The Economic Impact of Tourism on Westland District

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This kind of research can only be carried out if those in the tourism industry, the general business sector, and the District Council provide comprehensive information, and we would like to thank those who assisted for their information and time. We trust that this report will lead to greater public understanding of the role of tourism in the District economy, and that this in turn will help the industry and thus in some measure repay respondents for their assistance.

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Summary

Approximately 810 persons (Full Time Equivalent - FTE), on average over the Year 2000, were employed directly in tourism in the Westland District. While more than 1,300 people in the District work in businesses which are primarily dependent on tourism, this figure is adjusted down to reflect the part time and seasonal nature of the work, and the fact that many businesses sell only part of their turnover to tourists.

Every job in tourism leads, on average, to a further 0.11 jobs elsewhere in the District economy, increasing employment by 92 FTE to a total of 902 FTE. This excludes any jobs in social services (such as teaching) that might be lost if tourism (and hence employment) declined, and people emigrated from the District. Total employment in Westland District averaged over the year is estimated to be around 3,150 FTEs. Hence 29 per cent of all jobs in the District depend either directly or indirectly on tourism.

Total direct spending by tourists is estimated to be $108m per year and this increases regional output by $82m per year. Flow-on effects of visitor spending increase total visitor-dependent output in the District to an estimated $98m. The direct spending figure is based on a census of employment of all businesses which sell directly to visitors, and rating this up by output per employee in these businesses (based on a detailed survey of a much smaller sample).

Value-added[1] arising directly from tourist spending is estimated to be $44m (including $24m of household income). The flow-on effects of visitor spending increase total visitor-dependent value-added to $52m (including $28m of household income). Flow-on effects are very low, and reflects both the limited manufacturing base and business support services of the District, as well as the very low demand for external inputs in some businesses (particularly in land-based activities). The flow-on effect is only half that which occurs in Kaikoura, and less than a third of that in Rotorua. This reflects the very restricted range of manufacturing and business support services in Westland.

The impacts reported in the Summary Table arise from the on-going operation of existing tourist facilities. In addition to these are impacts arising from capital injections into the industry (that is, injections additional to ongoing repairs and maintenance - which tend to include considerable minor capital works). Capital expansion is not believed to have been particularly significant in the case of Westland in recent years, primarily because of the long-developed nature of the industry in the District and the spare capacity. However, the rapid growth of the last two years may lead to major capital expenditure in the near future.

There have been suggestions that further tourism growth will require a substantial level of local government expenditure (pressures on water, sewerage, and rubbish dumps are commented on by other researchers in this programme). Operators were not asked to identify other areas where further physical investment by Council was needed, although a number mentioned that the Council's investment in tourism marketing needed to be expanded both in scale and in scope (in terms of what was promoted).

1 This is the total of returns to land, labour and capital. Hence it includes wages and salaries, income of the self-employed, rents on land profits, and depreciation of capital.

Summary Table
Summary of Economic Impacts of Tourism in Westland

	Direct Impacts	Multipliers (Type II)	Total Impacts
Output ($m)			
Handicrafts for visitors	6.1	1.35	8.2
Retail	13.9	1.19	16.5
Visitor Centres	1.8	1.23	2.2
Restaurants & Cafes	16.4	1.17	19.2
Accommodation	23.4	1.18	27.6
Activities	20.8	1.16	24.1
Total	**82.4**	**1.19 (implied)**	**97.9**
Employment (FTEs)			
Handicrafts for visitors	63	1.28	74
Retail	133	1.10	150
Visitor Centres	45	1.04	47
Restaurants & Cafes	203	1.07	218
Accommodation	215	1.12	241
Activities	150	1.15	173
Total	**810**	**1.11 (implied)**	**902**
Value-added ($m)			
Handicrafts for visitors	3.9	1.27	4.9
Retail	7.2	1.20	8.8
Visitor Centres	1.4	1.17	1.7
Restaurants & Cafes	7.1	1.20	8.5
Accommodation	15.0	1.14	17.1
Activities	9.4	1.15	11.2
Total	**43.9**	**1.19 (implied)**	**52.2**
Household Income ($m)			
Handicrafts for visitors	2.0	1.30	2.6
Retail	5.1	1.11	5.7
Visitor Centres	1.3	1.06	1.4
Restaurants & Cafes	4.9	1.11	5.6
Accommodation	5.6	1.18	6.8
Activities	4.8	1.19	5.6
Total	**23.7**	**1.17 (implied)**	**27.7**

During the past 15 years there has been a slight decline in overall employment but a significant shift away from primary industries into the tertiary sector. In spite of having very low flow-on effects, tourism is responsible for almost 30 per cent of all employment in Westland District. This is half as much again as Rotorua District (20%) and about the same as Kaikoura (30%). Clearly Westland, like Kaikoura, is very vulnerable to tourism volatility. While tourism multipliers appear to have been declining steadily over the last decade or more, the high employment impacts of tourism suggest that growth of tourism continues to be an important force in regional development.

Finally, a review is made of environmental accounting measures, such as ecological foot printing as a tool for assessing regional and sectorial impacts.

Chapter 1
Report Structure and Overview of Tourism's Role in the Westland Economy

1.1 Introduction

In recent years tourism has been one of the fastest growing sectors of the New Zealand economy, and has become particularly important in some smaller communities. It has become particularly important in regions (such as Westland) which have suffered from a decline in long-established industries (timber in the case of Westland). What is uncertain is just how important the industry is, both in terms of its direct impacts and also its indirect impacts[2]. The original principal objective of this study was to estimate the relationship between such direct and indirect effects by surveying a sample of tourism businesses to find out their expenditure patterns, to incorporate this information into a model of the regional economy and calculate tourism multipliers (the ratio of direct impacts to total impacts for various types of visitor expenditure), and to see if this ratio appears to be changing over time. A declining trend in the value of multipliers would suggest that in future tourism is likely to have smaller flow-on effects than in the past, and this in turn suggests that tourism will be less of a panacea for declines in other industries.

The current multipliers were to be applied to existing estimates of tourist direct expenditures to get total economic impacts of tourism. During the research it became apparent that the existing estimates of direct visitor expenditure were unreliable (particularly estimates broken down by type of expenditure) and the measurement of the level of direct expenditure became a further objective of the research. This was done by estimating direct employment in the total visitor industry, and by applying estimates of employment to output ratios to these figures to get total output figures.

Regional economic models can be generated using a national production function and modifying the input coefficients to reflect average regional self-sufficiency in the various input industries. This approach presumes that input structures for a given industry are the same in different regions. By contrast, survey-based analysis establishes the input structure (type and origin) of the industries in question (in this case, tourism industries) in the particular region. The final research objective was to see whether the two approaches lead to significantly different multipliers, and hence to provide some information as to whether there is any significant advantage in undertaking the survey work (which is time-consuming, expensive, and fraught with data-gathering problems because of confidentiality issues). With the completion of this project, comparisons between multipliers generated by the two processes are now available for three regions (Kaikoura, Rotorua and Westland), and the research objective was to see whether a general conclusion about the two methods could be formed.

'Environmental Impacts' and particularly 'sustainability' has become a topic of considerable policy interest in recent years. A further objective of this study was to pilot an environmental accounting mechanism (if possible, based on input-output models) for tourism at the regional level. Recent work in this area has focussed on estimating the direct 'environmental impact to output' ratios of industries and in various regions. Our objective was to combine this work with

2 These indirect impacts arise from the spending by tourist businesses and their employees at other businesses. For example, a boating company buys fuel, and hotel employees buy groceries for personal consumption

the regional input-output models to estimate the total 'environmental impacts' of Westland tourism both directly in Westland and also on New Zealand as a whole, and to compare this with the environmental impact of other Westland economic activities. Analyses were carried out on the environmental impacts in terms of water use, energy, and land use.

Chapter 1 of this report discusses the objectives of this study and outlines the place of tourism in the Westland District economy. Chapter 2 describes the research methods used to estimate the significance of tourism, and describes the various surveys undertaken in this research project. Chapter 3 reports our estimates of direct tourism impacts and Chapter 4 reports on the multipliers derived for Westland tourism and hence the indirect impacts of tourism on the Westland economy. The chapter also compares the value of multipliers estimated as part of this research project with multipliers generated by much simpler methods, and comments on changes in multipliers during the last ten years. Chapter 5 brings the earlier results together to estimate total impacts of tourism on the Westland economy, and Chapter 6 outlines a first estimate of the environmental impacts of Westland tourism and other industries.

1.2 Changes in Research Method During the Project

It was originally expected that estimates of direct visitor expenditure could be derived from existing surveys of domestic and international visitor spending[3], but as the research progressed it became apparent that the international visitor survey (IVS) data, representing only broad average per day expenditure across the country, are not particularly accurate as regards any particular region. The number of respondents involved in the Domestic Travel Monitor (DTM) (Forsyte, 2000), was such that the number of respondents who had been to the remote Westland District was small, and hence at this stage[4] the sample is an unreliable guide to of the visitor population as a whole. In the light of these data limitations, it became necessary to calculate the direct expenditure by alternative methods. The two possibilities were either to survey visitors to Westland to establish rates of expenditure in different sectors, or to estimate direct employment in tourism activities (by undertaking a census of employment in relevant businesses) and combine this with this project's survey of activities' employment: output ratios to calculate activities' output. The latter approach was chosen because it was felt to be more accurate and more cost-effective than the alternative.

1.3 Employment in Westland District (1986 - 1998)

The 1996 census found that at March of that year, total employment in Westland District was around 3,600 people. Table 1 shows employment by sector for three recent census years and for two recent business survey years. A breakdown by sector (see Table 2) shows that the major sources of employment were agriculture, forestry, mining, food manufacturing, wood and paper products manufacturing, construction and the various services industries (which incorporate the various aspects of tourism). The table includes data from 1991 and shows that during the last 12 years the structure of employment in Westland District has changed significantly. There was a large (11%) decline in total employment from 1986 to 1991, but by 1996 employment had

3 The International Visitor Survey (Tourism New Zealand; www.tourisminfo.govt.nz) and the Domestic Tourism Monitor (Forsyte, 2000).

4 A second year of data current under collection "Domestic Tourism Monitor (2001)" (undertaken by Forsyte Research for Foundation for Research Science and Technology) will double the size of the database and allow more robust analysis in future years.

recovered to 1986 levels. Since then it has probably declined in the order of between zero and eight per cent. The high level of "unidentified industry" in the 1998 census and the less-than-complete (but constantly improving) coverage of the Business Survey make it difficult to be sure of changes over the last five years.

Over the last 15 years there have also been very significant changes in the distribution of employment between industries (although the very rapid increase in the number of people working in "unidentified" industries makes comparisons between the 1996 and 1986 censuses rather hazardous). From 1986 to 2000 there appears to have been a rapid decline in the number of people employed in forestry (-46%), hunting and fishing (-47%), mining (which doubled from 1986 to 1996, but has since dropped and is now 16 per cent below 1986), wood processing (-53%), utilities (-87%), construction (-29%) communications (-90%), health and education (-32%) and other services (-43%). The decline in these industries has been offset by growth in food manufacture (25%), other manufacturing (40%) and most industries associated with tourism including retail trade (21%), accommodation (31%), restaurants (260%) and air transport (21%). Interestingly, there has been little growth in employment in ground-based activities (included in recreation and cultural services) up by 11 per cent. During the past 15 years there has been a slight decrease in overall employment, but a significant shift away from primary industries into the tertiary sector.

The business survey has not collected data on agricultural employment, but the 1986 and 1996 census data suggests that any decline over this period was small. In the last five years there has been a 40 per cent increase in the number of dairy cows in Westland (Livestock Improvement Co-op., 2001), and we estimate that this has increased employment in agriculture by 50 FTEs.

While it has not been possible to determine accurately the number of people from the "declining" industries who have taken up jobs in tourism, it seems likely that tourism has been important in providing alternative employment for those displaced from other industries.

A comparison of "peak season" and "annual average" employment has been made using data collected in the employment census carried out for this study. There are significant differences in the two, and the implication is that Official Census and Business Survey data need to be adjusted down to get a true picture of average employment over the year. We estimate that mid-March employment figures (when tourism is still close to the peak) overstate the annual average figures by ten per cent in retail trade, 13 per cent in air travel, 30 per cent in activities, 32 per cent in restaurants, and 39 per cent in accommodation. Adjustments for these factors shows that average annual employment in Westland is probably in the range 3,000-3,300 FTEs (see Table 1).

Table 1
Employment (Full Time Equivalent)[1] by Sector (1986-2000)

Industry	2000 Annual Average [2]	Business Survey [3]		Census Data and Census Base (1998)		
		2000	1996	1996	1991	1986
Agriculture[4]	550	550	498	498	480	528
Forestry	112	112	160	156	168	207
Fishing & Hunting,	27	36	30	33	48	51
Mining	63	63	145	141	132	75
Food Manufacture	195	195	118	183	171	156
Wood & Paper Products	119	119	50	114	168	252
All other manufacturing	126	126	166	141	99	90
Electricity, Gas & Water	9	9	23	27	45	69
Construction	192	192	183	195	186	270
Wholesale & Retail Trade	360	397	417	354	297	327
Restaurants	140	183	123	132	54	51
Accommodation	250	350	310	279	219	267
Air Transport	50	55	40	39	27	21
Transport	142	142	111	99	81	117
Communications	12	12	18	18	39	117
Business & Prof. Services	116	116	194	156	150	126
Recreation & Cultural Services	70	88	65	90	45	81
Health & Education	365	365	458	381	468	537
All other services	112	112	151	273	294	195
Not identified	0-295[5]	0-295[5]	295[5]	285	0	24
TOTAL (FTEs)	**3,010-3,305**	**3,292-3,587**	**3,594[5]**	**3,594**	**3,171**	**3,561**
Change since preceding census		-8 to 0%		+13%	-11%	

Notes:
1. Measured as full time plus half of part time, as at the census survey date (March of the various years).
2. The '2000 annual average' figures adjust down the wholesale and retail, restaurants, accommodation, air transport and recreation industries according to the factors found by our survey
3. 'Business Frame 1998'. Statistics NZ.
4. Data on agriculture based on 1996 census and adjusted for known increase in dairying (a 40% increase in dairy cows between 1996 and 2001 (Livestock Improvement Co-op., 2000).
5. Business survey coverage was rather limited in 1996, which is one reason why the 1996 census and business survey figures differ. The difference in 1996 was 498 FTEs in agriculture and 295 FTEs in unidentified industries. Coverage is believed to now be much more complete, and it is possible that the census figures for 2001 will be similar to the Business Survey figures. Agriculture figures for 2000 data are based on 1996, but increased for reasons described in Footnote (4) above.

