Regional and national impacts of the 2007–2009 drought

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1. Executive summary

A widespread drought affected most of New Zealand from late 2007 until autumn 2008 with the impact covering two farming seasons. The only regions not to be significantly affected were Northland, Gisborne and Westland. MAF Policy commissioned Butcher Partners Ltd, with the assistance of The Agribusiness Group, to estimate the economic impact of the drought, and the regional distribution of this impact.

The primary method of direct impact analysis was to compare forecast budgets with actual outcomes for relevant farm types in each affected region. The forecasts were made prior to the drought and reflect a "without" drought expectation of physical performance and farming policy. The actual outcomes reflect a "with drought" situation. The difference between the two reflects the direct on-farm impacts of the drought[1].

As is shown in Table 1.1, output declined by $1.49 billion over the two-year period of the drought. The impacts of the drought on output are a combination of the difference in farm gate sales and the difference in changes in capital livestock[2]. Farm value added (net income) declined by $1.89 billion over the two-year period of the drought. This arose from a combination of the decline in output and an increase in the cost of inputs. There was a further loss of value added associated with a run-down in reserves of on-farm feed, and this was probably about $0.1–0.2 billion. There was little discernible change in direct farm employment or household income.

Table 1.1: Cost of the drought by farm type

2007/08 and 2008/09 combined	Dairy	Sheep and Beef	Deer	Total
Loss of income ($m)	(927)	(262)	(1)	(1 190)
Change in Capital Stock ($m)	-	(303)	-	(303)
Decline in output	(927)	(565)	(1)	(1 493)
Expenditure Impact ($m)*	(550)	161	(4)	(392)
Total Drought Cost ($m) (Loss in Value Added)	(1 476)	(404)	(5)	(1 885)
Sector share of total cost	**78%**	**21%**	**1%**	**100%**
Cost as % of production in the two drought years	**8%**	**4%**		

*A negative value implies an increase in expenditure. Excludes run-down in on-farm stocks of feed.

To get some feel for the significance of the drought, we compared the loss of value added over the two drought years to expected non-drought farm income over those two years. We estimate that for dairy farms the losses due to the drought were equivalent to about 8 per cent of production over the two years, while in the case of sheep and beef farms it was equivalent to about 4 per cent of production.

[1] The forecast budgets were adjusted to reflect subsequent changes to parameter values that had not been affected by drought. For example, they were adjusted to reflect actual international prices rather than those that had been expected at the time of the forecasts.

[2] Generally sales fell as a result of the effects of the drought on production, but rose as a result of destocking. Sales of capital stock do not reflect changes in production, but reflect changes in ownership of the asset base.

These losses may not seem overly significant, but when expressed as a proportion of net farm income, which is the income available to cover depreciation, a return to the labour of the farm family via drawings and a return to capital, the decline is two to three times as great (in the order of 15 percent).

In financial terms, the impact of the drought was felt most heavily by dairy farmers, who suffered almost 80 percent of the loss in value added (see Table 1.2). This impact was focused in Waikato, which suffered 44 percent of the national costs of the drought.

Table 1.2: Cost of drought (direct value added) by location

	Dairy	Sheep & Beef	Deer	Total	Share
Northland	-	-	(0.0)	(0)	0.0%
Auckland	(14)	5	(0.1)	(9)	0.5%
Waikato	(799)	(37)	(0.6)	(836)	44.4%
Bay of Plenty	(155)	(9)	(0.3)	(164)	8.7%
Gisborne	(1)	-	(0.1)	(1)	0.0%
Hawkes Bay	(14)	(61)	(0.5)	(76)	4.0%
Taranaki	(181)	(26)	(0.1)	(207)	11.0%
Wanganui/Manawatu	(91)	(133)	(0.5)	(225)	11.9%
Wellington	(21)	(43)	(0.1)	(64)	3.4%
Tasman	(17)	(2)	(0.1)	(19)	1.0%
Marlborough	(1)	1	(0.1)	0	0.0%
Canterbury	(35)	(6)	(1.6)	(43)	2.3%
West Coast	(51)	(1)	(0.1)	(53)	2.8%
Otago	(26)	(35)	(0.7)	(62)	3.3%
Southland	(71)	(56)	(0.7)	(127)	6.8%
New Zealand	**(1 476)**	**(404)**	**(5.4)**	**(1 885)**	**100.0%**

