge that many sources of information exist on New Zealand's land that may or may not be publicly available or easily discoverable. Crown Research Institutes (CRIs), universities, national and local government, and other private and public organisations also collect and hold data on land.

For various reasons including privacy, commercial sensitivity, cost of dissemination or commercial sale price of the data, there are many datasets on New Zealand's Resources that are inaccessible to the public. Without extensive research, funding or expertise to assist in the interpretation of the data, many others remain unavailable. The Institute has focused on open data; therefore no efforts have been made to retrieve the other datasets. This is a limitation of this project as gaps identified by the Institute could potentially be filled by these other data sources.

Aside from LUCAS, New Zealand currently lacks nationally consistent land-use information, and this was confirmed through recent surveys identifying a critical need for better information.[3] The information from these surveys will enable improved policy and planning development and resource management. Regional councils, in particular, highlighted a need

[2] www.sustainablefuture.info

[3] *Agricultural production survey* (Statistics New Zealand, 2009)

for nationally consistent, coordinated and regularly updated land-use information to help fulfil their statutory requirements under the Resource Management Act 1991.

A new project proposed by the Regional Council Land Monitoring Forum and Landcare Research aims to bring together the weaknesses LUCAS presents and provide a sound framework for ongoing land use information collection, analysis, monitoring and reporting. The New Zealand Land Use Database Envirolink Tools Project (LUDB) aims to offer better reporting of land use and land use change, improved tools to identify the key drivers of land use change, and better information on tracking intensification and urban expansion. It is important to note that LUDB is a smaller-scale project and not of a national scale like LUCAS (New Zealand Geospatial Strategy, 2010).

The Institute searched for and compiled its dataset in 2009. What we have selected and discussed within this report reflects data that fits our purpose within the environmental data landscape at the time of research.

As data availability increases rapidly on an ongoing basis, it would not be practical to include within this Working Paper all datasets relevant to land in New Zealand. Report 10 investigates the past, present and future of the environmental data landscape in New Zealand. It also provides a list of alternative sources of information pertaining to New Zealand resources. When appropriate, we have mentioned complimentary data sources in this Working Paper.

Data on New Zealand resources is often produced and targeted to industry experts. This makes a thorough analysis and evaluation of datasets a complex task for the uninitiated. We have referred to the original source documents to support our evaluation of the datasets.

2.3 Land Dataset Evaluation Criteria

The Institute has developed a series of criteria to support the effective evaluation of its datasets and to consider the data in the context of our wider work programme. Each criterion is supplemented with questions to direct attention to relevant areas for consideration. The aim is to structure the analysis of each dataset in a way that is consistent and replicable across the 11 datasets. In this Working Paper, these criteria are applied to the Land Dataset as a whole, and to the different indicators and sources that comprise the dataset.

The criteria and guiding questions are outlined in Table 1 below.

Table 1 Criteria for Evaluating the Institute's Datasets
Source: SFI, 2010

Criteria for evaluation	Guiding questions
Comprehensive time series	For how long has the data been collected? Are there gaps in the records? Are data/indicators consistent and comparable over time?
Quality data	What is the scope and range of indicators; are there any gaps? Is data comprehensive and detailed? How is data classified/categorised? Is the data local/regional/national? Is the data internationally comparable and valid? Is the data accurate – is there any sampling bias? Are error bars calculated? Is the data relevant and able to be interpreted with meaning?
Appropriate sources	How many sources are drawn on, and what are they? Who owns the data? Why, how and where is data collected/measured? Is it original data, self-reported/obtained by survey? Is the data collection and analysis informed by sound assumptions? Is data reliable, independent, verifiable and/or of international standard? Is the data subject to (external) review?
Publicly available	Is the data easy to access? Is the data located online, in publicly available reports or databases, or within institutions? Is the data freely available?