Table 2
Employment Changes by Sector (1986-1999)

Industry	Per centage of Non-Agricultural Employment		Changes from 1986-1999		
	1999	1986	Number	%	Share of Total
Forestry	4.2	6.9	-95	-46	-2.7
Fishing & Hunting	1.0	1.7	-24	-47	-0.7
Mining	2.4	2.5	-12	-16	-0.1
Food Manufacture	7.3	5.2	+39	+25	+2.1
Wood & Paper Products	4.5	8.4	-133	-53	-3.9
All Other Manufacturing	4.7	3.0	+36	+40	+1.7
Electricity, Gas & Water	0.3	2.3	-60	-87	-2.0
Construction	7.2	9.0	-78	-29	-1.8
Wholesale & Retail Trade	14.9	10.9	+70	+21	+4.0
Restaurants	6.9	1.7	+132	+260	+5.2
Accommodation	13.1	8.9	+83	+31	+4.3
Air Transport	2.1	0.7	+34	+162	+1.4
Transport	5.3	3.9	+25	+21	+1.4
Communications	0.5	3.9	-105	-90	-3.4
Business & Prof. Services	4.4	4.2	-10	-8	+0.2
Recreation and Cultural Services	3.3	2.7	+7	+9	+0.6
Health & Education	13.7	17.8	-172	-32	-4.1
All Other Services	4.2	6.5	-83	-43	-2.3
Total	**100.0**	**100.0**	**-346**	**+3.8**	--------

1.4 Capital Growth and Infrastructure Demands

Tourism has a long tradition in Westland, and one could expect there to be a lower level of ongoing investment in Westland than in places like Kaikoura where there was only a very small tourism base a decade ago. However, in the last few years, tourism in Westland has been growing rapidly and there has been concomitant upgrading of buildings, plant and equipment. It has been suggested that significant investment in the public sector is needed, (e.g., see NZ Tourism Strategy, 2001) but no investigation of this requirement has been made during this study.

Chapter 2
Theory and Research Method

2.1 Introduction

This chapter contains definitions of terms used in this report, a summary of the way in which both regional economic tables were developed and multipliers were calculated, and details of the surveys undertaken to get the data necessary to build an improved tourism industry structure into the Westland District economic model, and to estimate direct expenditure by visitors. The section on the theory of economic impact models is brief, and assumes the reader has some prior understanding. Those who wish to know more should consult one of the numerous texts on the subject[5].

2.2 Definitions

Employment

Employment is work done by employees and self-employed persons, and is measured in Full-Time-Equivalent jobs (FTEs). A person working part time all year is deemed to be equivalent to 0.5 FTEs. Where it was apparent that the part time work was quite limited, and information was available on the approximate hours worked per week, the FTEs of a part time job was based on 35 hrs per week per FTE. Hence 12 hours per week is 0.3 FTEs.

Where work is seasonal, the conversion to FTEs is based on 12 months work per year. So a seasonal worker working full time for six months per year is 0.5 FTEs, and a part time seasonal worker working ten hours per week for four months is 0.1 FTEs.

Output

Output is the value of sales by a business. In the case of wholesale and retail trade, it is the total value of turnover (and not simply gross margins)[6].

Value-Added

Value-added includes household income (wages and salaries and self-employed income), and returns to capital (including interest, depreciation and profits). It also includes all direct and indirect taxes.

Household Income

Household income is the gross income of households. It includes the income of self-employed persons. There is sometimes considerable uncertainty as to the proportion of business income which goes to households, especially for small businesses. In assessing this proportion, dividends and interest payments to local householders have been excluded, except to the extent that "drawings" by owners for the purposes of household spending could be identified. When estimating indirect economic impacts, one needs to know the increase in household income

5 For example, Richardson et al., (1972); Jensen & West (1982), Butcher (1985).

6 Care has to be taken in combining retail sales figures with employment per $m of output from input - output tables. In these tables, output is generally defined as gross margin. By contrast, business statistics figures usually give employment per $m of turnover.

which occurs in the District and how it will be spent. Where owners of business capital live out of the District, dividends and interest do not form part of the District household income. Even where the owners do live in the District, profits which are not used for household spending do not lead to economic impacts[7].

Direct Economic Impacts

The direct impact arises from the initial spending by visitors on the goods and services they want to consume. The direct employment is of people who produce and sell goods and services directly to tourists. The direct output is the value of purchases made by tourists. The direct value-added is the value-added in those businesses which sell directly to tourists.

Indirect Economic Impacts

The indirect impact arises from increased spending by businesses as they buy additional inputs so that they can increase production to meet visitor demand. This indirect effect can be envisaged as an expanding ripple effect. A tourist buys food and drink at a cafe. The cafe has to employ more staff and buy more bread, so the bakery output expands. The bakery has to employ more staff and buy more electricity, so the power company increases its output. The power company has to increase its maintenance, so it employs another person and spends more on a vehicle for that person. All the increased employment, output and value-added (apart from that at the cafe) is the indirect effect. Note that indirect effects only include "upstream" effects (via buying more inputs), but do not include any stimulated development downstream. So although an expansion of "tourism activities" may lead to more tourists and hence an expansion of accommodation, the extra accommodation is not included as a flow-on effect of the activity, and hence is not included in the multiplier.

Induced Economic Impact

The induced impact is the result of increased household income being spent, and leading to a further ripple effect of increased employment, output and income.

Flow-on Effects/Upstream Impacts.

The sum of indirect and induced effects are sometimes termed the flow-on effects, or upstream impacts.

Downstream Impacts

Impacts which are not driven by an activity's demand for extra inputs, but which might arise as a result of a particular activity, are sometimes called the "downstream impacts". An example in Westland tourism would be where the development of guided trips on glaciers has led to people staying longer and hence to an increased demand by visitors for accommodation and food. The accommodation and food is not an input into the guiding, and hence is not an indirect or induced effect of the guiding. It is a downstream effect.

Total Economic Impacts

The total Type I impact is the sum of the direct and indirect impacts, and a Type II impact is the sum of direct, indirect and induced impacts.

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7 Profits may be invested back into the District, but the impacts of this investment are excluded on the grounds that the investment could be financed by borrowing and hence is not dependent on the earlier profits.

Multipliers

A Type I multiplier is the ratio of (direct + indirect) impacts to direct impacts, and a type II multiplier is the ratio of (direct + indirect + induced) impacts to direct impacts. The Type II multipliers include the impact of household spending and hence will always be greater than a Type I multiplier. Both multipliers will always be greater than one. Note that downstream effects (whether positive or negative) are not included in the multiplier, and must be calculated separately.

2.3 Principles of Multiplier Analysis

When visitors spend money on various services and goods, this generates direct employment, output, and value-added. The businesses which sell to tourists use part of the money received to purchase goods and services from other local businesses, which as a result purchase more inputs than they otherwise would. These "business support" effects are generally termed "indirect" effects. To find out the scale of the indirect effects, one must examine the expenditure patterns of the tourism businesses. What do they buy, and from where do they buy it (in Westland or out of Westland)? This examination was done through the expenditure survey of tourism businesses (see Section 2.6).

Businesses purchase not only goods and services, but also labour. The businesses pay for labour via either wages and salaries or drawings (by the owners of the business). The increase in household income arising from tourist spending leads to increased household expenditure, which further increases output, value-added and employment in the Westland economy. These additional effects generated by household spending are termed "induced" effects, and their extent depends on the proportion of household spending which is undertaken within the District. This proportion was estimated during the development of the GRIT model (see below) as being 25 per cent, but those interviewed during the business survey believed that a more realistic figure for their households was of the order of 75 per cent. The model was adjusted accordingly.

2.4 Generation of a Westland District Economic Model

While one can question businesses in tourism to find out what they purchase, this gives only the first round of indirect impacts. To estimate the further impacts caused by the spending of businesses further down the chain, one has the option of surveying all those businesses as well (which is prohibitively expensive), or estimating the probable pattern of their expenditure on the basis of information that already exists about national average expenditure patterns of businesses of this type, and the regional location of businesses that supply those inputs. For example, if we know that one per cent of all retail costs is spent on plastic bags and we know that Westland has no plastics factory, then we can assume that this one per cent of costs are imported into the region. If we know that on average three per cent of retail costs is spent on uniforms, and if we know that there are sufficient clothing factories in Westland for the District to be 50 per cent self-sufficient in clothing, then we assume that 1.5 per cent of inputs are purchased from the local clothing industry, and a further 1.5 per cent of inputs are imported into the area.

All the information and assumptions are incorporated into a separately estimated District input-output model. This specific District model is generated using an existing national input-output model, information about the regional distribution of employment and output, and a relatively simply mathematical technique called GRIT [8] (Generation of Regional Input-output Tables - which estimates the source of inputs into regional industries). This model is then adjusted by incorporating into it the survey data that has been gathered about the structure of actual tourism businesses in Westland (see Expenditure Survey of Tourism Businesses - Section 2.6). The input-output model can be used to calculate the total effects on all sectors of an increase in output of any single sector. These total effects include the original effect and all the consequential rounds of indirect and induced effects. Note that it does not include any downstream impacts (see definition of indirect impacts above).

The Westland District economic model generated for this study is based on the national inter-industry model for 1994/95[9]. Up-to-date District tourism industry survey data, gathered during this project, and 1996 census data are then incorporated into the Westland District model to update it still further.

The GRIT process uses District output by industry as its starting point. There is limited information currently available on regional output by industry, especially for a small region such as Westland. Statistics New Zealand will not release highly disaggregated data on the grounds that to do so would breach commercial confidentiality of businesses supplying the data. For Westland the most detailed data that are available relates to employment as measured by the census. Using these data the process for estimating Westland District output for each industry is as follows:

1. Take the best output distribution data that are available. In this case it is relatively old (1986/87) data, and is for a larger region (West Coast Region),

2. Estimate the subsequent change in the West Coast region's share of national output on the basis of the subsequent change in the region's share of national employment in that industry (comparing the 1986 and 1996 census data),

3. Estimate the Westland District's share of West Coast Region output on the basis of the District's share of regional employment (using 1996 census data).

Once this has been done, the District inter-industry table is estimated using the standard GRIT procedure. It should be noted that the District input/output table shows employment which differs from actual employment in the District. This is so that estimates of changes in regional employment which flow from the expansion of industries reflect national average employment: output ratios rather than existing District ratios[10].

8 Developed in Australia and widely used there and in New Zealand. See West et al., (1982), or Butcher (1985).

9 It may seem that even a 1994/95 model is very dated, but it is quite up-to-date as far as inter-industry models go, since a full model requires the collection of considerable data, much of which does not become available until two years after the year to which it refers. A more accurate 1996/97 model is expected to become available in mid-2001.

10 For details of the reasons, see Butcher (1985) pp. 6 - 10. In short, it is believed that any under-employment in a particular regional industry will not persist long-term, and it is likely that expansion will reflect national average technology rather than current local technology.

2.5 Estimates of Multipliers for Tourism

Once the survey information had been incorporated into the District model, employment, output, value-added and household income multipliers can be estimated using matrix algebra[11]. Type II multipliers (which include induced effects) were calculated. It is clear that the increased direct household income from tourism stimulates household spending and hence economic activity in the District, and for this reason it seems appropriate that Type II multipliers be used to calculate total economic impacts of tourism.

2.6 Estimates of Direct and Total Impacts.

Output

The original hope was that estimates of direct visitor spending would be made by surveying visitors to find out how much they spend per day, and by rating this up by estimates of total visitor days provided by the International Visitor Survey (IVS) and Domestic Travel Monitor (DTM). Unfortunately, this approach was not feasible for two reasons. First, visitors spend quite some time in Westland and accurate recall on exit would have been difficult and time consuming. This was a particular problem in that the expenditure questions would have been incorporated into a visitor behaviour survey which was already very demanding on participants. A second reason for not pursuing this approach was that it became obvious that results from the IVS and DTM were likely to have a high error margin because of the low number of participants who actually visited the West Coast. Hence the estimate of total direct expenditure from this source was not made.

Alternative estimates of visitor spending in accommodation and activities were obtained from the project survey of tourism businesses coupled with the project census of tourism-related employment. The project survey of tourism business accounts provided data on typical output per employee in the accommodation and tourism activities businesses, and these figures were multiplied by the estimate of total employment in accommodation and activities to give total output for these sectors. Output per person (FTE) in retailing was estimated from national average data[12], and this figure was multiplied by the number of FTEs in retailing established through the employment census (see above) to give employment in the tourism sub-sector of each of these industries. Earlier work[13] suggests that this approach does give in fact an estimate of output which is similar to the figure obtained by surveys of visitor expenditure per person multiplied by estimates of visitor numbers.

A comparison was made with other available data (surveys in Kaikoura and Rotorua and the Statistics New Zealand accommodation survey) to highlight any major differences in employment to output ratios between centres (and hence identify potential errors in accounts analysis). By this test, the data from the West Coast survey was found to be very consistent with earlier work.

11 Customised software (e.g., IO7- available from the authors) which undertakes the matrix manipulation is readily available. Numerous texts are available which describe general input-output models.

12 "Business Activity 97", Statistics New Zealand 1998.

13 "The Economic Impact of Tourism on Kaikoura", Butcher et al., (1998).

Employment

We estimated total direct employment in all tourism-related businesses by undertaking an employment census of these businesses (every business in Westland with an obvious "public presence" was contacted face-to-face). Businesses were asked for data on total employment during the previous year, and were also asked to estimate what proportion of their sales were made directly to "visitors". The two figures were multiplied together to give total tourism employment. Data on direct employment in accommodation was also compared with employment data obtained from the Statistics New Zealand accommodation survey, and the results were found to be similar.

The project survey data were preferred because of the known casual approach of businesses to complying with the Statistics New Zealand survey and, more importantly, the uncertainty as to how survey respondents allocate employment where there are joint outputs (accommodation and restaurants).