Flow-on impacts

Up until the mid-1990s, typical drought economic impact analysis in New Zealand related primarily to sheep and beef farms. Total impacts were calculated using average farming multipliers, which implicitly assumed that farm inputs declined by the same proportion as farm outputs. Hence there were calculated to be significant flow-on effects in the rest of the economy. On sheep and beef farms in severe and prolonged drought or when farmers are in a weak financial position, this tends to be the case, as is borne out by casual observation and anecdotal information. However, the direction of expenditure shift is less certain where the drought affects dairy farms that are less able to change inputs without severely affecting output in the short-term, are not used to coping with drought, or when the drought occurs at a time when farmers are in a strong financial position.

In the case of the 2007/08 drought, dairy farmers were getting exceptionally high prices for milksolids. Their response was to spend heavily on feed to maintain production as much as possible and then on pasture resowing to restore lost production as quickly as possible after the event. Sheep and beef farmers had already been financially squeezed for some time with low profitability and had limited opportunity to reduce costs further. Sheep and beef farmers sold capital stock in 2007/08 hence improving cash flow. In 2008/09 they enjoyed a substantial improvement in product prices, but did not restock to the same extent as they destocked, hence again enabling them to maintain expenditure in other areas. For all of these reasons the drought led to an increase in farm spending.

To estimate the flow-on effects of changes in farm spending we estimated changes in farm spending by category of spending and by region. We allocated this spending to generate estimates of changes in production by industry by region[3], and applied relevant industry regional and national multipliers to estimate total indirect and induced economic impacts associated with this change in spending.

Milk for processing declined significantly. We have converted this to changes in output of processed dairy products and applied dairy industry multipliers[4] to estimate the regional economic impacts of this reduction. Meat processing increased in 2007/08 as farmers killed capital stock, but declined in 2008/09 as livestock production declined with a smaller base of breeding stock and poorer reproductive performance. We converted the change in the value of livestock going to slaughter to a change in the output of meat processing works and applied meat industry multipliers to estimate the total regional and national economic impacts of this.

We estimate that the total loss of off-farm value added as a result of the drought was $887 million (see Table 1.3). This large loss was predominantly due to the impacts of the drought on dairy processing (down in both years) and meat processing (up in 2007/08 and down in 2008/09). The negative impacts of this reduction in processing sector activity completely swamped the small positive effect associated with increased farm spending on such items as pasture restoration. It is also possible that the loss of off-farm value added is understated, because some costs are fixed overheads and the marginal value added: output ratios are higher than the average ratio.

Table 1.3: Direct, off-farm and total output and value added impacts of drought, by region ($m)

Region	Output ($m)			Value Added ($m)		
	Direct	Off-Farm	Total	Direct	Off-Farm	Total
Northland	-0	-34	-34	-0	-14	-14
Auckland	1	-132	-130	-9	-76	-85
Waikato	-624	-1 449	-2 073	-836	-384	-1 221
Bay of Plenty	-107	-230	-337	-164	-68	-232
Gisborne	-0	-3	-4	-1	-2	-3
Hawkes Bay	-100	-17	-117	-76	-49	-125
Taranaki	-154	-278	-432	-207	-91	-298
Wanganui/ Manawatu	-211	-46	-258	-225	-89	-314
Wellington	-62	-40	-102	-64	-41	-105
Tasman	-9	-10	-18	-19	-3	-21

3 In some case to imports or to changes in stocks of feed, which have little flow-on impact apart from on the transport sector.

4 In order to avoid double counting of on-farm economic impacts, we calculated modified dairy and meat processing multipliers, which excluded backward linkages through farms.

Marlborough	-1	-2	-3	0	-1	-1
Canterbury	-44	186	143	-43	3	-40
West Coast	-19	-21	-40	-53	-6	-59
Otago	-55	15	-40	-62	-27	-89
Southland	-109	-6	-115	-127	-38	-165
New Zealand	-1 493	-2068	**-3 561**	-1 885	-887	**-2 773**

We estimate that the drought led to a potential loss of almost 3000 job-years[5] of work off-farm and a loss of $143 million of household income (see Table 1.4). This is equivalent to 1500 full time jobs being lost for the duration of the drought. Given that there are 9500 people employed in milk processing, 24 000 in meat processing and probably twice as many in the various support industries for these sectors, the numbers seem realistic.