2.4 Selected Sources

In order to find possible sources of data to establish a baseline portrait of land in New Zealand, the websites of agencies and organisations with relevant links to New Zealand's land resources were reviewed for all publications which provided information and data on land use,[4] land cover,[5] and land ownership. A search was undertaken to find online datasets

[4] Land use refers to the 'modification of and related activities on the land by people to sustain human life – the total of arrangements, activities, and inputs that people undertake in a certain land cover type' (FAO, 1997a; FAO/UNEP, 1999 cited in IPCC, 1999). National categories of land use differ, but many have been harmonised in line with the FAO's periodical *World Census of Agriculture* (IPCC, 2000).

[5] Land cover refers to 'the observed physical and biological cover of the earth's land, as vegetation or man-made features'(FAO, 1997a; FAO/UNEP, 1999 cited in IPCC, 1999).

and statistics, documentation on the data collection and its uses, and specific publications on land use and land cover, as well as general publications such as annual reports.

The Institute's land dataset is compiled from national statistics based on Land Use Maps (LUM) from the Land Use and Carbon Analysis System (LUCAS) and the Land Cover Database (LCDB), both compiled by the Ministry for the Environment. The LUCAS and LCDB datasets and their associated metadata can be found, viewed and downloaded from the MfE website or www.data.govt.co.nz.

The Cadastre and Land Titling systems managed by Land Information New Zealand (LINZ) were used for the section on land ownership in this Working Paper, but the information was not included in the Institute's dataset for practical reasons. However, we felt it was important to understand how land titling works in New Zealand, especially when attempting to manage natural resources. Therefore, we have included a text overview of what it is and who is involved.[6]

Specific land use data for agriculture and forestry in New Zealand compiled by Statistics New Zealand and the Ministry of Agriculture and Forestry (MAF) was retrieved from the MAF land use statistics webpage as an example of other land-data sources that could be used to complement national datasets such as LUCAS or LCDB.

2.5 Purpose for which the Data was Initially Collected

LUCAS

The Land Use and Carbon Analysis System (LUCAS) was created to help New Zealand meet its international reporting requirements under the Kyoto Protocol. LUCAS tracks and quantifies changes in New Zealand land use, back to 1990. LUCAS is made up of a number of different datasets and programmes; the principle dataset used in this research is the Land Use Map (LUM).

LUCAS is a cross-government programme led by the Ministry for the Environment in partnership with the Ministry of Agriculture and Forestry. Several other government departments, including Treasury and the Department of Conservation also provide input (MfE, 2010a).

The LUM programme involves mapping land use as at 1990, and then land-use changes for the periods 1990–2007 and 2008–2012. All mapping was performed at a minimum mapping unit (MMU) of one hectare and has involved extensive use of satellite imagery, some aerial photography and other spatial data.

The 15 metre resolution satellite imagery captured for LUM was obtained under an all-of-government purchase agreement. That means other government departments and local bodies can also gain access to this data (MfE, 2009a). Examples of uses by the Ministry of

[6] In order to gather geospatial data on land ownership see the Land Institute New Zealand website www.linz.govt.nz or http://www.landonline.govt.nz/

Agriculture and Forestry include: (i) verifying land that is or can be planted with forestry; (ii) the Permanent Forest Sinks Initiative, and (iii) the Emissions Trading Scheme.

MAF Land Use statistics

The MAF land use statistics dataset looks specifically at how land is used for agriculture and forestry purposes. The data has been mainly sourced from the Agricultural Production Survey administered by Statistics New Zealand. The purpose of the survey is to provide up-to-date and reliable statistics on agricultural, horticultural and forestry activity. The survey is conducted annually, with a full census every five years (Statistics NZ, 2009). This survey was chosen by the Institute to compliment the data provided by LUCAS as the information gained from the survey is used to (i) fulfil duties and commitments to the various international organisations of which New Zealand is a member, (ii) to monitor the state of the agriculture sector and its contribution to our economy and to (iii) aid policy advice – all of these which LUCAS aims to achieve (*ibid*).