Value-added

We estimated the ratio of value-added to output for accommodation and activities by undertaking a survey of business expenditure. For other industries, national average value-added to output ratios were obtained from Statistics New Zealand[14]. For each industry, value-added was estimated by multiplying output by the appropriate ratio.

Total Impacts

The multipliers estimated from the District economic model were applied to the estimates of direct employment, output and value-added to get estimates of total employment, output, and value-added arising from tourism. By definition, the difference between total and direct effects is the indirect plus induced effect.

2.7 Surveys

Two surveys were undertaken to gather the data necessary to estimate regional economic impacts of tourism.

Employment Census of Westland Tourism Businesses.

All businesses in Westland with an obvious "public face" (advertising or road frontages) were visited (a total of 250 businesses were contacted). Responses were not available from a small number of small businesses (no one available to talk to) and in these cases estimates were made based on information from other local people. Businesses visited included tourist activities, accommodation, manufacturing retailers (e.g., greenstone studios) and all forms of retail trade. The respondent at each business was asked how many people worked at the business, whether the work was full time or part time, and for how many months per year the work lasted. This information was combined to estimate total Full Time Equivalent (FTE) jobs in the business. Each business was then also asked to estimate what proportion of sales were directly to visitors, and the numbers were combined to estimate direct tourism employment. Some small businesses may have been missed (identification was by reviewing available data sources and walking/driving the streets and roads of Westland from Jacksons Bay north). For this reason the

14 "Business Activity 97", Statistics New Zealand 1998; "New Zealand Inter - Industry Study, 1994/95", Statistics New Zealand.

survey may have underestimated direct employment, but the understatement is expected to be only one or two per cent.

Expenditure Survey of Tourism Businesses.

To estimate the indirect effects of tourism spending, it is necessary to know what inputs (including labour) tourism businesses purchase. Detailed expenditure data were sought initially from 40 tourism operators (the population was stratified by activity and size, and the participants were randomly selected within each stratum, except that almost virtually all the major operators were included). The refusal rate was low (around 20%) and a further ten per cent gave data that were not sufficient for the purposes of the analysis. A total of 27 completed sets of data were gathered. These included two manufacturers/retailers, two retailers who focus on visitors, a visitor centre, six restaurants, 15 accommodation businesses, and seven activities businesses (see Table 3).

Of the eight businesses who refused or could not be contacted, two had not owned the business for long enough to generate a set of annual accounts, and the remainder seemed to refuse primarily because of their reluctance to provide financial data, in spite of the fact that the interview was being undertaken directly by the researchers (rather than a market research company) and the respondents were assured that no other person would see the information relating to an individual company. All except three of those who did provide data made most or all of their financial data available, but in some cases it was difficult to distinguish between profit and household income. This was particularly true of smaller owner-operated businesses, which are common in the accommodation sector. In comparison to other Districts studied, small scale "activities" operators in Westland form a low per centage of the activities industry, with the majority of people being employed in a few relatively large businesses (guiding and flying).

The level of business co-operation was as good as was the case in Kaikoura and considerably better than in the case of Rotorua, and it is believed that the available data give a reasonable representation of types of business in the tourism sector of the Westland District economy. The data should therefore give a good indication of typical expenditure patterns of those involved in the industry. The sample selection procedure meant that data were obtained from a range of large and small firms in all activity sectors (except that homestay accommodation providers were not surveyed). The sub-sector definition, the number of businesses interviewed, and the respondents as a proportion[15] of the sub-sector are also shown in Table 3. No hunting guides were contacted because they operate very informally and often have other employment as well. The number of guides is believed to be of the order of five FTEs.

15 Estimated on the basis of share of sectoral employment or, in the case of accommodation, as a proportion of the share of sectoral room capacity.

Table 3
Business Survey Respondents by Sector

Sector	No. Interviewed	Sample employment as proportion (%) of sector employment
Souvenir Manufacture & Retail	2	10
Retail and Information	3	8
Restaurants	6	42
Accommodation	15	27
Aerial Activities	2	25
Ground-based Activities	5	40
Total	**33**	

2.8 Estimation of Employment to Output, Valued Added to Output and Household Income to Output Ratios

The relationships between output and employment as well as output and value-added were estimated on the basis of a detailed analysis of the accounts of a sample of tourism businesses which included most of the larger tourism operators (several large hotels, restaurants, guiding and aircraft [including helicopter] companies).

Chapter 3
Direct Tourism Impacts

3.1 Introduction

This chapter focuses only on direct tourism impacts while the next chapter focuses on multipliers and Chapter 5 brings all these figures together to show total impacts of tourism. This chapter starts with direct tourism employment and estimates total sales (as well as gross margins in the case of retailing), added value and household income on the basis of surveyed employment to output, household income to output and value-added to output ratios. The results presented here are brought together in a comprehensive table at the end of the chapter.

3.2 Direct Tourism Employment

Direct tourism employment was estimated on the basis of the census of tourism businesses (described above). The results suggest (see Table 4 below) that total direct employment in tourism was approximately 810 FTEs.

Table 4
Surveyed Employment in Westland Tourism (1999/2000)

	Total FTEs Employed	Proportion (%) of Sales to Visitors	Total FTEs in Tourism
Handicrafts[1] for Visitors	73		63
Retail	294	86	123
Visitor Centres[2]	46	50	46
Restaurants	281	72	203
Accommodation	220	98	215
Activities (air)	67	93	62
Activities (ground)	94	94	88
Other Surveyed Services	28	14	5
Hunting Guides	6		5
Total			**810**

Notes: 1 This includes glass, greenstone and other handicrafts with output sold primarily to visitors. It generally includes a retail element of direct sales to visitors.
2 Employment at DOC visitor centres is included. Employment in other DOC conservation and visitor amenity maintenance is excluded.

3.3 Direct Output in Tourism

The detailed industry survey data provided information on employment to output ratios, except for retail sales (no detailed industry survey was done for retailing). These ratios were applied to the employment figures above, and in the case of retailing, national average figures for employment per $m of output[16] (gross margin as opposed to sales) were used. For visitor centres, an employment to output ratio of 25 FTEs/$m was assumed[17]. On the basis of those figures, we estimate that total direct output in tourism was $82m per year in 1999/2000. As explained in Footnote 16 retail sales are approximately three times the value of retail output. Hence total direct expenditure by tourists is calculated as $82.4m plus an additional doubling of the retail output figure (i.e., two times $12.6m) to equal $107.6m.

Table 5
Estimated Direct Output in Westland Tourism (1999/2000) ($M)

	Total FTEs in Tourism	**Employment per $M of output**	**Output in Tourism ($M)**
Handicrafts[1] for visitors	63	10.3	6.1
Retail	123	9.8	12.62
Visitor Centres[2]	46	25	1.83
Restaurants	203	12.4	16.4
Accommodation	215	9.2	23.4
Activities (air)	62	}	}
Activities (ground)	88	}7.2	}20.8
Other services	10	8	1.3
Total	**805**	**9.9**	**82.4**

Notes: 1 This includes glass, greenstone and other handicrafts with output sold primarily to visitors.
2 "Output" in retail is defined as gross margin. The value of "sales" to tourists is approximately three times the value of "output".
3 This includes staff at DOC Visitor Centres. Employment in DOC outside the visitor centres is excluded from employment and output estimates. The output per employee in visitor centres is based on data for one Westland visitor centre, which is reasonably consistent with figures for education.

The surveyed employment to output ratios of 12.4 FTEs per $1m sales for restaurants and 9.2 FTEs per $1m sales for accommodation are very similar to national averages, suggesting that Westland accommodation and restaurant businesses use labour as efficiently as does New Zealand as a whole.

3.4 Direct Value-added and Household Income in Tourism

Information on the ratio of value-added to output and, household income to output comes from the study survey of businesses (accommodation, restaurants, manufacturing for visitors, and activities) and from Statistics New Zealand[18] (retail). Based on these data, we conclude that tourism is directly responsible for $44m added value and $24m gross household income in Westland District.

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16 In retailing, output is equivalent to gross margin rather than sales. Gross margin is reported for retail activity because it is the concept of output used in the Inter-Industry regional economic model, and also because it gives a more realistic indication of economic impact. The value of "sales" to tourists is approximately three times the value of "output".

17 This is reasonably consistent with data gathered from one visitor centre in Westland, and also with data for "education", which was chosen as a typically labour intensive industry.

18 "Business Activity 97"; "National Inter-Industry Study 1995".

The household income figures for small businesses are uncertain because the reported allocation of income between profits and drawings reflects very much accounting and tax advantages rather than actual financial flows. However, while the small businesses are large in number, they represent less than a third of the survey turnover.

3.5 Conclusion

Table 6 brings together the key results of this chapter. Visitors to Westland spend approximately $82m per year in the District. This expenditure leads directly to 810 jobs, $44m of value-added, and $24m of household income.

Table 6
Direct Employment, Value-added and Household Income in Westland Tourism

Sector	Sector Output ($M)	Direct Value-added to Output Ratio	Direct H/hold Income to Output Ratio	Direct Empl./$M	Direct Impacts		
					Value-added ($M)	H/hold Income ($M)	Empl. (FTEs)
Handicrafts for Visitors	6.1	0.64	0.33	10.3	3.9	2.0	63
Other retail							
Total Sales	38.0						
Gross Margin	12.6	0.52	0.37	9.8	6.6	4.7	123
Visitor Centres	1.8	0.78	0.49	25.0	1.4	0.9	46
Restaurants	16.4	0.43	0.30	12.4	7.1	4.9	203
Accommodation	23.4	0.64	0.24	9.2	15.0	5.6	215
Activities	20.9	0.44	0.23	7.2	9.2	4.8	150
Other Services	1.3	0.45	0.54	8.0	0.6	0.7	10
Total	**82.4**				**43.8**	**23.6**	**810**

Chapter 4
Multipliers and Total Tourism Impacts

4.1 Survey Results

As one might expect, the limited range of manufacturing enterprises in Westland means that while most businesses buy from local retailers, the vast majority of goods are produced out of the District (obvious exceptions include a number of food items and some souvenirs). This would indicate multipliers would be relatively low. A large proportion of services are purchased locally.

4.2 Estimates of Multipliers for Tourism

Once the basic GRIT-generated District model had been "enhanced" (by incorporating the handcraft manufacturers, restaurants, accommodation and activities business expenditure survey data), multipliers were estimated for employment, output, value-added and household income. Given the error margins associated with the estimates of direct value-added and household income, the value-added and household income multipliers are also subject to wide margins of error.

Multipliers based on this enhanced model are given in Table 7 for the four major industry groups of handcrafts manufacturing, restaurants and cafes, accommodation, and activities. Also given are multipliers for education (as a proxy for visitor centres) and retailing from the basic GRIT table. Employment multipliers[19] range from 1.07-1.28 and total employment impacts range from 8.3-13.3 jobs per $1m of direct visitor expenditure. Output multipliers range from 1.21-1.65. Value-added multipliers range from 1.14-1.27 and total value-added ranges from 52 per cent to 81 per cent of direct visitor expenditure. Household income multipliers range from 1.11-1.30, and total household income ranges from 27 per cent to 43 per cent of direct visitor expenditure.

The interpretation of the figures in Table 7 (using accommodation as an example) is as follows:

- Output: Every $1m of visitor spending has flow-on effects of $0.18m, and the total increase in District output is $1.18m.
- Employment: Every $1m of annual spending increases employment directly by 9.2 FTEs, and flow-on effects generate a further 1.1 FTEs so that in total 10.3 FTEs are created. The ratio of total to direct employment effects is 1:12.
- Value-added: Every $1m of direct expenditure increases value-added directly by $0.64m, and flow-on effects increase value-added by a further $0.09m so that in total valued added in the District increases by $0.73m. The ratio of total to direct value-added effect is 1:14.
- Household Income: Every $1m of direct expenditure increases household income directly by $0.24m, and flow-on effects increase household income

19 Leaving aside visitor centre multipliers, because these are not directly commercial ventures funded by visitor spending.

by a further $0.05m, so that in total household income increases by $0.29m. The ratio of total to direct household income effects is 1:18.

Table 7
Tourism Impacts and Multipliers in the Westland District

	Enhanced GRIT model adjusted to reflect survey data [1]				Basic GRIT Model [2]			
	Manufacturing	**Restaurants**	**Accommodation**	**Activities**	**Retail**	**Visitor Centre**	**Restaurant**	**Accommodation**
Output Multiplier								
Direct	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Indirect	0.25	0.09	0.11	0.10	0.09	0.05	0.15	0.11
Induced	0.10	0.08	0.07	0.06	0.10	0.18	0.08	0.07
Multiplier(Type II)	1.35	1.17	1.18	1.16	1.19	1.23	1.23	1.18
Employment Impacts								
Direct (FTEs/$m)	9.5	12.3	9.2	7.2	9.8	25.0	12.4	9.2
Indirect	2.2	0.7	0.8	0.8	0.6	0.5	0.8	0.8
Induced	0.4	0.3	0.3	0.3	0.4	0.5	0.3	0.3
Total (FTEs / $m)	12.1	13.3	10.3	8.3	10.8	26.0	13.5	10.3
Multiplier (Type II)	1.28	1.07	1.12	1.15	1.10	1.04	1.09	1.11
Value-added								
Direct : Output ratio	0.64	0.43	0.64	0.45	0.52	0.78	0.44	0.39
Indirect	0.11	0.04	0.05	0.07	0.05	0.03	0.05	0.05
Induced	0.06	0.05	0.04	0.02	0.06	0.11	0.05	0.05
Total : Output ratio	0.81	0.52	0.73	0.54	0.63	0.92	0.54	0.49
Multiplier (Type II)	1.27	1.20	1.14	1.20	1.20	1.17	1.23	1.26
Household Income								
Direct : Output ratio	0.33	0.30	0.24	0.23	0.37	0.70	0.29	0.27
Indirect	0.09	0.03	0.03	0.03	0.03	0.02	0.03	0.03
Induced	0.01	0.01	0.02	0.01	0.01	0.04	0.01	0.01
Total : Output ratio	0.43	0.34	0.29	0.27	0.41	0.76	0.33	0.31
Multiplier (Type II)	1.30	1.11	1.18	1.19	1.11	1.06	1.15	1.16

Notes: 1 The survey data were incorporated into the District table (generated by the GRIT process) and multipliers were then calculated from this expanded and adjusted table.
2 The multipliers were obtained directly from the GRIT-based District table, and do not take account of the survey data. Visitor centres are based on education.