In many cases the impacts on jobs will have been felt as shorter working periods in the seasonal industries or on fewer hours per day. It is also probable that our estimates of potential lost household income and employment overstate the actual impacts because average multipliers will not be the same as marginal multipliers. For example, tanker drivers may face only a small reduction in hours, even if they are picking up 10 percent less milk at each farm, and the processing sector will be reluctant to make staff redundant if they see that the downturn is likely to be short-lived. This means that business will not have been able to adjust completely to the reductions in throughput caused by the drought and will most probably have reduced productivity rather than reduced employment by the amount reported here.

The probable overstatement of lost household income off-farm is a partial offset to the likely understatement of lost household income on-farm. Anecdotal evidence is that even although the model farm budgets show little change in farm drawings, some families had a very severe drop in disposable income and household spending.

Table 1.4: Direct, off-farm and total employment and household income impacts of Drought, by region ($m)

Region	**Employment (job-years)**			**Gross Household Inc ($m)**		
	Direct	**Off-Farm**	**Total**	**Direct**	**Off-Farm**	**Total**
Northland	0	-100	-100	0	-4	-4
Auckland	0	-460	-460	0	-21	-21
Waikato	0	-2 728	-2 728	0	-126	-126
Bay of Plenty	0	-438	-438	0	-20	-20
Gisborne	0	-13	-13	0	-1	-1
Hawkes Bay	-0	-67	-67	-0	-3	-3
Taranaki	0	-395	-395	0	-18	-18
Wanganui/ Manawatu	-0	106	106	-0	1	1

[5] A job-year is one person working full-time for one year; four persons working full-time for three months, etc.

Wellington	0	-144	-144	0	-7	-7
Tasman	0	20	20	0	0	0
Marlborough	0	-4	-4	0	-0	-0
Canterbury	0	818	818	0	36	36
West Coast	0	67	67	0	2	2
Otago	0	143	143	0	6	6
Southland	0	240	240	0	12	12
New Zealand	0	-2 959	**-2 959**	0	-143	**-143**

The estimates of economic impacts ignore any restocking in 2008/09, and any associated reduction in meat slaughtering. While comprehensive data is not yet available, initial indications are that many sheep and beef farmers have only partially restocked. Reasons include:

- Some land is still in drought and restocking is not appropriate.
- Some land has converted to other uses such as dairy grazing.
- Some farmers have decided to retain fewer capital stock but try and achieve higher reproduction rates and slaughter weights.
- Some farmers are simply waiting to see whether the recent upturn in stock prices will continue and whether it is worth remaining in sheep and beef farming.

Limitations of the study

While the process adopted for the analysis had its limitations with regard to accuracy, particularly in estimating results at a regional level, we were unable to identify any method of estimating drought impacts at a regional level other than to use the MAF Farm Monitoring models. While this study converted forecast model values to reflect changes in international commodity prices, no other parameter values were changed. Future analysis could consider re-running the “without drought” forecast budgets using the same non-drought-affected parameter values as were revealed by the “actual” budgets.

Advantages of the process used

Advantages of the approach used are:

- The inclusion of the benefits that accrue to those finishing farms that benefit from the purchase of store stock at very low prices, hence avoiding potential overstatement of drought costs.
- The only simple way of calculating regional impacts.
- Includes adjustments for sales of capital stock, hence avoiding understatement of drought impacts during the destocking phase and overstatement during a restocking phase.
- Avoids the need for one-off large-scale surveying of individual farm types by taking advantage of the existing on-going surveying that underlies the various farm models. The down-side is that specific questions directly relevant to the impacts of the drought are not asked. Impacts have to be inferred from data that might also incorporate other impacts.

2. Background to study and overview

In late 2007 a severe drought affected parts of New Zealand, and became more widespread over the next few months until it affected almost the entire country, with the exceptions being Northland, Gisborne and much of the West Coast. The effects of the drought in 2007/08 extended into 2008/09 as a result of fewer capital stock being retained, and those that remained being in poor condition at mating. Moreover, the drought itself continued. There is the potential for the effects of the drought to extend into the 2009/10 year if breeding stock numbers do not recover to 2007/08 opening levels. Our understanding is, however, that any failure to restock to pre-drought levels reflects the financial and market environment rather than physical limitations imposed by the drought.