LCDB

Land cover is the indicator of the state of our land, and describes the types of features present on the surface of the earth (MfE, 2007a: 225). The Ministry for the Environment's land cover databases (LCDB) are digital maps of the land surface of the country, created by grouping together similar classes which can be identified in satellite images. Being digital, they can be used to make a number of different maps, which can then be combined with other geographical information to reveal patterns and trends in land use and land cover. New Zealand has land cover maps corresponding to the periods 1996 to 1997 (LCDB1) and 2001 to 2002 (LCDB2) (MfE, 2009b).

Uses of the land cover databases include:

- calculating the amount of carbon contained within vegetation;
- identifying vegetation in areas that are vulnerable to erosion or fire;
- monitoring changes in land use, for example between farming and forestry, and to show the rate and degree of urbanisation;
- identifying the habitats of certain pest species for biosecurity protection;
- identifying the condition of our biodiversity, areas at risk from development, and opportunities for protection and enhancement.

(MfE: 2009b)

An update of the LCDB is planned using the satellite imagery captured for the LUCAS programme. The planned database (LCDB3) will be mapping land cover for the period 2007 to 2008. The minimum mapping unit (MMU) for LCDB2 is one hectare, which is consistent with the LUCAS MMU.

Land Information New Zealand Cadastre and Land Titling systems

Understanding how land titling works in New Zealand is essential when attempting to manage natural resources. Resources will overlap and different types of land and ownership of that land may determine who is responsible for the resource or how it is, or can be, administered (LINZ, 2010a).

In New Zealand, we can be confident of our property rights because of the strong survey and legal framework supporting land ownership. LINZ is responsible for providing and maintaining the certainty of private property ownership, by recording survey and land title information and by making this information available to support economic activity (LINZ, 2010a). For more than 160 years, New Zealand's land records were managed under a paper system. Since 2002, LINZ's titles, survey plans and related documents have been held in an electronic database called Landonline. The Landonline database holds digital cadastral survey records for freehold, leasehold, Māori owned land and Crown land.[7]

The cadastral survey system, Land Transfers, and Crown Land (unalienated and some leased) are administered by LINZ. The Māori Land Court administers Māori land. Māori land tends to have characteristics not associated with other forms of privately owned land, and is subject to a range of unique restrictions and protections.[8] Crown property covers land, buildings and other properties owned in the name of Her Majesty the Queen. LINZ administers three million hectares of Crown land or eight percent of New Zealand's land area (LINZ, 2010b).

The LINZ data provides a significant amount of topographical and background data for other databases and has not been included in the Institute's dataset for practical reasons. However, we will refer to land ownership in Report 10, as we investigate certain issues related to the management of resources in New Zealand.

2.6 Additional sources

The Institute's 11 working papers, prepared as background papers to Report 10, *The State of New Zealand's Resources*, are selective in their use of specific information and data from within a broader pool of information. The boundaries set for these working papers were tightly focused on openly accessible online data available as at February 2009, the original time of data collection for the Institute's accompanying datasets. For further reading and comparisons which fall outside of our collection strategies we suggest the following additional sources. Please note that these have not been included within this working paper due to the reasons outlined above, but that references to these additional sources are included in the reference list at the back of this paper.

Databases and tools

New Zealand Topographical Map is an interactive topographic map of New Zealand using the official LINZ's 1:50,000 / Topo50 and 1:250,000 / Topo250 maps.

New Zealand Land Resource Inventory (NZLRI) is a spatial database containing similar information to that in the NZLRI worksheets. There are about 100,000 polygons (map units) within the NZLRI, each of which describes a parcel of land in terms of five characteristics or attributes (rock, soil, slope, erosion, vegetation).

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7 In New Zealand, a single cadastral survey system supports five different tenure systems, information on these are available from http://www.fig.net/cadastraltemplate/fielddata/c2.htm

8 The Controller and Auditor General website offers information on what Māori land is and how it is administered http://www.oag.govt.nz/2004/maori-land-court/part2.htm

The New Zealand River Environment Classification (REC), developed by NIWA with the support of MfE, is an ecosystem-based spatial framework for river management purposes. It provides a context for inventories of river resources, and a spatial framework for effects assessment, policy development, developing monitoring programmes and interpretation of monitoring data and state-of-environment reporting.