4.3 Comparison of Multipliers

The purpose of undertaking survey work is to ensure that the District economic model reflects the expenditure patterns of businesses more accurately than does the Basic GRIT model. There has always been concern about the accuracy of multipliers from Basic GRIT tables, especially where analysts assume that they can apply employment multipliers for an apparently similar industry directly to some estimates of direct employment for the project they are reviewing. This study provides an opportunity to compare impacts and multipliers from a survey-enhanced GRIT table with multipliers for similar industries calculated from a Basic GRIT table. Table 7, shows Basic GRIT model multipliers for Accommodation and for Restaurants, and also shows adjusted multipliers for the surveyed industries of accommodation and restaurants. The results of the comparison are shown in Table 8.

A comparison of the impacts and multipliers derived from the Basic GRIT model with the impacts and multipliers from the Enhanced GRIT model suggests that using Basic GRIT total ratios to estimate total effects, or applying Basic GRIT multipliers to survey estimates of direct impacts to estimate total impacts, will give generally reliable results for employment, but not such reliable results for value-added. Applying Basic GRIT total ratios to surveyed direct expenditure gives results which are on average closer to results from a survey-enhanced GRIT model, but the differences can still be significant.

Table 8 suggests that if one is not able to incorporate survey data into a regional model, then if one wants to estimate total employment or value-added impacts, one is better to apply GRIT-based multipliers to survey-based direct employment or direct value-added figures than to apply GRIT-based total impact ratios. In the former case the error range is +1 to +10 per cent while in the latter case the error range is +1 to - 33 per cent. While the figures in Table 8 suggest that the GRIT-based tables are reasonably reliable, this ignores the fact that the GRIT-based tables do not provide any multipliers at all for visitor activities or for craft industries.

The implication is that detailed surveying provides more accurate results, and is justified where this greater accuracy is necessary. Our judgement is that in the case of the three Districts we have studied so far in this project (Kaikoura, Rotorua and Westland) the surveying has been worthwhile both to establish more accurately the margins of multiplier error and also to establish the absolute level of economic effect. Given that results suggest the Basic GRIT tables are only accurate to plus or minus 20 per cent, and given that the error sign is not consistent, then in our view surveying is justified in almost all cases where decision makers wish to know something about the economic impacts of industry growth or decline. This is particularly the case where (as in tourism, and particularly in tourism activities) basic data about the size of the industry are not known, or where the industry is not easily analysed from the existing input-output tables.

Table 8
Comparisons of Basic GRIT and Survey-enhanced GRIT Impacts

Industry	Survey-enhanced GRIT	Basic GRIT	Variation (%) Basic to Enhanced
	Restaurants	Restaurants	
Direct Emp/$m	12.3	12.4	+1
Total Emp./$m	13.3	13.5	+2
Emp Multiplier	1.07	1.09	+1 [1]
Direct Value-added	0.43	0.44	+2
Total Value-added	0.52	0.54	+4
Value-added Mult.	1.20	1.23	+2 [1]
Output Multiplier	1.17	1.23	+5
	Accommodation	Accommodation	
Direct Emp/$m	9.2	9.2	0
Total Emp/$m	10.3	10.3	0
Emp Multiplier	1.12	1.11	-1 [1]
Direct Value-added	0.64	0.39	-60
Total Value-added	0.73	0.49	-33
Value-added Mult.	1.14	1.26	+10 [1]
Output Multiplier	1.18	1.18	0

Notes: 1 This figure is equivalent to the error in total employment estimates resulting from multiplying surveyed employment (or value-added) by the GRIT-based District multiplier.

4.4 Changes in Multipliers Over Time

Multipliers for specific industries can be expected to change over time, particularly in a small region where an industry is expanding rapidly. This is because industry growth makes it viable for support industries to establish. However, in an industry which has been long-established in a region, one might expect the multipliers to change according to national trends towards concentration in fewer centres. Information[20] on changes in District self-sufficiency over the last decade was examined to see whether the multipliers could be expected to change. By looking at changes in GRIT-based multipliers over the last decade, we were able to form a view on likely trends in Westland tourism multipliers. As Table 9 shows, there has been a steady decline in West Coast regional multipliers over the last decade or more, with the decline being most pronounced in the employment multipliers (where the flow-on effects are only half to two thirds of what they were 15 years ago). The implication of this decline is that expansion of driving industries such as tourism now has a smaller flow-on effect than in the past, which in turn means that growth in tourism is less of a panacea than it was for declines in other industries. The smaller flow-on effects, however, do not annul the argument for public support of the industry, because the relatively high employment impacts of tourism suggest that growth of tourism continues to be a valuable regional development tool.

20 Using a series of regional Basic GRIT models for 1986/87, 1990/91 and 1994/95. See Butcher 1985, 1994, 1996 and 1998.

Table 9
Trends in West Coast[1] Tourism Multipliers over Time

	Retail	Accommodation	Restaurants	Recreation & Culture
Output Multipliers				
1976/77	?.? (joint)	?.? (joint)	?.? (joint)	-
1986/87	1.58	1.69	1.76	1.69
1990/91	1.60	1.78 (joint)	1.78 (joint)	1.67
1994/95	1.53	1.65	1.62	1.46
% Change in Flow-on effect from 1986/87 to 1994/95[2]	-4%	-6%	-18%	-33%
Employment Multipliers				
1976/77	?.? (joint)	?.? (joint)	?.? (joint)	-
1986/87	1.51	1.63	1.48	1.77
1990/91	1.35	1.42 (joint)	1.42 (joint)	1.55
1994/95	1.36	1.43	1.30	1.36
% Change in Flow-on effect from 1986/87 to 1994/95[2]	-29%	-32%	-63%	-53%
Value-added Multipliers				
1976/77	-	-	-	-
1986/87	1.55	1.84	1.90	1.74
1990/91	1.57	1.96 (joint)	1.96 (joint)	1.75
1994/95	1.54	1.79	1.64	1.41
% Change in Flow-on effect from 1986/87 to 1994/95[2]	-2%	-6%	-29%	-45%

Notes: 1 West Coast region was used since models for Westland District are not available for earlier periods.
2 The decline in flow-on effects must exclude the direct effects in each case. Hence in the case of retail output, the total output impacts have gone from 1.91-1.75, but the flow-on impacts have gone from 0.91-0.75, hence a decline of 18%.

Chapter 5
Total Impacts of Tourism on Westland

5.1 Introduction

This chapter brings together the data on direct impacts and multipliers to estimate total economic impacts of tourism in the Westland District. The direct impacts of tourism (Table 6) are combined with the tourism multipliers generated from the survey-enhanced GRIT District model (Table 7) to generate estimates of total tourism employment, output and value-added impacts in Westland District. These are summarised in Table 10.

5.2 Employment

On the basis of the information collected by our surveys and supplemented with data from other sources, it is estimated that direct employment in tourism (including a share of employment in businesses who sell only part of their output to tourists) is 810 FTEs. Many more people than this (of the order of 1,300 people[21]) work in industries with a significant (>50%) tourism component.

On the basis of the estimated employment multipliers and (additional downstream indirect) employment, we conclude that tourism generates a total of 902 FTE jobs in Westland. On average, every direct tourism job generates approximately 0.11 other jobs elsewhere in the District. A comparison of indirect and induced impacts suggests that about one third of this additional activity arises as a result of increased household spending by those working in the industries which depend on tourism.

Figures from the March 1996 census and more recent employment surveys suggest that in March 2000 there were some 3,300-3,600 jobs (FTE) in Westland District. Investigation of the data gathered in the survey of businesses suggests that at the seasonal peak, there are approximately 300 more jobs (FTEs) than there are on average during the year. Given that the census and business survey data were done when the season is still in full swing, it seems likely that annual average employment is in the range 3,000-3,300 FTEs.

If this is so, then 24-27 per cent of all jobs in the District depend directly on tourism, and 27-30 per cent depend directly or indirectly on tourist spending. The total direct employment of 810 FTEs in tourism makes it the largest sector of the economy. Table 1 page 2 shows that agriculture employs 550 FTE. On the basis of FTE components the data in this report indicate tourism generates 29 per cent of the regional economy.

21 Many of those in tourism industries are working only part time or part year. Approximately one third of the FTEs are people who work only part time or part year. There were 870 FTEs involved in jobs with a tourism component of over 50 per cent (and 930 FTEs involved in jobs with a tourism component of over 30%). If half of those FTEs in predominantly-tourism industries were part time or seasonal, then the number of people working in tourism industries was 1,300.

5.3 Output

It is estimated that annual visitor spending of approximately $108m in Westland District increases output by approximately $82m directly per year. Flow-on effects increase the total tourism-dependent output in the District to $98m per year.

5.4 Value-added and Household Income

Visitor spending generates directly $44m of value-added per year in Westland. Our estimate suggests that approximately $24m of this is gross household income. The inclusion of flow-on effects means that total tourism-dependent value-added is approximately $52m per year, with almost $28m of this being gross household income.

5.5 Multipliers

Employment multipliers (flow-on effects) for tourism in Westland are about half of what they are in Kaikoura and less than a third of what they are in Rotorua. The much lower levels than in Rotorua are expected because the Westland economy is very concentrated in a few sectors and as such resorts to 'importing' many of the ongoing requirements to support the tourism sector. However, it is surprising that the multipliers in Westland should be so much lower than in Kaikoura, when both centres have around the same proportion of their economy (30%) dependent on tourism. The tautological answer is that Kaikoura is more self-sufficient than is Westland, but an interesting extension of this research programme would be to investigate the areas of greater self-sufficiency and the reasons for this.

Table 10
Summary of Economic Impacts of Tourism on Westland District

	Direct Impacts	Multipliers (Type II)	Total Impacts
Output ($m)			
Handicrafts for visitors	6.1	1.35	8.2
Retail and other	13.9	1.19	16.5
Visitor Centres	1.8	1.23	2.2
Restaurants & Cafes	16.4	1.17	19.2
Accommodation	23.4	1.18	27.6
Activities	20.8	1.16	24.1
Total	**82.4**	**1.19 (implied)**	**97.9**
Employment (FTEs)			
Handicrafts for visitors	63	1.28	74
Retail and other	133	1.10	150
Visitor Centres	45	1.04	47
Restaurants & Cafes	203	1.07	218
Accommodation	215	1.12	241
Activities	150	1.15	173
Total	**810**	**1.11 (implied)**	**902**
Value-added ($m)			
Handicrafts for visitors	3.9	1.27	4.9
Retail	7.2	1.20	8.8
Visitor Centres	1.4	1.17	1.7
Restaurants & Cafes	7.1	1.20	8.5
Accommodation	15.0	1.14	17.1
Activities	9.4	1.15	11.2
Total	**43.9**	**1.19 (implied)**	**52.2**
Household Income ($m)			
Handicrafts for visitors	2.0	1.30	2.6
Retail	5.1	1.11	5.7
Visitor Centres	1.3	1.06	1.4
Restaurants & Cafes	4.9	1.11	5.6
Accommodation	5.6	1.18	6.8
Activities	4.8	1.19	5.6
Total	**23.7**	**1.17 (implied)**	**27.7**

Chapter 6
Environmental Accounting: Tourism Compared With Other Sectors

6.1 Introduction

Growing concerns about environmental sustainability generally mean that a number of parties are interested in the environmental impacts of tourism. It is currently possible to estimate several environmental impacts of an industry using existing data on land use, energy use, water use and waste water production by that industry. Since tourism is a composite industry, the data from several industries have to be combined to give a 'tourism' environmental impact. The assessment of an environmental impact can be expressed as either a rate (e.g., land use per $1 million of industry value added or per 1,000 jobs) or as an industry total. The significance of a particular environmental indicator depends on the significance of that particular resource in the region being studied[22]. The calculation of individual environmental impacts may initially appear to be a straight-forward process, but there are a number of issues to consider. These include: the issue of the use of 'public goods'[23] by tourism, the existence of 'joint products', the significance of 'flow-on effects', the importance of 'perspective', and the data problems. The latter being particularly significant when estimating water use. Each of these issues is addressed here. Results are presented showing the land use (in Westland) and total energy use per $1 million of output for each industry in Westland.

In recent years the 'Ecological Footprint' (EF) approach has gained popularity as a more composite indicator of sustainable development compared to others methods, and we present have estimated the 'Ecological Footprint' of Westland households and of Westland tourism. We also discuss the limitations associated with the use of an EF as a measure of sustainability.

6.2 Issues of Analysis and Measurement of Environmental Impacts

Data are available on the direct use by each industry of several environmental resources including land, energy and water. In the same way that tourism has flow-on employment and value-added impacts through associated industries, so there are flow-on environmental effects. These can be modelled by using the same regional input–output models as were used for assessing other economic effects. First the input-output models are used to estimate total output changes in each industry which result from an initial direct output change in a particular industry. Then the environmental impacts (e.g., for water) are estimated by multiplying the output change in each industry by the environmental impact per unit of output in that industry. However, there are a number of issues to consider when undertaking this analysis and in interpreting the results.

6.2.1 Public Goods

Tourism on the West Coast in particular is focussed on public goods, including mountains, forests and water. A high proportion of activities including sightseeing is only possible with access to the land resource. However, the land is not 'used up' during these activities and

22 For example, the fact that dairying uses a lot of fresh water may not be significant in a West Coast context, but would be much more significant in a Canterbury context.

23 From an economics perspective, a public good is one where use by one person does not affect use by another, d where people can not be excluded from use.

superficially, at least, appear to be available to other potential users. In an assessment of effective resource use, this land should not be seen as a cost of tourism. However, in some areas there is competition for access, and examples include tracks (natural values may depend partly on low density of users) and air space (noise impacts on people on the ground, and there are limits to how many flights can operate in an area at any one time). In some areas there has also been competition with extractive industries. In these instances efficient resource allocation should recognise that tourism is using land.

An alternative view is that leaving land in its natural state has other benefits which tourism does not prevent, and hence the land is not 'used' in any competitive sense by tourists. In the Ecological Footprint analysis which follows, use of public land with no associated market production has been ignored in assessing the size of the footprint.