MAF Policy commissioned Butcher Partners Ltd to estimate the 2007-2009 economic impacts of the drought on a regional and national basis. The impacts are to cover the pastoral sector and to include both impacts at the farm gate and impacts on the wider community, which will be affected by changes in farm spending and by changes in the quantities of meat and wool processed.

Section 3 of this report describes the main physical manifestations of the drought in terms of its effects on production, capital stock numbers and farm expenditure, while section 4 describes the framework used for modelling the economic impacts associated with these physical changes. Section 5 presents estimates of the on-farm financial impacts of the drought, while section 6 presents estimates of the off-farm impacts of the drought, including those associated with the processing sector.

3. Physical effects of the drought

The drought affected most areas from late December 2007 onwards and continued into late autumn 2008, hence affecting the middle to end of the productive season. At this point the reproductive performance levels for the year had already been achieved but reproductive performance was affected in 2008/09. Major impacts of the drought were reduced quality of stock, a reduced quantity of milk production and increased costs of inputs to offset the lack of feed and to restore pastures to normal productivity.

3.1 Production effects – overview

Dairy

Dairy farms tended to try and offset a shortage of feed by purchasing feed from other New Zealand farms and from overseas via imported palm kernel meal. Notwithstanding this, production declined substantially in both 2007/08 and, to a lesser extent, in 2008/09. We have assumed that milksolids prices were not affected by the drought, although it is possible that the lower than anticipated production could have had some modest upwards impact on prices. To the extent that this may have occurred our estimates of the drought impact would be overstated.

In the case of Northland there was no drought effect, and in the case of Marlborough and Canterbury any drought effect was more than offset by an increase in production arising from recently converted farms coming into full production, with significantly higher production than in the preceding season. Hence although the model farms show an increase in milk production in the latter two regions, we have ignored this in calculating the drought impacts and have focused solely on the increases in production costs over and above “normal year” budgeted costs.

Sheep and Beef

When the drought hit, lamb finishing was well advanced on many farms. Therefore the impacts in the first year took the form primarily of reducing the quality and quantity of lambs that were sold to slaughter and increasing the number of lambs sold as stores. In the latter case prices fell both because stock quality was poorer and because the increased supply went into a market in which demand had been reduced by the drought. The initial impacts are shown in decreased farm gate incomes from sales of wool, grazing income and stock. The cash flow impact of the decline in value of livestock production was masked by the sale of capital stock, and reduced purchases of stock. In 2008/09, production was down because of a reduced number of breeding stock achieving lower-than-normal lambing and calving percentages.

Livestock traders that were drought-affected purchased fewer store lambs to finish, although in some instances farmers loaded up on cheap store stock during the drought. In MAF’'s Farm Monitoring Western Lower North Island Intensive Sheep and Beef model it appears that farmers purchased stock, particularly beef cattle, at the discounted prices and retained them over the winter, hence actually profiting from the drought. Those farmers that were able to feed lambs also had the potential to sell that feed into the dairy industry at a higher return than their traditional livestock finishing, so they would only buy lambs if they could purchase them cheaply and were able to make historically high margins on them.

3.2 Capital stock impacts – overview

As it became obvious that the farms were not going to recover sufficiently from the drought to have enough fresh and supplementary feed[6] to maintain capital stock numbers into and through the winter, farmers implemented strategies to reduce numbers of capital stock, hence increasing total sales at the farm gate and increasing output at meat processing works. Farm output[7] fell because the disposal prices received for the capital stock were less than their opening value as breeding stock.

The destocking apparent in most sheep and beef farms was partially drought pressure and partially the acceleration of a trend to shift the production emphasis away from sheep and beef, because of the poor returns of recent years. Meat and Wool NZ Economic Service estimates that only about 60 percent of the total reduction in stock numbers on sheep and beef farms was a result of the drought, and the rest was a movement away to other land uses. Destocking, however, does not in itself cause a loss of output or profit, because the decline in stock value is offset by an increase in sales revenue. What the drought did was to reduce the value of stock sold below their value as breeding stock, and hence the drought was the reason for the decline in output.

The pressure on processing capacity of the meat industry caused by the drought (accelerated lamb kill) and the conversion from sheep farming to other land uses meant that slaughter space was at a premium, and farmers were forced to take the option of disposing of the class of stock that was most easy to get rid of in a timely manner. This meant that in some cases instead of killing older ewes they were forced to kill ewe hoggets or replacement ewe lambs. In some hill country models, breeding cattle were also sent to the works or sold into the store market instead of sheep.