Freshwater Ecosystems of New Zealand (FENZ) is a database put together by the Department of Conservation. It consists of a large set of spatial data layers and supporting information on New Zealand's rivers, lakes and wetlands. It contains data gathered from a wide variety of sources.

FarmsOnLine is a Ministry of Agriculture and Forestry initiative to develop a government-owned database of information about the ownership and management of all rural properties, land use, stock and crops. It is intended to be the authoritative source of rural property information for biosecurity management.

3. Data Exploration

Land underpins a significant part of New Zealand's economy; it plays an essential role in supporting our top two export earners: tourism and primary production (MfE, 2007a: 213). In this Working Paper and Report 10 we have adopted the definition of 'land' used by the Ministry for the Environment. Land is considered to include:

> The aesthetic components of landform and landscape including the vegetation cover [and] the variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part.' (MfE, 2007a: 215)

It is necessary to investigate three sub-categories of land in order to gain a picture of New Zealand's land resource on a national scale: (a) general land use and specific agricultural and forestry land use; (b) land cover, and (c) land ownership.

Table 2 Land Dataset Summary Table

Dataset Category	Data Custodian	Data Classification		Dates	Measures	Data Reporting Frequency
Land use (LUCAS)	Ministry for the Environment	Cropping & horticulture	Forestry land planted before 1990	1990 and 2008	Hectares (ha)	N/A
		High-producing grassland	Scrubland			
		Lakes & rivers	Settlements			
		Low-producing grassland	Wetland			
		Natural forest	Other land			
		New forest land				

Land cover (LCDB)	Ministry for the Environment	Artificial surfaces	Grassland	1996 and 2001	Hectares (ha)	N/A
		Bare or lightly vegetated surfaces	Sedgeland saltmarsh			
		Water bodies	Scrub and shrubland			
		Cropland	Forest			
Agricultural and forestry land use	Ministry of Agriculture and Forestry and Statistics New Zealand	Grassland	Farm numbers	1972–2007	Hectares (ha)	Annual
		Tussock & danthonia used for grazing	Grazing, arable, fodder & fallow land			
		Grain, seed & fodder crop land	Land in horticulture			
		Mature native bush	Planted production forest			
		Native scrub & regenerating native bush	Other land			

LUCAS and the Institute's Land Use Dataset

Land use is categorised by human activities or economic functions that occur on land (MfE, 2007a: 216). In turn, different land uses can affect the environment, economy and society in different ways. Many environmental, economic and social factors influence how we use our land.

LUCAS mapping focuses on four key land-use classes: natural forest; forestry land planted before 1990; scrubland, and new forest land. All other land uses have been determined from pre-existing datasets such as the Land Cover Database (LCDB).

The data presented by the Institute was originally extracted from LUCAS LUM by MfE and summarised by the Ministry in table format. It includes general information on land use in New Zealand at a national scale. Data is only available for 1990 and 2008, as these were the only two timeframes mapped by the LUCAS project at the time the Institute's dataset was prepared.

Figure 2 Excerpt from the Land Use Dataset

Source: SFI, 2010b

Indicator	Attribute		Data 1990	Data 2008	Data source table #
1.1 Land use[11]	cropping & horticulture	ha	417,900	422,400	1a
	high producing grassland		5,856,500	5,803,100	
	lakes & rivers		529,400	529,600	
	low producing grassland		8,016,900	7,705,800	
	natural forest		8,152,600	8,101,900	
	new forest land		0	586,600	
	forestry land planted before 1990		1,480,300	1,432,400	
	scrubland		1,184,700	1,059,600	
	settlements		203,400	206,100	
	wetland		114,700	114,500	
	other land		894,800	889,100	

Agriculture and Forestry Land Use

Data on agricultural and forestry land use extends back to 1972 for most attributes, but was only available up to 2007 at the time of research. The greatest land area in occupation seems to be in the category of 'grazing, arable, fodder and fallow land'; where 11,353,986 hectares were being used for this purpose in 2007. Note that this excerpt excludes entries from 1974 to 2004 for representation purposes.