6.2.2 Joint Products

Some inputs give rise to several outputs. In the case of tourism, the most obvious product is international and domestic travel which is an input to tourism in a number of different locations. For example, fuel used to travel from Germany to New Zealand may have been necessary for a tourist to travel to both Australia and New Zealand, and to numerous destinations within each country. There is no 'correct' way to allocate use to each site, although an obvious way is to allocate the input according to the proportion of the holiday time spent at or beyond a particular point. So, for example, an air ticket from Munich to Queenstown and back via Sydney, Auckland, and Christchurch would have the fare allocated between each of the sectors according the distance. The costs of the Munich – Sydney – Munich sector would be split between all destinations according to the amount of time spent there. The Sydney – Auckland – Sydney sector costs would be allocated between all New Zealand destinations. The Auckland – Christchurch sector costs would be allocated between the South Island destinations, and the Christchurch – Queenstown – Christchurch sector costs would be allocated to destinations visited between arrival and departure from Christchurch. There are obvious problems with this approach including huge computational ones and also the fact that people often do not retrace their steps in this neat pattern.

In the 'Ecological Footprint' analysis, travel costs incurred outside Westland have been ignored, and travel costs incurred within Westland have also been generally ignored in that no data on them are available. Given that the major user of land is energy [24], this approach is not at all satisfactory when estimating the 'Ecological Footprint' for tourism.

6.2.3 Perspective

There are three obvious geographic perspectives that can be taken. The first is the impact on Westland District, the second is the impact on New Zealand, and the final one is the global impact. There is no 'correct' perspective to take. It depends on the objectives of the user. The local District Council may be concerned about district impacts with regards to water use because of its need to supply water, in which case the local perspective is relevant. Other groups may be concerned about global impacts because a concern about sustainability. The Council may share this concern if it believes that in the long run, international pressures (whether market or non-market) mean that 'sustainable' industries do better.

24 Land use associated with energy relates either to the production of biomass of equivalent energy value or the absorption of carbon sufficient to offset the CO_2 production associated with energy generation.

In the 'land use per $m' results for Westland presented below, the land referred to is land in Westland. In the 'energy use / per $m', the energy referred to is total energy, no matter where it is produced. In the 'Ecological Footprint' analysis, the perspective is global, and all use of imported inputs and the associated land used is taken into account.

6.2.4 Data Accuracy

The data relating to water in particular appears to have very large margins of error, with direct uses of water in a given industry varying hugely between regions. For example, 'Accommodation and Restaurants' water use varies by a factor of ten between Auckland (375 cubic metres per $1 million turnover), Waikato (2,109 cubic metres) and Northland (3,326 cubic metres). It seems most unlikely that the tourism industry has a resource use that varies so widely across regions, and the alternative is to presume that there are large measurement errors in the base data. Because of the uncertainty, no data on water use per $m of output has been included in this report. The Ecological Footprint analysis does not consider water use or the disposal of waste water.

6.3 Environmental Indicators of Economic Activity

Table 11 shows the land and energy use associated with various economic activities in Westland, including tourism. Note that the land used is only the land used in Westland, and hence ignores land used to produce imported inputs. The land used also excludes the 'energy land' which is a focus of the Ecological Footprint analysis shown later. The energy used is energy from all sources, both within and outside Westland. The energy use of tourism excludes fuel used for travel within the region or to the region, but includes fuel used by the businesses which provide services to visitors (including air activities).

The results suggest that tourism is a very moderate user of land and a very high user of energy in comparison with most other industries. The latter outcome is in spite of the fact that the energy use of tourism excludes all travel within and to Westland[25].

25 Separate studies of tourism transport and energy use are being undertaken in other parts of the current programme of research.

Table 11
Land Use and Energy Use Associated with Various Economic Activities in Westland

Industry	Land Use (Ha / $m)		Energy Use - heat units (Terrajoules/ $m)	
	Direct	Total	Direct	Total
Agriculture	2,468.3	2,666.0	1.4	1.6
Fishing and Hunting	25.7	27.8	6.1	6.2
Forestry	729.0	1,021.5	0.5	0.9
Mining & Quarrying	3.8	8.5	3.3	4.1
Food, Beverages and Tobacco	0.7	655.6	1.0	1.8
Textiles, Clothing & Footwear	0.1	69.0	2.1	2.2
Wood and Wood Products	4.6	163.1	2.4	3.3
Pulp and Paper Products, Print & Publish	1.4	3.4	2.0	2.2
Petroleum, Chem, Plastics & Rubber	0	7.2	1.1	1.2
Non-metallic Mineral Products	1.2	4.5	63.4	66.8
Basic Metal Products	0	0	0.0	0.0
Fab Metal Prod., Machinery and Equip.	0.6	2.8	0.8	1.0
Other Manufacturing	4.2	7.8	0.5	1.4
Electricity, Gas and Water Distribution	45.0	60.5	0.1	0.3
Construction	0.4	12.4	0.4	2.7
Wholesale and Retail Trade	0.7	18.7	1.5	1.8
Transport and Storage	21.5	27.1	7.7	8.3
Communication	0.9	6.3	0.4	0.6
Finance, Ins, Real Est. & Business Serv.	0.1	1.9	0.2	0.3
Ownership of Owner Occupied Dwellings	0	1.7	0.0	0.2
Comm., Social and Personal Services	105.9	109.9	0.9	1.1
Central Government	59.9	68.4	0.2	0.4
Local Government	110.8	125.2	0.3	0.7
Tourism	**16.1**	**31.1**	**2.0**	**2.3**

6.4 The Ecological Footprint: Description and Issues

Over the past few years the Ecological Footprint (EF) has gained popularity as an indicator of sustainable development. The EF is defined as the 'area of productive land and water ecosystems require to produce the resources that a population consumes and assimilate the wastes that the population produces, wherever on Earth that land and water may be located'. The EF can be seen as a 'sustainability indicator' in two senses. First, it measures the *total ecological cost* (in land area) of supplying goods and services to a human population. This recognises that people not only *directly* require land for agricultural production, roads, buildings and so forth, but also *indirectly* via manufactured goods and services. A second, and more controversial interpretation of the EF as a sustainability indicator, invokes the idea of carrying capacity. Some proponents of the EF argue that the biologically productive[26] land required by a population should not 'overshoot' its' bio-capacity[27].

Proponents of the EF argue that it provides an effective way of capturing current human resource use in an easily digestible form. In this way, the EF frequently invokes discussion on issues directly relevant to sustainable development, such as:

(a) the critical dimensions of human activity,

(b) the key resources and ecosystem functions for sustainable development,

(c) the role played by trade in distributing ecological resources and pressures,

(d) selection of indicators for monitoring progress toward sustainable development and so forth.

Opponents argue that there a number of shortcomings of EF. First, there is no commonly accepted methodology for calculating the EF, and this has led to ambiguities in interpreting the results of various EF studies. Second, the inclusion of 'energy land'[28] is queried, on the grounds that alternatives exist[29], and that in any case planting production forest to sequester CO_2 is arguably only a temporary measure. Moreover, the EF focuses exclusively on energy related CO_2 emissions, neglecting the ecological consequences caused by other emissions[30] and ignoring the impact of production on other scarce resources (such as water). Next, the selection of appropriate spatial boundaries and the treatment of trade is a critical issue in ecological footprinting. Finally, there is debate as to the policy relevance of EF analysis.

Proponents of the EF advocate that the EF can evaluate potential strategies for avoiding ecological overshoot. In this view, the EF is seen as an instrument that provides decision-makers with a physical criterion for ranking policy, project or technological options accounting for their ecological impacts. This claim has, however, been hotly debated. Ayres (2000) asserts that the EF provides no meaningful rank ordering, and even less so any value for policy evaluation or planning process. This view is shared by Moffatt (2000, p.360), who notes 'it offers no policy suggestions apart from either including more land, reducing population, or reducing consumption per head'. Although it is agreed that the policy instruments or actions required to counteract overshoot cannot be implied from the EF method, it is argued here that the EF does provide a broad level measurement of ecological impact. In this way, the EF may be used to 'signal' the relative ecological cost of different policy options. Careful consideration of the components of the EF may also help to evaluate the relative ecological cost of various economic activities, enabling policy analysts to identify 'hotspots' for policy action. By far the greatest contribution the EF can make to policy and decision-making is as an educative tool stimulating thinking about the far-reaching nature of the indirect ecological effects of human activities.

26 Biological productivity refers to Net Primary Productivity (NPP). This is the rate at which biomass is produced, allowing for respiration loss by (mainly) green plants.

27 Bio-capacity is a measure of the total biologically productive land available to a specified population.

28 Land required to be planted in forest to absorb CO_2 produced by energy use.

29 Such as liquefying CO_2 and pumping it into oil and gas fields replacing the fuel extracted, while increasing pressure of the remaining reserves.

30 For example, the depletion of ozone by CFCs or acidification caused by SO_2 and NO_x. Also, other greenhouse gases are worse than CO_2. For example, methane is approximately 25 times as bad (in terms of greenhouse gas effects) as CO_2, and nitrous oxides are up to 300 times as bad.

6.5 Estimation of the Ecologiocal Footprint for Westland

Input-output analysis provides a comprehensive snapshot of the structure of inter-industry linkages in an economy, and enable one to calculate the indirect effects of economic change. In particular, in the analysis one can examine the relationship between changes in final demand and production of goods and services, or in the EF context, the use of resources and generation of wastes and emissions. Manipulation of the table permits one to estimate the embodied (direct plus indirect) land required to increase final demand in each sector by an additional one unit. The land embodied in inter-regional and international imports is also calculated. The method is applied to Westland District and to tourists visiting Westland District.

Using the method, Table 12 shows the EF for each type of land and for all Westland residents and then for tourists. The Westland District's EF is estimated to be 39,150ha or 33.9 per cent of the District's bio-capacity. This means that on average each Westland resident occupies 3.85 ha of biologically productive land. Significant amounts of agricultural land are appropriated from other regions and countries by Westland residents. The Westland District tourist EF is 7,061 ha or 6.1 per cent of the District's bio-capacity.

Table 12
Westland District and Westland District Tourist
Ecological Footprint, Disaggregated by Land Type, 1997-98

Land type	Within region land	Land from other NZ regions	Land from other nations	Total land	ha per capita	% of total
Westland Residents						
Agricultural land	21,420	3,450	3,340	28,210	2.77	72.1
Forest land	450	40	250	740	0.07	1.9
Degraded land	5,830	30	170	6,030	0.59	15.4
Energy land	3,120	120	920	4,160	0.41	10.6
Total	30,820	3,640	4,680	39,140	3.85	100.0
Westland Tourists						
Agricultural land	4,390	6	310	4,706	N/A	66.6
Forest land	59	0	12	71	N/A	1.0
Degraded land	1,497	1	7	1,505	N/A	21.3
Energy land	729	2	48	779	N/A	11.0
Total	6,675	9	377	7,061	N/A	100.0

Note: All values are in ha per year unless otherwise stated.

Energy land is a measure of the hypothetical planted forest needed to sequester CO_2 emissions. It accounts for 4,160 ha or 10.6 per cent of the District's EF. Tourists to Westland appropriate some 779 ha of energy land or 11.0 per cent of the tourist EF. These figures are relatively low when compared with most developed nations, but coincide with other rural districts in New Zealand.

The EF can also be disaggregated by economic sector and these results are shown in Table 13. As in Table 12, the results show that the majority of land appropriated by Westland residents originated from within the region, while 12.0 per cent and 9.3 per cent was embodied respectively in international and inter-regional imports. Interestingly, 43.1 per cent of all land was appropriated by the manufacturing and service sectors, a consequence of backward linkage purchases of agricultural and forestry products. Tourists to Westland appropriated land almost entirely in the form of service industry products (e.g., handicrafts, retail, visitor centres, accommodation, air and ground activities and other services).

Table 13
Westland District and Westland District Tourist
Ecological Footprint Disaggregated by Economic Sector, 1997-98

Economic sector	Within region land	Land from other NZ regions	Land from other nations	Total land	ha per capita	% of total
Westland Residents						
Agriculture	4,260	40	60	4,360	0.43	11.1
Forestry	100	0	0	100	0.01	0.3
Fishing and hunting	0	0	0	0	0.00	0.0
Mining and quarrying	0	0	0	0	0.00	0.0
Manufacturing	13,010	3,400	450	16,860	1.66	43.1
Utilities and construction	1,150	10	210	1,370	0.13	3.5
Services	10,790	50	1,260	12,100	1.19	30.9
Domestic final demand	1,520	150	2,700	4,360	0.43	11.1
Total	30,830	3,640	4,680	39,150	3.85	100.0
Westland Tourists						
Agriculture	0	0	0	0	N/A	0.0
Forestry	0	0	0	0	N/A	0.0
Fishing and hunting	0	0	0	0	N/A	0.0
Mining and quarrying	0	0	0	0	N/A	0.0
Manufacturing	0	0	0	0	N/A	0.0
Utilities and construction	0	0	0	0	N/A	0.0
Services	6,675	9	377	7,061	N/A	100.0
Domestic final demand	0	0	0	0	N/A	0.0
Total	6,675	9	377	7,061	N/A	100.0

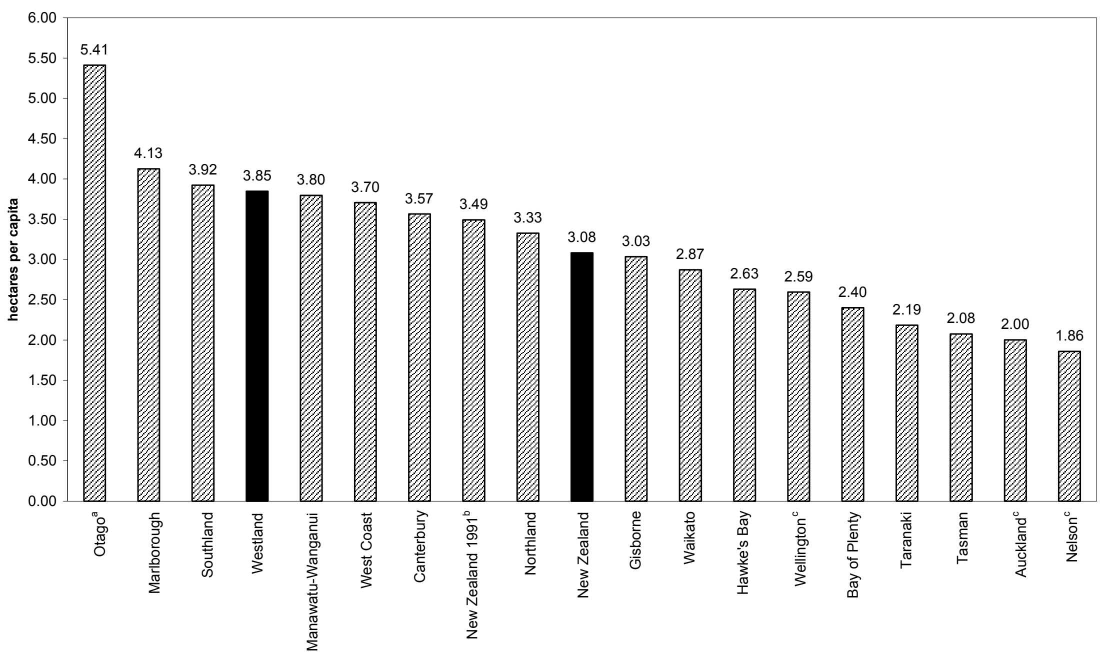
Note: All values are in ha per year unless otherwise stated.