It would be normal for farmers to restock capital breeding stock in the year following the drought. However, it seems that many farmers have adopted a wait and see attitude to this and have not rushed back into sheep. This meant that while the number of stock slaughtered in the following year was down because of the reduced number of breeding animals, the number was not further reduced by as much as would normally be expected due to retention of lambs to build capital stock numbers back up. We do not see the failure to rebuild capital stock as being primarily an impact of the drought. Although there is no doubt that some farmers are not restocking because of weak cash flow, we perceive the reluctance to restock as being primarily a reflection of low confidence in the sheep and beef farming sector and, perhaps, a recognition by farmers that they had previously been somewhat over-stocked[8].

Details of the impacts on stock values in 2007/08 are contained in Appendix 2. We have not tried to forecast rates of restocking in 2008/09. Hence our estimates may have understated the effects of the drought on meat processing in 2008/09, having accounted only for the reduction in slaughter due to fewer breeding stock and lower reproductive rates.

3.3 Expenditure impacts

The impacts of a drought on farmer spending are strongly affected by their underlying equity and cash flow positions. In the short-term, capital livestock are sold, cash flow improves and spending does not come under immediate pressure. In extreme droughts of long duration, or when farmers restock following a drought, all forms of farm spending tend to be reduced

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[6] Sheep and beef farmers tried to purchase feed, but little was available because it had been taken up and inflated in value by the dairy industry demand.

[7] We define output as the value of sales less the reduction in value of stock.

[8] It has been suggested that farmers are now achieving higher slaughter weights that also have a higher value per kilogram.

because farmers simply do not have the funds to spend on inputs. This decline in spending is magnified if farmers start a drought with low cash reserves or high debt and little ability to borrow additional funds. The decline in spending can be exacerbated still further if product prices are low when the drought ends.

The impacts on operational spending tend to be less on dairy farms than on sheep, beef and deer farms. In the latter, financial overheads are a lower proportion of income and current costs a higher proportion. Cutbacks in spending such as fertiliser, repairs and maintenance and fencing can take some time to be reflected in a reduction in income. In contrast to this, dairy farming has high fixed overheads, many operational costs are harder to reduce, and reductions in spending on operational costs tend to be reflected immediately in income reduction.

The 2007/08 drought occurred at a time when milksolids prices were high and farmers were committed to a high supplementary feed input system to maximise returns. Farmers' immediate reaction was to spend more on supplementary feed to offset the effects of the drought. By the middle of the subsequent year it became apparent that income was going to be significantly below early season expectations but farmers had already undertaken expenditure to restore productivity. The budgets we have worked with have not indicated any reduction in spending as a result of the drought, although later versions of the budget may show this. However, any subsequent reduction in spending should be seen as a response to a rapid decline in dairy commodity prices.

The drought hit sheep and beef farmers at a time when product prices were low and spending was already constrained, so further reductions in spending were hard to achieve. Moreover in the first year of the drought cash flow and liquidity was improved by sales of capital stock, so immediate pressure on spending was reduced. By the end of the drought, product prices had increased markedly and restocking appears to have been less than destocking. Both factors have improved cash flow significantly from what might normally be expected post-drought, and so there was significant spending on restoring pastures to full capacity.

We have not commented on the economic impacts of any reduction of expenditure on capital items, such as farm machinery, or on household spending. For the dairy sector the drought occurred at a time of record profitability and equity and the drought did not change discretionary expenditure behaviour greatly. For the sheep beef and deer sectors the opposite was the case with little discretionary expenditure planned and little carried out. If it is the case that the drought reduced discretionary expenditure then our analysis is likely to have under stated the true economic impacts.

In summary, an examination of the farm budgets suggests that this drought had the primary impact of increasing economic activity off the farm, with this being funded by either a reduction in cash profit or in the case of sheep and beef farmers who enjoyed a significant increase in product values, a lesser reduction in debt than would otherwise have been the case.