Figure 3 Excerpt from the Agriculture and Forestry Land Use

Source: SFI, 2010b

Indicator	Attribute		1972	1973	2005	2006	2007	Data source table #
1.3 Land use for agriculture & forestry[1]	grassland	ha	..	..	8,241,926.00	8,144,413.00	8,086,160.00	1c
	tussock & danthonia used for grazing		..	..	2,982,472.00	2,768,977.00	2,900,463.00	
	grain, seed & fodder crop land		..	..	369,391.00	347,202.00	367,404.00	
	mature native bush		..	..	468,717.00	488,922.00	448,247.00	
	native scrub & regenerating native bush		..	..	852,208.00	812,779.00	625,981.00	
	other land		..	..	558,929.00	512,133.00	431,467.00	
	farm numbers		62,789.00	63,196.00	65,000.00	65,000.00	63,000.00	1d
	grazing, arable, fodder & fallow land		8,470,900.00	8,537,700.00	11,593,789.00	11,260,592.00	11,353,986.00	
	land in horticulture[5]		..	..	118,759.00	115,174.00	132,892.00	
	planted production forest		518,736.00	558,279.00	1,713,075.00	1,682,517.00	1,708,282.00	
	other land[5]		10,040,764.00	5,853,800.00	1,879,854.00	1,682,517.00	1,505,695.00	
	Total land area in occupation		**19,030,400.00**	**20,667,400.00**	**15,305,478.00**	**14,872,117.00**	**14,700,855.00**	

LCDB and the Institute's Land Cover Dataset

The data presented by the Institute was originally extracted from LCDB mapping by MfE and summarised by the Ministry in table format. It includes general information on land cover in New Zealand at a national scale. Data is only available for 1996 and 2001, as these were the only two timeframes mapped by the LCDB project at the time the Institute's dataset was prepared.

Figure 4 is an excerpt from the land cover dataset, showing artificial surfaces, bare or lightly vegetated surfaces, water bodies and croplands as examples of land cover types. Grassland, sedgeland salt marsh, scrub and shrubland, and forest have been omitted from this excerpt for representation purposes.

Figure 4 Excerpt from the Land Cover Dataset

Source: SFI, 2010b

Indicator	Attribute			Data 1996	Data 2001	Data source table #
1.2 Land cover[2]	artificial surfaces	built-up area	ha	158,120.00	163,438.00	1b
		urban parkland/open space		40,093.00	40,164.00	
		surface mine		9,781.00	9,773.00	
		dump		591.00	568.00	
		transport infrastructure		6,414.00	6,519.00	
	bare or lightly vegetated surfaces	coastal sand & gravel		51,286.00	51,249.00	
		river & lakeshore gravel & rock		179,741.00	179,736.00	
		landslide		17,038.00	16,992.00	
		alpine gravel & rock		698,092.00	698,145.00	
		permanent snow & ice		110,972.00	110,972.00	
		alpine grass/herbfield		224,379.00	224,379.00	
	water bodies	lake & pond		356,810.00	357,526.00	
		river		81,936.00	81,936.00	
		estuarine open water		92,499.00	92,499.00	
	cropland	short-rotation cropland		334,960.00	333,719.00	
		vineyard		19,894.00	25,400.00	
		orchard & other perennial crops		58,098.00	58,325.00	

4. Data Evaluation

4.1 Comprehensive Time Series

Only two data points available for land use and land cover post 1990

A consistent problem across the land use and land cover datasets is that few data points are available, which makes it difficult to establish long-term trends. For example, data for land use is only available for the years 1990 and 2008, while data for land cover is only available for the years 1996 and 2001.