It is worth noting that the biologically productive land area appropriated to support the Westland District service sector, by both residents and tourists (respectively 12,100 ha and 7,061ha), is greater than the actual land occupied by the sector (6,780 ha). In other words, the physical space occupied by the service sector is a deceptive indicator of the biologically productive land needed to support it. The service sector resides near the top of the production chain and is therefore characterised by a high degree of upstream interdependencies – all of which appropriate land.

Westland District households (domestic final demand) are the largest appropriators of land embodied in international imports, accounting for 2,700ha from other nations. This includes goods that are imported directly by retailers and wholesalers and then resold without further processing to households with an additional markup.

Finally, the data can be used to compare Westland District's EF per capita with other areas in New Zealand. These results are shown in Figure 1. On a per capita basis the Westland District EF is higher than the New Zealand average, but lower than Southland, Marlborough and Otago regions.

Figure A
Comparison of Westland District's Ecological Footprint Per Capita With Other Regions in New Zealand



Note: All values are in ha per capita for the 1997-98 year unless stated otherwise.

a The average Otago farm is 656ha, the largest of any New Zealand region (Statistics New Zealand, 1998). Extreme contrasts in seasonal temperatures mean that stocking rates are among the lowest per ha. Thus, agricultural land appropriated per capita is significantly greater relative to the nation.

b As calculated by Bicknell *et al.* (1998). This approach applies a single energy-to-land ratio in its estimate of embodied energy land. One shortcoming with this approach is that it treats energy generated through hydro and geothermal as if it were fossil fuels.

c Auckland, Wellington and Nelson are urban regions. All three regions overshoot their available biologically productive land, yet on a per capita basis their respective EFs rank among the lowest in New Zealand. This is explained by (1) the relatively small number of agricultural processing industries in these regions, (2) the implicit assumption that imported goods are essentially finished or final goods and (3) urban efficiency arguments.

6.6 Notes and Conclusions

Over the last few years the EF has gained popularity as one possible indicator for monitoring progress toward sustainable development. The EF tells us the area of biologically productive land ecosystems requires to produce the resources we consume, and to assimilate the wastes that we produce. The EF is considered to be a sustainability indicator on the grounds that it measures 'carrying capacity'. Supporters of the EF argue that a given population should not 'overshoot' the bio-capacity of the land on which it resides. The EF for a population is usually expressed in hectares, or hectares per capita, for a given year.

This report calculates the EF based on input-output analysis. Most developed nations prepare input-output tables at regularly intervals based on internationally recognised classifications. This facilitates comparison over time, between nations and with standard economic aggregates. Input-output analysis is a well-established field of economics with assumptions well documented. The major strengths of the proposed method is that it (1) provides a formal structure for EF calculation, (2) permits sub-national or regional level EF estimates to be generated, and (3) makes explicit inter-regional appropriation of biologically productive land.

The key findings associated with applying the presented method to the Westland District are noted below:

- The Westland District's EF was estimated to be 39,150ha for the 1997-98 year. This constitutes 33.9 per cent of the district's bio-capacity. The Westland District tourist EF is 7,060ha or 6.1 per cent of the district's bio-capacity.
- The manufacturing sector is the largest appropriator of land, requiring some 16,860ha or 43.1 per cent of the district's EF to support its activities. This includes not only the direct land occupied by the manufacturing sector, but also the *indirect* land embodied in the goods and services needed to support it.
- The service sector is also a considerable appropriator of land, requiring some 12,100ha or 30.9 per cent of the district's EF. Tourist appropriation is entirely via the service sector, appropriating some 7,061ha. In both cases, the service sector appropriates more land than the actual area it occupies.
- Households also require large amounts of land to support them, accounting for 11.0 per cent of the district's EF. This is mostly land embodied in international imports.
- On a per capita basis Westland District's EF of 3.85ha. This is slightly lower than Southland, but significantly higher than the New Zealand EF per capita average of 3.08ha.

Overall, the EF is an effective pedagogic device that serves to creating awareness of sustainability issues, and in particular that there are identifiable *indirect* environmental effects associated with human activity. The EF is therefore an attempt to make visible nature's work, and by doing challenge the "out of sight, out of mind" that so often prevails.

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Appendix 1
Error Margins

The survey of businesses has several potential sources of error, which are discussed below. Errors in any particular sector are likely to be greater than errors in the combined tourism sector since some errors will be off-setting.

A1.1 Source of Errors

A1.1.1 Direct Impacts

Employment

The census of businesses to get employment figures meant that there were no sampling errors, but it is not possible to be sure that all businesses were covered by the census. Some businesses had multiple outputs (e.g., restaurants and accommodation) and there may have been some error in the allocation of FTEs between the two outputs. The ongoing entry and exit of small businesses from the activities sector, and the difficulty in ensuring all artisans and guides are covered means that we may have missed some small operators and hence there may have been a coverage error. Rapid growth in the industry and strong seasonality means that respondents are relying heavily on memory to give figures for the most recent year, and this may have introduced errors. Respondents were also making informed guesses about the proportion of turnover that was purchased by visitors and their estimates could have been wrong. However, any errors here are probably quite small. We believe that on balance the accommodation, restaurants and activities employment figures are accurate to within ten per cent, and the retail and accommodation employment is accurate to within five per cent.

Output in all industries was based on estimated employment, and surveyed and national average employment to output ratios. There could have been significant sampling errors (the ratios for the sampled businesses may not be a good guide to the industry as a whole), and it is possible that the national ratios for retail were not appropriate to the Westland situation. On balance, we believe that errors in output and value-added could be as high as 30 per cent.

Output

There are sampling errors for direct activities output since only 23 per cent of activities were surveyed and there were significant sample variations in employment to output ratios. Accordingly we believe the likely margin of error is around 20 per cent. Output in accommodation was based on Statistics New Zealand censuses (all accommodation businesses have to provide quarterly data on sales), so there is no sampling error and perhaps a five per cent reporting and coverage error. Levels of expenditure on food and other retail compared to accommodation are based on the visitor expenditure survey. Two separate surveys gave quite similar results, and although both were undertaken in summer (which may differ from winter) the two survey populations varied significantly in terms of origin and average duration of stay. The similarity of results indicates that these factors do not significantly affect relative expenditure patterns. There may have been misallocation of spending (reported spending on activities may have included spending on retail and food at activities sites). We believe that the probable margin of error is around 20 per cent.

Value-added
Data were collected for only 23 per cent by value of activities and about 13 per cent by value of accommodation. In addition, a number of businesses did not give us full access to accounts, so there may have been some errors in our assessment of value-added. Margins of error (from sampling and data inaccuracy) could be of the order of 30 per cent.

Downstream Impacts
The error in downstream output impacts arises from errors in estimating direct impacts and from errors in the basic GRIT table for the District. Also, any inaccuracy in employment to output or value-added to output ratios in the downstream industries will flow directly into employment and value-added estimates. We would expect errors in the tables to lead to up to a 30 per cent error in the flow-on effects in any particular industry. These errors will be on top of the direct output errors. Hence in the case of retail value-added, there could be a 20 per cent error in direct output and a 30 per cent error in flow-on value-added which combine to give a total error of 50 per cent in flow-on value-added.

Total Impacts
Previous experience has shown that errors in ratios tend to be offsetting, and hence it is uncommon for total errors in any industry to exceed 20 per cent over and above the individual output errors. Moreover, errors in a combination of industries are also likely to be offsetting, and it is unlikely that combined errors for all of tourism will exceed 20 per cent for output and employment, and 30 per cent for value-added.

A1.2 Size of Errors

A1.2.1 Direct Impacts

Employment

Manufacturing for visitors	20 per cent	(data inaccuracy)
Retail	20 per cent	(data inaccuracy, errors in assessing proportion to visitors)
Accommodation	10 per cent	(data inaccuracy)
Restaurants	10 per cent	(data inaccuracy)
Activities	10 per cent	(data inaccuracy)

Output

Manufacturing for visitors	30 per cent	(employment error, industry sample error)
Retail	30 per cent	(employment error, industry sample error)
Accommodation	20 per cent	(employment error, industry sample error)
Restaurants	20 per cent	(employment error, industry sample error)
Activities	20 per cent	(employment error, industry sample error)

Value-added

Manufacturing for visitors	40 per cent	(employment error, industry sample error)
Retail	30 per cent	(employment error, industry sample error)
Accommodation	30 per cent	(employment error, industry sample error)
Restaurants	30 per cent	(employment error, industry sample error)
Activities	30 per cent	(employment error, industry sample error)

Flow-On Impacts
Variable, but generally likely to be equivalent to direct output errors plus multiplier errors equivalent to 30 per cent for any given industry.

Total Impacts for All Tourism

Output:	Sampling errors plus estimation errors - 20 per cent
Employment	Sampling errors plus estimation errors - 30 per cent
Value-added:	Sampling errors plus estimation errors - 30 per cent

Table 14
Employment Error Margins

Sector	**Direct ($M)**	**Error**		**Indirect ($M)**	**Error**		**Total**	**Error**	
		%	**$M**		**%**	**$M**		**$M**	**%**
Accommodation	1,150	5	60	470	35	120	1,620	180	
Food & Beverages	1,480	30	440	490	60	120	1,970	660	
Activities	525	10	50	235	40	60	760	110	
Other	345	30	100	185	60	50	530	150	
Total	**3,500**	**20**	**650**	**1,380**	**25**	**350**	**4,900**		**20**

Table 15
Output Error Margins

Sector	**Direct ($M)**	**Error**		**Indirect ($M)**	**Error**		**Total**	**Error**	
		%	**$M**		**%**	**$M**		**$M**	**%**
Accommodation	87	5	4	57	35	20	144	24	
Food & Beverages	87	20	17	51	50	25	138	42	
Activities	50	20	10	27	50	13	77	23	
Other	86	20	16	18	50	9	104	25	
Total	**310**	**15**	**47**	**153**	**43**	**67**	**463**		**20**

Table 16
Value-added Error Margins

Sector	**Direct ($M)**	**Error**		**Indirect ($M)**	**Error**		**Total**	**Error**	
		%	**$M**		**%**	**$M**		**$M**	**%**
Accommodation	44	35	15	25	35	9	69	24	
Food & Beverages	38	50	19	25	50	13	63	32	
Activities	29	50	15	14	50	7	43	22	
Other	15	50	7	11	50	6	26	13	
Total	**126**	**44**	**56**	**75**	**47**	**35**	**201**		**30**

Appendix 2
Detailed Report on Environmental Accounting

A2.1 Introduction

Over the last few years the Ecological Footprint (EF) has gained popularity has an indicator of sustainable development. In this report, a method is presented for calculating the ecological footprint at a sub-national level based on an input-output approach. The presented method is applied to Westland District and to tourists visiting Westland District. Comparisons are made with other Councils in New Zealand. The method is developed in light of a review of EF strengths and weaknesses.

Note: The EFs generated in this report are not comparable with those generated by Mathis Wackernagel for reasons outlined in Table 1 in Section 3. Comparable EFs do exist, but must be directly requested from the author.

A2.2 The Ecological Footprint Concept

The EF is defined by Rees (2000) as the "area of productive land and water ecosystems require to produce the resources that a population consumes and assimilate the wastes that the population produces, wherever on Earth that land and water may be located". It can be seen as a 'sustainability indicator' in two senses. Firstly, it measures the *total ecological cost* (in land area) of supplying goods and services to a human population. This recognises that people not only *directly* require land for agricultural production, roads, buildings and so forth, but also *indirectly* via manufactured goods and services. In this sense, the EF can be used to make visible the 'hidden' ecological cost of an activity or population.

A second, and more controversial interpretation of the EF as a sustainability indicator, invokes the idea of carrying capacity. 'Carrying capacity' in ecology is the maximum population a given land area can support indefinitely. The idea is relatively straightforward when applied to well defined biological populations (e.g., a certain number of hectares are required to support a herd of deer). If the number of deer exceed the carrying capacity then the population is said to be in 'overshoot'. Resources (mainly food) will become scarce and population die-back will occur. This idea is more controversial when applied to human populations, as in the 'Limits to Growth' study, which predicted a decline in global human population as it overshot its carrying capacity (Meadows *et al*., 1972; Meadows *et al*., 1992). Some proponents of the EF argue that the biologically productive[31] land required by a population should not 'overshoot' its' bio-capacity[32]. For example, Loh (2000) estimates the EF of the Netherlands is 92.9 million ha, compared with its bio-capacity of 37.4 million ha resulting in a considerable population overshoot. At the global level the EF for humanity exceeds global bio-capacity by 34 per cent (Loh, 2000)[33].

31 Biological productivity refers to Net Primary Productivity (NPP). This is the rate at which biomass is produced, allowing for respiration loss, by (mainly) green plants.