There were the usual impacts on meat processing, where activity increases during the drought as capital stock are reduced, and then activity declines post-drought as reproductive performance is lower, there is a lower breeding stock base, and slaughter is reduced as capital livestock is rebuilt. In this instance, the decline in post-drought activity is likely to be less than might have been expected, because farmers did not fully restock. In the long-term this failure to restock will mean a decline in numbers of stock going to slaughter, although there is an expectation that the lower stocking rates will lead to higher carcass weights.

Traditionally, economic impact modelling of droughts assumed that reductions in farm income would lead to a commensurate reduction in all forms of farm spending. More detailed research of the 1997-99 Canterbury drought showed that spending can follow a very different path to income in the short-term, with a loss in income being offset by changes in capital and debt structures. Our analysis of the 2007/08 drought suggests that the flow-on effects on the rest of the community were the reverse of what has been typically assumed to be the case. That is, the loss of income was accompanied by an increase in expenditure.

4. Modelling process

Modelling of the drought impacts had three components. The first was to estimate the impact of the drought on farm gate production, and on stock numbers. This had implications for farm output, farm value added and economic activity in the processing industry.

The second component was to estimate the impact of the drought on farm input expenditure, which affects farm value added and also has implications for output, employment and value added for all those businesses that supply inputs to farming and those employed in the farm sector.

The final component was to generate regional economic models, to calculate multipliers for the various industries affected by the changes in farm expenditure, and to apply these multipliers to the changes in direct farm purchases in order to estimate the total economic impacts of the drought, including multiplier effects, on the regional and national economies. We also estimated multipliers for processing, and applied these multipliers to the changes in processing output implied by the changes in farm inputs to processing[9].

4.1 Farm models

The estimates of effects on farm gate production, farm inputs and stock numbers were made using available MAF model farm budgets[10], which enabled us to estimate both "with drought" and "without drought" output and expenditure for each farm type.

Table 4.1: Allocation of farm models to regions

Region	Representative Model
Auckland	Waikato–Bay of Plenty
Waikato	Waikato–Bay of Plenty
Bay of Plenty	Waikato–Bay of Plenty
Gisborne	Lower North Island
Hawkes Bay	Lower North Island
Taranaki	Taranaki
Wanganui/Manawatu	Lower North Island
Wellington	Lower North Island
Tasman	Lower North Island
Marlborough	Canterbury
Canterbury	Canterbury
West Coast	Lower North Island
Otago	Canterbury
Southland	Southland

[9] We did not attempt to estimate any difference between average and marginal production functions for processing.

[10] These are based on financial and physical performance of actual farms in individual years, rather than being mathematical models of expected financial performance based on physical indicators.

The way in which the various farm models were used is described in more detail in Appendix 1. In simple terms we used a forecast income and expenditure budget, where the forecast was made before the drought took place, as a proxy for expected outcomes without drought. We compared this with the budget based on actual farm outcomes, which is the "with drought" budget. The difference between the "with drought" and "without drought" financial outcomes was the net impact of the drought.

4.1.1 Adjusting models to constant prices

Prices for fixed quality and quantity units (for example, 1 kg of P.M. lamb) are shown in the "with" and "without" drought models. Comparisons of these prices gives a price deflator for that product so that the "without" model outputs can be converted to the same prices[11] as the "with drought" outputs. Prices are also specified in the models for units that are of variable quantity and quality (for example, per store lamb), where the variation is due to the drought. In these cases we applied the same price deflator as had been applied to the relevant fixed quantity and quality product. So, for example, the value of store lambs was adjusted by the change in the P.M. lamb schedule. It is possible that the store lamb price is affected by demand and supply effects during the drought, as opposed to being affected purely by weight and quality effects, and hence we are combining both quantity and price effects that are due to the drought.

We did not adjust input expenditure for price changes[12]. This could have led to an overestimate or underestimate of the drought effects. However, we included in our analysis only changes in inputs that the farm model commentaries identified as being related to the drought.

Consideration of the effects of the drought on prices and incomes

While the models identify some farm gate price changes, we have been unable to allocate these between:

- Shifts in final market demand, including exchange rate effects.
- Shifts in competitive advantage between meat processors and farmers due to destocking because of drought.
- Shifts in competitive advantage between meat processors and farmers due to destocking because of the decision of some farmers to convert from sheep and beef to other land uses (e.g. exiting cattle to enter dairy grazing).