Clear commitments from the government to fund ongoing updates for the LUCAS and LCDB datasets would ensure continuity for the monitoring of land use and land cover over time. Further use and analysis of the data in its mapping format, coupled with other land-related datasets, may improve understanding and establish trends over time and space.

Shorter gaps between data collection years may however not be a priority of government and may be unrealistic in terms of cost-benefits if looking at these datasets alone.

User dependant analysis of land use and land cover: combination with other supporting data sources is desirable

It is important to note that monitoring changes in land use and cover is dependent on the analysis the user wants to achieve. It may be more appropriate to look at the datasets created by the Institute alongside complementary resources such as the agriculture and forestry land use dataset, which contains additional information on certain specific land-use types, to understand what changes are occurring, the time scale and the reasons. This includes the spatial relationships between the different land uses and land covers in relation, for example, to water, development plans and land ownership. Access to mapping expertise may be critical in making those assessments.

Comprehensive Agriculture and Forestry Land Use Statistics but gaps in data gathered over the 1972-2002 period

The data obtained from the Agriculture and Forestry Land Use dataset is based on field data and is presented on a more regular and up-to-date, though shorter, time frame than LUCAS and LCDB. This makes it a good example of a related dataset that can be used to inform more generic databases such as LUCAS and LCDB, meaning potential issues around benchmarking data over time can be mitigated. However, there are still gaps as no data is available prior to 2002 for a large number of attributes such as grassland, tussock and danthonia used for grazing, mature native bush and other land.

4.2 Quality Data

Comprehensive methodologies for LUCAS, LCDB and LINZ

The accuracy of LUCAS LUM, LCDB and land ownership information is not discussed in this paper as to date there has been no accuracy assessment performed on either LCDB or the LUCAS LUM. These projects follow specific methodologies adapted to the sources used to

compile the datasets.[9] They are considered to be very comprehensive by industry experts and can be accessed from the respective source website, however LCDB is not considered to be completely accurate for large scale purposes. Forest Research, a Crown Research Institute, was commissioned by MfE in 2000 to carry out an accuracy assessment of the classification classes used in LCDB1. Overall map accuracy was estimated at 93.9% using the simple accuracy percentage statistic. However, classification error in LCDB1 is being corrected as part of the LCDB2 process and the overall accuracy of LCDB1 is expected to improve accordingly (MfE, 2007b).

Land use and land cover use different classification systems
The base data for the land use and land cover classes use different classification systems for identifying land categories in New Zealand. The LUCAS LUM classification scheme has been defined by the IPCC for Kyoto Protocol reporting with some additions for local (New Zealand) use. The LCDB developed a set of target classes and then developed the classification techniques to map those classes. The initial high-level classes for LCDB1 were based on the Food and Agriculture Organization of the United Nation's Land Cover Classification System. This makes comparisons or matches (e.g. a land-use land-cover match) between datasets difficult.

4.3 Appropriate Sources

LUCAS is a geospatial award winning project
The LUCAS project was the recipient of an award for Special Achievement in Geospatial Information Systems (GIS) at the 2010 International ESRI User Conference held in San Diego. This award demonstrates the groundbreaking impact this project has had for the mapping industry and for the implementation of carbon accounting systems.

LUCAS main purpose is to meet Kyoto reporting requirements
LUCAS has been built for monitoring land use change to meet Kyoto reporting requirements. Therefore it may not be fit for purpose for other applications such as detailed land use mapping and ongoing management of land use change on a small area or time scale. At the time of writing this Working Paper, LUCAS had been generated for 1990 and 2008. As yet there is no clear commitment from the government that the database will continue to be updated past 2012.

This means that other data may be required to accompany a LUCAS analysis for research subjects different than carbon accounting. This is why the Institute has chosen to present the MAF land use statistics as an example of complementary data.

LUCAS technical limitations related to the satellite imagery used and some subjectivity in the classification
While LUCAS has many advantages, there are also a few limitations. The Ministry for the Environment has reported:

[9] Accuracy statements and complete metadata for this data can be found on http://www.data.govt.nz/ under the Ministry for the Environment section.