32 Bio-capacity is a measure of the total biologically productive land available to a specified population.

33 The figures noted in this paragraph are not comparable with those produced later in this report.

A2.3 Strengths and Weaknesses the Ecological Footprint

Costanza (2000) and Moffatt (2000) argue that the key feature of the EF is that it provides an effective heuristic and pedagogic tool that captures current human resource use in an easily digestible form. In this way, the EF frequently invokes discussion on issues directly relevant to sustainable development - viz, issues such as (a) the critical (finite) dimensions of human activity, (b) the key resources and ecosystem functions for sustainable development, (c) the role played by trade in distributing ecological resources and pressures, (d) selection of indicators for monitoring progress toward sustainable development and so forth. Current EF calculation methods also have a number of weaknesses. Some of these are discussed below.

Lack of common definitions and methodologies

There is a lack of commonly accepted methodology for calculating the EF. The EF is not, for example, constructed according to widely accepted international conventions such as that used in the United Nations System of National Accounts (UNSNA). This has led to ambiguities in interpreting the results of various EF studies. For example, estimates of New Zealand's EF range between 3.49 and 9.6 ha per capita (Bicknell *et al.*, 1998; Wackernagel *et al.*, 1999; Loh, 2000). Investigation of these studies reveals that differences result largely from assumptions concerning biological productivity, the use of equivalence factors when aggregating land types and the calculation of energy land. To avoid misinterpretation in this report, and to allow comparison with earlier EF estimates, differences in application are outlined in Table 17.

Table 17
Differences between Bicknell et al. (1998), Loh (2000) and this report

Bicknell *et al*. (1998)	Loh (2000)	This paper
Assumes local yields for pasture, arable and forest land	Applies global average yields for pasture, arable and forest land	Assumes local yields for pasture, arable and forest land
Does not apply equivalence factors when aggregating different land types	Applies equivalence factors when aggregating different land types	Does not apply equivalence factors when aggregating different land types
Applies energy-to-land ratio from Wackernagel and Rees (1996)	Applies world average CO_2 absorption factor	Applies CO_2 absorption factor for New Zealand *Pinus radiata* (Hollinger *et al*., 1993)
Ignores CO_2 absorption by oceans	Allows for CO_2 absorption by oceans. Estimated at 35 percent	Ignores CO_2 absorption by oceans
No allowance for securing biodiversity	Includes a 12 percent allowance for securing biodiversity as per WCED (1987)	No allowance for securing biodiversity
Excludes sea space	Includes sea space, estimated to be 0.1 ha per capita in NZ	Excludes sea space
Land embodied in international imports is based on NZ averages	Land embodied in international imports is based predominantly on FAO (1998)	Land embodied in international imports is based on NZ averages
Does not make explicit ecological interdependencies between regions	Does not make explicit ecological interdependencies between regions	Makes explicit ecological interdependencies between regions
Based on input-output analysis	Based on work of Wackernagel and Rees (1996). Lacks formal structure	Based on input-output analysis

Why include hypothetical energy land?

It is assumed that a forestation is the preferred option for CO_2 sequestering. Serious alternatives already exist, such as liquefying CO_2 and pumping it into the ocean depths where it would remain for thousands of years, or into oil and gas fields replacing the fuel extracted, while increasing pressure of the remaining reserves. Planting production forest to sequester CO_2 is arguably only a temporary measure. The forests will grow old, die, be harvested or are used as a fuel source, all of which will eventually result in CO_2 being re-released back into the atmosphere. Moreover, the EF focuses exclusively on energy related CO_2 emissions, neglecting the ecological consequences caused by other emissions (e.g., the depletion of ozone by CFCs or acidification caused by SO_2 and NO_x).

What spatial boundaries?

The selection of appropriate spatial boundaries is a critical issue in ecological footprinting. For example, EFs can be calculated at global, national, regional, local (city or district) and even smaller scales. Wackernagel and Silverstein (2000) argue for political or cultural boundaries, as they represent the level at which environmental policy and decision making is most often made. By contrast, van den Bergh and Verbruggen (1999) dispute the use of such boundaries on the grounds that the have no environmental meaning, favouring instead hydrological, climate zone, or larger connected ecosystem boundaries. In this report New Zealand TLA boundaries have been adopted, covering both only the political dimension.

Closely associated with the selection of EF spatial boundaries, are the ecological implications of trade. Rees (1992) argues that trade has the effect of physically and psychologically distancing populations from the ecosystems that sustain them. From a regional perspective, this does not pose a problem provided that an importing region draws on ecologically sustainable surpluses. Thus, information is required not only on footprint size (and on component shares e.g., agricultural, arable, forest, built-up and energy land), but also on the origins of contributions made by each imported component and how sustainable it is. The EF methodology employed here includes an analysis of the ecological interdependencies between New Zealand regions. This considers not only the ecological footprint from the consumption (end-use) perspective, but also the production (source) perspective.

Policy relevance – a policy evaluation tool?

Proponents of the EF (Wackernagel and Rees, 1996; Wackernagel and Silverstein, 2000) advocate that the EF can evaluate potential strategies for avoiding ecological overshoot. The EF is seen as an instrument that provides decision-makers with "a physical criterion for ranking policy, project or technological options accounting for their ecological impacts" (Wackernagel and Rees, 1996, p.57). This claim has, however, been hotly debated. Ayres (2000) asserts that the EF provides no meaningful rank ordering, and even less so any value for policy evaluation or planning process. This view is shared by Moffatt (2000, p.360), who notes "it offers no policy suggestions apart from either including more land, reducing population, or reducing consumption per head".

Although it is agreed that the policy instruments or actions required to counteract overshoot cannot be implied from the EF method, it is argued here that the EF does provide a broad level measurement of ecological impact. In this way, the EF may be used to 'signal' the relative ecological cost of different policy options. Careful consideration of the components of the EF may also help to evaluate the relative ecological cost of various economic activities, enabling policy analysts to identify 'hotspots' for policy action. By far the greatest contribution the EF can make to policy and decision-making is as an educative tool stimulating thinking about the far-reaching nature of the indirect ecological effects of human activities.

A2.4 An Input-Output Methodology for Estimating Regional Ecological Footprints

Several methods have been advanced for calculation of the EF (refer to Wackernagel and Rees, 1996; Folke *et al.*, 1997; Wackernagel *et al.*, 1999; Loh, 2000, van Vuuren and Smeets, 2000; etc). Although each of these methods has its own peculiarities and insights, many have their roots in the work of Wackernagel and Rees (1996). Much of this work lacks formal structure - leading to results that are not easily reproduced, either through time or across space. In turn, this restricts comparability or leads to inconsistencies that are more an artifact of method than actual occurrence. Such concerns led Bicknell *et al.* (1998) to develop an alternative formulation of the EF based on input-output analysis.

Contemporary input-output analysis, developed by Wassily Leontief during the 1930s, provides a comprehensive snapshot of the structure of inter-industry linkages in an economy. Such linkages are captured in an input-output table. Most developed nations prepare input-output tables at regular intervals. Generally speaking, an input-output table of a nation is conceptually reconcilable with its System of National Accounts (SNA). In addition, input-output tables adopt internationally recognised systems of commodity/industry classification (e.g., the International Standard Industrial Classification (ISIC)). This facilitates comparison over time, between nations and with standard economic aggregates such as GDP and balance of trade. Input-output analysis is a well-established field of economics with assumptions well documented.

Although input-output tables are usually presented in monetary terms, authors such as Daly (1968), Isard (1968), Leontief (1970) and Victor (1972) have demonstrated that biophysical information on resource use and pollution generation may also be placed in an input-output framework. A major strength of input-output analysis is that it may be used to calculate the *indirect* effects of economic change. In particular, the relationship between changes in final demand and production of goods and services, or in the EF context, the use of resources and generation of wastes and emissions.

In this report the method employed (1) provides a formal structure for EF calculations, (2) permits calculation of the EF at a regional (sub-national) level, and (3) makes explicit interregional appropriation of biologically productive land. Essentially, the method requires the calculation of EF land contributions as defined by the following accounting identity:

$$\mathbf{EF} \equiv \alpha + (\beta_1 + \beta_2 + ... + \beta_{\mathbf{n}}) + \chi, \tag{1}$$

where:

$\alpha =$ land appropriated from within the study region

$\beta_1, \beta_2, ..., \beta_{\mathbf{n}} =$ land appropriated from other regions (1…n)

$\chi =$ land appropriated internationally.

Generation of regional input-output tables

The method begins with calculation of input-output tables for the study region and for all other regions it trades with. These tables are derived using the GRIT (Generation of Regional Input Output Tables) system (see Jensen *et al.*, 1979; West *et al.*, 1980). This method consists of a series of mechanical steps that reduce national input-output coefficients to sub-national (regional) equivalents, while providing opportunities for the insertion of 'superior data'. It is most frequently utilised, as in this report, when time, cost and data constraints preclude generation of input-output tables based on survey data.

Estimation of land appropriated within the region, α

Calculate Leontief Inverse

Determining the land appropriated from within the region begins with calculation of a technical coefficients matrix $\mathbf{A}$. This matrix is derived by dividing each element in a transactions matrix $\mathbf{Ax}$ by its associated output x. The resulting technical coefficients matrix $\mathbf{A}$ represents the direct inputs from row sector i required to increase column sector j by an additional dollar. The contribution made by a sector to an economy is not solely limited to the value it creates directly - an increase in final demand in a sector has repercussions throughout the entire economy, causing *indirect* increases in output beyond the initial change in final demand. Such repercussions are captured in the Leontief Inverse Matrix $(\mathbf{I}-\mathbf{A})^{-1}$.

The Leontief Inverse Matrix $(\mathbf{I}-\mathbf{A})^{-1}$ is derived by subtracting the matrix of technical coefficients $\mathbf{A}$ from an identity matrix $\mathbf{I}$ of the same dimensions, and inverting the result. Each element represents the direct and indirect economic requirements in row sector i needed to generate an additional unit of output in column sector j.

Determine the direct and indirect land requirements for each economic sector

The embodied (direct plus indirect) land required to increase final demand in each sector by an additional unit is calculated as follows. First, land-to-output ratios (known as land coefficients) are obtained by dividing the total land use in each sector by its corresponding total output. Second, these coefficients are then placed in a matrix $\hat{\mathbf{B}}$. Finally, embodied land requirements $\mathbf{C}$ are calculated by premultiplying the Leontief Inverse matrix by the matrix of land coefficients. Hence,

$$\mathbf{C} = \hat{\mathbf{B}}(\mathbf{I} - \mathbf{A})^{-1}. \qquad (2)$$

Apportion direct and indirect land requirements between domestic final demand and exports

Not all of the land appropriated supports domestic consumption. A portion passes out of the study region as land embodied in exports. The land supporting domestic final demand $\mathbf{E}$ is calculated by multiplying the matrix of direct plus indirect requirements $\mathbf{C}$ by a matrix representing domestic final demand $\hat{\mathbf{D}}$. Thus,

$$\mathbf{E} = \mathbf{C}\hat{\mathbf{D}}. \qquad (3)$$

The domestic final demand matrix $\hat{\mathbf{D}}$ is obtained from the 'domestic final demand' column (or household consumption) in study region's transactions table.

Repeat above steps for the calculation of energy land

Energy land represents the area of planted forest needed to sequester CO_2 emissions resulting from burning of fossil fuels. The approach used to calculate energy land appropriated within the region is analogous to that used to calculate the within region land supporting domestic final demand. Essentially, there are two differences (1) CO_2 coefficients are used instead of land coefficients, and (2) total embodied CO_2 emissions are converted into planted forest using a *Pinus radiata* sequestration rate of 0.0758 ha per t of CO_2.

Estimation of land appropriated from other regions, $\beta_1, \beta_2, ..., \beta_n$

Calculate interregional trade flows

Land embodied in inter-regional trade may have a considerable influence on the size of the EF, particularly if the EF is being calculated for an urban region. It is argued here that not only must the size of such a contribution be known, but also the locations from where it originated. Adjustments can then be made for differences in biological productivity resulting from land management and practices utilised and environmental factors such as soil type, climatic conditions and so on.

One possible method for determining the origins of inter-regional land appropriated is to solve an optimisation problem. Essentially, a problem is solved so that the level of inter-regional trade (by sector) between any permutation of regions can be defined. The optimisation assumes that the major considerations when trading are (1) availability of goods/services and (2) road freight travel time. These are common considerations in logistics operations. Minimisation of road freight travel is set as the objective function, while known levels of imports/exports for each sector (by region) are used to formulate binding constraints.

Determine the direct and indirect land and energy land appropriated from other regions
The land (and energy land[34]) embodied in inter-regional imports is derived by premultiplying the interregional imports by the direct plus indirect land requirements needed to make them. This is performed separately for each supplying region. It is assumed here that imported goods and services are essentially final or finished goods. This implies that only backward linkages through the economy in the region of origin require measurement. If, however, the imported goods require further processing in the study region then forward linkages may also need to be estimated.

Apportion direct and indirect land requirements between domestic final demand and exports
Not all of the inter-regional land appropriated supports domestic consumption. A portion passes out of the study region as land embodied in exports. The fraction of final demand supporting domestic consumption is derived from the study region's transactions table.

Estimation of land appropriated from other nations, χ

The availability of land (and energy) data is a major issue when determining the amount of land appropriated internationally. Ideally this would involve the acquisition of detailed information by economic sector from each international trading partner. Undoubtedly data limitations will require that information for the national economy in which the study region resides be applied. In this report it is assumed that international land management practices are similar to those employed nationally. In this way, crude estimates of the land (and energy land) embodied in international imports can be made.

The calculation procedure is similar to that employed for inter-regional trade. First, international imports are pre-multiplied by the direct plus indirect land requirements needed to make them. This derives the amount of international land appropriated. Second, land supporting domestic consumption is calculated by multiplying the international land appropriated by the fraction of final demand consumed locally.

Caveats

There are a number of critical assumptions that are unique to the method presented. Many of which stem from input-output analysis. The homogeneity assumption, for example, requires that a commodity be supplied by a single industry via one method of production. This is not always the case (e.g., a dairy farm may use land to produce not only milk-fat but also lesser amounts of beef or horticultural product). Fortunately, the use of disaggregated industry data can help reduce the extent to which joint production affects the EF size.