1. The use of remote sensing does limit the ability to identify young forest (especially those younger than 3 years) due to the low resolution of the imagery. The second major limitation results from cloud cover.
2. In the 1990 imagery, key areas such as Otago, Northland and Gisborne had a high incidence of cloud and no alternative imagery could be obtained. LUCAS mapping therefore relied on analysing other datasets such 1996 SPOT and 2001 Landsat 7 satellite imagery to determine the land use classes at 1990 where there were clouds and in instances where a forest might have been planted between 1989 and 1993. However, the approach does have limitations in that the decision process introduces a degree of subjectivity which could result in misclassification. The most likely scenario is misclassification of post-1989 forest and pre-1990 forest.
3. Noting that this is the first iteration of the LUCAS land use mapping, there are areas of uncertainty. There is a plan for making iterative improvements during the commitment period.

(MfE, 2009c).

LCDB limitations: classification errors and some classes mapped too generally for certain regions or land cover types

The New Zealand Land Cover Database (LCDB) is digital map of the land surface of the country. It provides the basis for better resource management decisions, more effective use of natural resources and improved environmental management. However, the LCDB database has a few limitations, the Environment Waikato Regional Council has reported:

> The LCDB database has classification errors of plus or minus 10 percent. Any changes in land cover less than this cannot be identified with confidence. Therefore, a large change in Regional land cover (plus or minus 60,000 ha) must occur before it can be detected using this method. However changes may be detectable at a larger scale, for example by district council areas.
>
> Some vegetation types are incorrectly identified electronically in the LCDB satellite imagery. Errors in classification have been identified in the Waikato Region, for example, some young kahikatea stands have been classified as plantation forest.
>
> The class 'shrubland' does not distinguish between native and exotic cover – for example, it may include vegetation dominated by gorse or woolly nightshade.
>
> The LCDB gives a 'snapshot' of vegetation when the data was collected and should not be considered the definitive current vegetation cover.
>
> The data was presented as a percentage of each district council area in the Region by major land use type. However, the data do not allow for a breakdown of land use type by activity, for example, separating pastoral farming into different types such as dairy farming or sheep and beef farming.
>
> (EWRC, n.d)

4.4 Public Availability

All data publicly available and well documented

It is the aim of this project to assess publicly available data, i.e. data that is able to be accessed by parties independent of those who collect or present it. Both MfE's and MAF's reports fit this criterion; the reports are freely available to the public via each agency's website or on http://www.data.govt.nz. Data available includes metadata, methodologies, classification information, mapping data and summary reports.

Knowledge and experience with mapping and LUCAS methodology recommended to use LUCAS to perform in-depth analysis

It should be noted that to use this database effectively, it is imperative that the LUCAS methodology is well understood. Knowledge and experience with mapping software and interpretation of mapping data is also recommended.

5. Summary Evaluation of the Dataset

The Institute chose summary reports of the Ministry for the Environment (i) LUCAS and (ii) LCDB datasets, the Land Institute New Zealand (iii) Cadastre and Land Titling system, and the Ministry of Agriculture and Forestry (iv) Land use statistics, to inform its upcoming Report 10 and a National Sustainable Development Strategy. These sources are deemed as comprehensive and reliable, the first three are part of significant geospatial government projects. Expert knowledge is essential if these datasets are to be used in their original formats, therefore the Institute has selected the summary reports to inform the Land Dataset along with the MAF statistics. Table 3 below summarises the Institute's evaluation of the Land dataset.