The inter-industry linkages in an economy generally represent flows of physical goods. In input-output analysis such flows are summarised in a transactions table denominated in monetary units. The use of a monetary numeraire facilitates the preceding analysis. If, however, the price paid for a given product differs across purchasing industries then physical linkages may be distorted. If Industry 1, for example, purchases 10kg of goods at 0.20$\$kg^{-1}$ and Industry 2 purchases 10kg of goods at 0.10$\$kg^{-1}$ from the same industry, then both industries receive the same physical

34 The calculation of energy land is based on "direct plus indirect energy land" rather than "direct plus indirect land".

quantity of goods (10kg), but spend different amounts ($2.00 and $1.00 respectively). This implies from a monetary transaction perspective, that the land embodied in Industry 1 purchases is twice that of Industry 2 purchases. This may result in both under and overestimation of sector contributions made to the EF.

A2.5 Ecological Footprint of the Westland District

Using the presented methodology, the Westland District's EF is 39,150ha, or 33.9 per cent of the district's bio-capacity. The Westland District tourist EF is 7,060ha, or 6.1 per cent of the district's bio-capacity. This means that on average each Westland resident occupies 3.85ha of biologically productive land. The results presented here are in condensed form facilitating comparison with Bicknell's *et al.* (1998) earlier study.

Data Sources

The presented methodology is applied for Westland District for the 1997-98 year. The input-output tables employed are based on data collected by Statistics New Zealand (1991, 1996, 1998, 1998a, 1999). Estimates of Tourist spending in Westland District was generated by Butcher (2001). Estimates of land use data by economic sector are based on data gathered from Quotable New Zealand (1998), Statistics New Zealand (1998b, 1998c), Ministry of Agriculture and Forestry (1999), Ministry of Forestry (1999), and Works Consultancy Services Ltd (1996). These estimates exclude National Parks, inland water bodies (lakes and rivers) and marine land[35]. Energy related CO_2 emissions by economic sector were obtained from the Energy Efficiency Conservation Authority (1997). The conversion of CO_2 emissions into energy land is based on sequestration work by Hollinger *et al*. (1993). This work suggests that an average hectare of *Pinus radiata* in New Zealand absorbs 3.6 t of C per ha, which equates to 0.0758 ha per t of CO_2. Population statistics are based on sub-national estimates produced by Statistics New Zealand (1998d).

Ecological footprint disaggregated by land type

Agricultural land consists of land used for sheep and beef, dairy, mixed livestock, other farming and horticulture. An estimated 95,000ha or 82.6 per cent of the District's biologically productive is economically viable for agricultural purposes (predominantly sheep and cattle farming). Westland District residents appropriate some 21,420ha of agricultural land from within the district (Table 2). This amounts to 2.77 ha per capita or 54.7 per cent of the district's EF. By comparison, tourists to Westland District appropriate 4,390ha of within district agricultural land or 62.2 per cent of the tourist EF. Significant amounts of agricultural land are appropriated from other regions and countries by Westland residents.

35 Given that the District is characterised by inaccessible mountainous areas, including Westland, Mt Aspiring and (part of) Mt Cook National Parks, is largely covered in natural forest and is susceptible to flooding and erosion, it is perhaps not surprising that the biological productive land available for economic purposes amounts to only 9.7 per cent of the Districts 1,188,000ha.

Table 18
Westland District and Westland District tourist ecological footprint disaggregated by land type, 1997-98

Land type	Within region land	Land from other NZ regions	Land from other nations	Total land	ha per capita	% of total
Westland Residents						
Agricultural land	21,420	3,450	3,340	28,210	2.77	72.1
Forest land	450	40	250	740	0.07	1.9
Degraded land	5,830	30	170	6,030	0.59	15.4
Energy land	3,120	120	920	4,160	0.41	10.6
Total	30,820	3,640	4,680	39,140	3.85	100.0
Westland Tourists						
Agricultural land	4,390	6	310	4,706	N/A	66.6
Forest land	59	0	12	71	N/A	1.0
Degraded land	1,497	1	7	1,505	N/A	21.3
Energy land	729	2	48	779	N/A	11.0
Total	6,675	9	377	7,061	N/A	100.0

Note: All values are in ha per year unless otherwise stated.

Forest land includes exotic plantings used for commercial gain. It excludes both the indigenous beech and podocarp forests (covering significant portion of the District's land area) and the hypothetical forest planted to sequester CO_2 emissions. Until recently, the indigenous forests were the predominant source of log supply. Planted forest is now the main supply of the local wood processing industry, with harvest rates increasing five-fold between 1990 and 1996. Westland residents and tourists appropriate an estimated 450ha and 59ha of district forest land, respectively. A significant portion of the District forest land is exported in embodied forestry products. On a per capita basis, Westland residents appropriate 0.07ha or 1.9 per cent of forest land.

Degraded land represents built up areas that host human settlements. Degraded land accounts for 15.4 per cent of the Westland District EF and equates to 0.59ha of biologically productive land per Westland resident. Some 1,505ha of degraded land or is appropriated by tourists to Westland. This amounts to 21.3 per cent of the Westland tourist EF. This is comprised of land used for residential, commercial and governmental[36] purposes. It also captures the District's road network. Housing is a significant component in the degraded land appropriated by Westland residents, as is accommodation for tourists.

Energy land is a measure of the hypothetical planted forest needed to sequester CO_2 emissions. It accounts for 4,160ha or 10.6 per cent of the District's EF. Tourists to Westland appropriate some 779ha of energy land or 11.0 per cent of the tourist EF. These figures are relatively low when compared to most developed nations, but coincides with other rural districts in New Zealand. Loh (2000), for example, estimates Australia's energy land contribution to be 56.4 per cent, Canada's to be 47.0 per cent and the United States' at 60.8 per cent. This is a consequence of the structure of the Westland economy, which focuses on less energy intensive agricultural and forestry production rather than more energy intensive heavy manufacturing of these nations.

36 Large commercial land users include private schools, wholesalers/retailers, holiday parks, car parks, private golf courses and so on. Large government land users include central government administration, local government administration, and public schools and hospitals.

Ecological footprint disaggregated by economic sector

The majority of land appropriated by Westland residents, some 78.7 per cent (30,830ha), originated from within the region, while 12 per cent and 9.3 per cent was embodied respectively in international and inter-regional imports (Table 3). Interestingly, in excess of 43.1 per cent (1.66ha per capita) of this land was appropriated by the manufacturing and service sectors, a consequence of backward linkage purchases of agricultural and forestry products. Tourists to Westland appropriated land entirely in the form of Service industry products (e.g., handicrafts, retail, visitor centres, accommodation, air and ground activities and other services).

Table 19
Westland District and Westland District Tourist ecological footprint disaggregated by economic sector, 1997-98

Economic sector	Within region land	Land from other NZ regions	Land from other nations	Total land	ha per capita	% of total
Westland Residents						
Agriculture	4,260	40	60	4,360	0.43	11.1
Forestry	100	0	0	100	0.01	0.3
Fishing and hunting	0	0	0	0	0.00	0.0
Mining and quarrying	0	0	0	0	0.00	0.0
Manufacturing	13,010	3,400	450	16,860	1.66	43.1
Utilities and construction	1,150	10	210	1,370	0.13	3.5
Services	10,790	50	1,260	12,100	1.19	30.9
Domestic final demand	1,520	150	2,700	4,360	0.43	11.1
Total	30,830	3,640	4,680	39,150	3.85	100.0
Westland Tourists						
Agriculture	0	0	0	0	N/A	0.0
Forestry	0	0	0	0	N/A	0.0
Fishing and hunting	0	0	0	0	N/A	0.0
Mining and quarrying	0	0	0	0	N/A	0.0
Manufacturing	0	0	0	0	N/A	0.0
Utilities and construction	0	0	0	0	N/A	0.0
Services	6,675	9	377	7,061	N/A	100.0
Domestic final demand	0	0	0	0	N/A	0.0
Total	6,675	9	377	7,061	N/A	100.0

Note: All values are in ha per year unless otherwise stated.

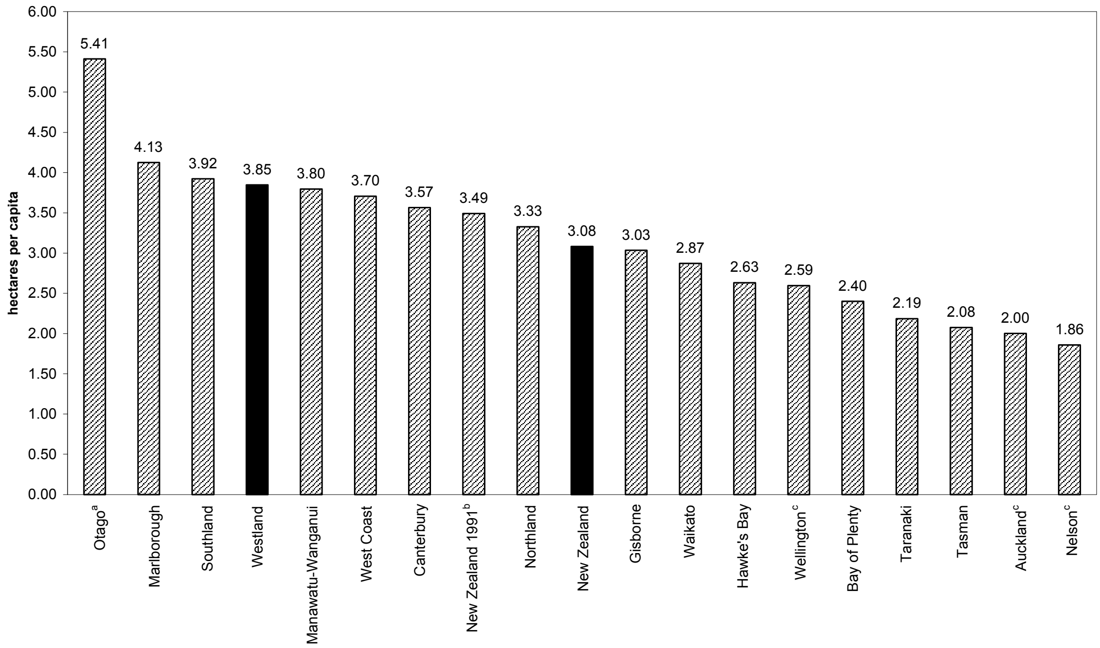
It is worth noting that the biologically productive land area appropriated to support the Westland District service sector, by both residents and tourists (respectively 12,100ha and 7,061ha), is greater than the actual land occupied by the sector (6,780ha). In other words, the physical space occupied by the service sector is a deceptive indicator of the biologically productive land needed to support it. The service sector resides near the top of the production chain and is therefore characterised by a high degree of upstream interdependencies – all of which appropriate land.

Westland District households (domestic final demand) are the largest appropriators of land embodied in international imports, accounting for 2,700ha from other nations. This includes goods that are imported directly by retailers and wholesalers and then resold without further processing to households with an additional markup.

Comparison with other New Zealand Ecological Footprints

The Westland District's EF per capita is compared with other New Zealand areas in Figure A-1. On a per capita basis the Westland District EF is higher than the New Zealand average, but lower than Southland, Marlborough and Otago regions. A primary reason for the Westland District being so high relative to other areas is that it is the most sparsely populated District in the New Zealand. In addition, the average farm size is approximately 450ha or 1.8 times the New Zealand average. With much of the District susceptible to flood and bank erosion this is perhaps not surprising.

Figure A-1
Comparison Of Westland District's Ecological Footprint Per Capita With Other Regions In New Zealand



Note: All values are in ha per capita for the 1997-98 year unless stated otherwise.

a The average Otago farm is 656ha, the largest of any New Zealand region (Statistics New Zealand, 1998). Extreme contrasts in seasonal temperatures mean that stocking rates are among the lowest per ha. Thus, agricultural land appropriated per capita is significantly greater relative to the nation.

b As calculated by Bicknell *et al.* (1998). This approach applies a single energy-to-land ratio in its estimate of embodied energy land. One shortcoming with this approach is that it treats energy generated through hydro and geothermal as if it were fossil fuels.

c Auckland, Wellington and Nelson are urban regions. All three regions overshoot their available biologically productive land, yet on a per capita basis their respective EFs rank among the lowest in New Zealand. This is explained by (1) the relatively small number of agricultural processing industries in these regions, (2) the implicit assumption that imported goods are essentially finished or final goods and (3) urban efficiency arguments.

A2.6 Conclusions

Over the last few years the EF has gained popularity as one possible indicator for monitoring progress toward sustainable development. The EF tells us the area of biologically productive land ecosystems requires to produce the resources we consume, and to assimilate the wastes that we produce. The EF is considered to be a sustainability indicator on the grounds that it measures 'carrying capacity'. Supporters of the EF argue that a given population should not 'overshoot' the bio-capacity of the land on which it resides. The EF for a population is usually expressed in hectares, or hectares per capita, for a given year.

This report calculates the EF based on input-output analysis. Most developed nations prepare input-output tables at regularly intervals based on internationally recognised classifications. This facilitates comparison over time, between nations and with standard economic aggregates. Input-output analysis is a well-established field of economics with assumptions well documented. The major strengths of the proposed method is that it (1) provides a formal structure for EF calculation, (2) permits sub-national or regional level EF estimates to be generated, and (3) makes explicit inter-regional appropriation of biologically productive land.

The key findings associated with applying the presented method to the Westland District are noted below:

- The Westland District's EF was estimated to be 39,150ha for the 1997-98 year. This constitutes 33.9 per cent of the district's bio-capacity. The Westland District tourist EF is 7,060ha or 6.1 per cent of the district's bio-capacity.
- The manufacturing sector is the largest appropriator of land, requiring some 16,860ha or 43.1 per cent of the District's EF to support its activities. This includes not only the direct land occupied by the manufacturing sector, but also the *indirect* land embodied in the goods and services needed to support it.
- The service sector is also a considerable appropriator of land, requiring some 12,100ha or 30.9 per cent of the District's EF. Tourist appropriation is entirely via the service sector, appropriating some 7,061ha. In both cases, the service sector appropriates more land than the actual area it occupies.
- Households also require large amounts of land to support them, accounting for 11.0 per cent of the District's EF. This is mostly land embodied in international imports.
- On a per capita basis, Westland District's EF is 3.85ha. This is slightly lower than Southland, but significantly higher than the New Zealand EF per capita average of 3.08ha.

Overall, the EF is an effective pedagogic device that serves to creating awareness of sustainability issues, and in particular that there are identifiable *indirect* environmental effects associated with human activity. The EF is therefore an attempt to make visible nature's work, and by doing challenge the "out of sight, out of mind" that so often prevails.

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