Table 3 Summary of Land Data Evaluation

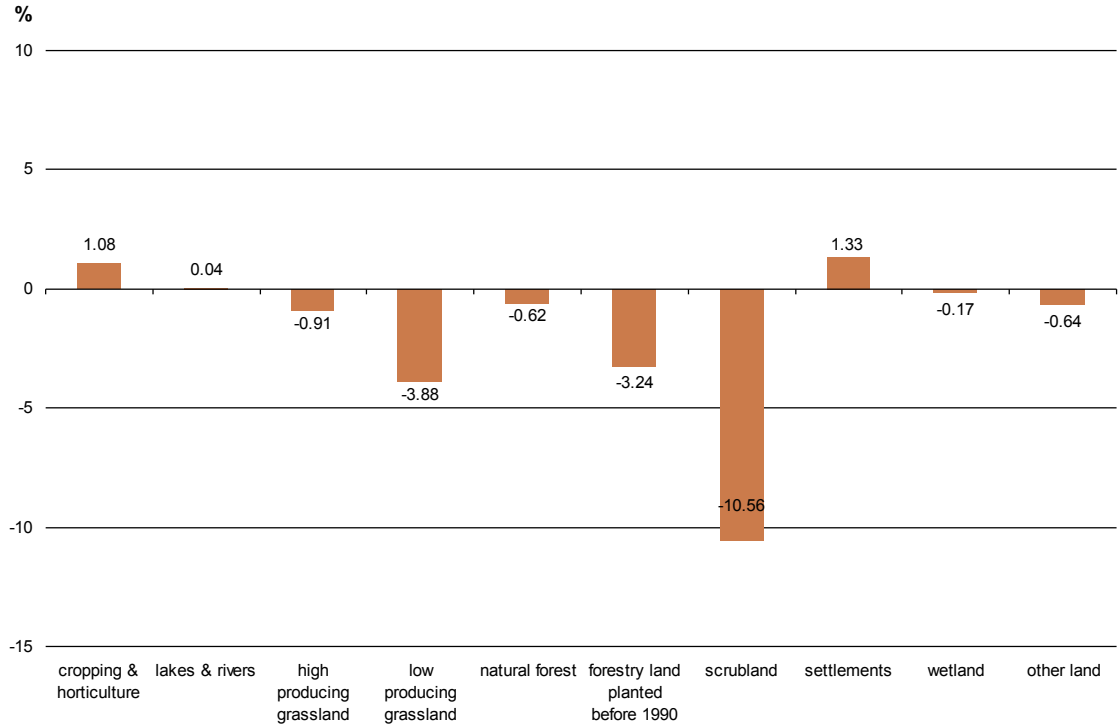
	Strengths	Weaknesses
Comprehensive time series	• Comprehensive Agriculture and Forestry Land Use Statistics but gaps in data gathered over the 1972-2002 period	• No historical records available prior 1972 in the MAF land use statistics • Only two data points available for land use and land cover all post 1990 • User dependant analysis of land use and land cover: combination with other supporting data sources is desirable
Quality Data	• Comprehensive methodologies for LUCAS, LCDB and LINZ	• Land use and land cover use different classification systems for identifying land categories • No accuracy assessment has been performed on either LCDB or the LUCAS LUM
Appropriate Sources	• LUCAS is a geospatial award winning project • LUCAS main purpose is to meet Kyoto reporting requirements which makes it very useful for this purpose	• LUCAS main purpose is to meet Kyoto reporting requirements: can be unsuitable for other purposes and may need to be combined with other datasets • Knowledge and experience with mapping and LUCAS methodology recommended to use LUCAS to perform in-depth analysis • LUCAS technical limitations related to satellite imagery used and some subjectivity in the classification • LCDB limitations: classification errors and some classes mapped too generally for certain regions or land cover types

Publicly available	• All data publicly available and well documented	• Expert knowledge may be required for a detailed usage of LUCAS LCDB and LINZ Cadastre information and data

The Institute acknowledges that other sources will need to be consulted in order to gain a complete and comprehensive overview of land resources in New Zealand. The Institute's dataset does not answer the questions outlined in Section 1.3, but it can provide background statistics to support reporting analysis and argumentation. If need be, further information and details can be extracted from the LUCAS, LCDB and LINZ dataset. An example of how the data may be used is presented in Figure 5 below.

Figure 5 Percentage Change in Land Use (1990–2008)

Adapted from SFI, 2010b



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