After a review of price changes during the drought years, discussions with industry participants and consideration of transfer effects between farmers, we concluded that price changes arising from the drought had little effect on production, and that the primary effect of such price changes was a transfer of wealth between buyers and sellers. In the case of store stock, both parties were in the pastoral sector and/or in the same region. In the case of stock going to slaughter, the transfer is between farmers and meat processors. In both cases, a transfer should not be included as a net cost of the drought.

[11] This is to ensure that changes in income due to general price changes are not attributed to the drought. We assume that international prices are not affected by the drought.

[12] Stored feed is much more expensive during droughts, but this cost reflects the holding costs and risks associated with stored feed, and hence is the true cost of consuming that feed. Even if there is an element of "profiteering"/economic rent, this is in any case a transfer between participants in the same broad sector rather than a net cost to the sector as a whole.

We have assumed that the entire price effect is due to changes in the market environment rather than the drought. Our reasons are as follows:

- We think it unlikely that a change in supply of the magnitude due to the drought would significantly affect the international price of sheep, beef and dairy.
- Even if there is a price effect, no one has estimated what that might be.
- Drought-induced price effects are just as likely to be reversed in the following year as supply is reduced due to restocking. Ignoring the effect in both years leads to a realistic estimate of the net effect on farmer income.

For all the above reasons we have ignored any price effects of the drought on farm and national income.

4.1.2 Model anomalies

While the farm financial models used represent the best efforts of the modellers, they are developed for other purposes and may not be particularly well-suited for calculating drought impacts by comparing the results of different model runs. For example, assume the forecast (without drought) model is run with a particular parameter value, and assume that six months later there is a minor change in this parameter value for non-drought reasons[13]. The revised parameter value will be incorporated into the actual (with drought) model run. This may result in apparently minor changes in the actual model output values (say plus 2 percent). Assume a comparison of the forecast and actual model output values reveals a difference of 10 percent. This entire 10 percent is attributed to the drought, whereas in fact one-fifth of the impact (2 percent) is attributable to the non-drought parameter value change. If the forecast model had been re-run with this changed parameter value, the 2 percent increase would occur in both model runs and hence the “difference” would decline to 8 per cent, but this does not happen because the models are not developed with this use in mind.

The models do not use the same price basis for valuing stock sales as for valuing stock changes. Hence while in principle destocking should not affect net financial income or output, in practice it may do so. The current practice of setting livestock standard values using average prices for the last year have reduced the significance of this issue but it still exists. We are unable to say whether this has had any significant impact on our estimate of the costs of the drought.

We have assumed no change in capital livestock in 2008/09. We have modelled only the changes in production flowing on from the drought (fewer opening breeding stock and lower-than-normal reproduction rates) and the farm gate value of this. This will not affect the modelled costs of the drought in 2008/09, although if we thought that stock numbers would not recover because of the drought (as opposed to because of changes in decisions about optimal stocking rates for other reasons), then this would imply on-going drought effects into 2009/10. Our current view is that it is not the drought that is preventing restocking, but changes in the overall profitability of sheep and beef farming. The drought was simply the trigger that accelerated those changes. This assumption of no changes in capital stock means that the decline that might be expected to occur in freezing works in 2008/09 is not picked up.

Apparent dairy production increases in Northland, Marlborough and Canterbury were ignored on the grounds that in the former case the drought had a minimal effect anyway, while in the other two regions an increase in production for other reasons has masked the decline due to the drought, but it was not possible to disentangle the drought impacts from these.

[13] An example would be the lambing percentage in the first year of the drought. The drought did not have an effect until after lambs were weaned, so clearly this is not a drought-related effect.

One sheep and beef farm type in particular (West Coast North Island) showed a very significant profit during the drought. When we looked at the individual parameter values in the “without drought” and “with drought” budgets, it became apparent that the results reflected the situation where some farmers did get rid of more of their prime stock than they would in a normal year, and then bought in store stock at low prices and retained them over winter, hence making a significant profit when they sold them again the following year at “normal” prices. This result gives us confidence that we are correctly incorporating the economic transfers that occur between the farmers that suffer from low prices as a result of the supply demand imbalance for store stock during a drought and the farmers that benefit from those low prices.

4.2 Modelling regional impacts

We derived regional economic impact models from a national 2005/06 input – model developed by Stroombergen and Nana[14]. The regionalisation process estimates regional output by allocating national output on the basis of physical output parameters or labour inputs, and estimates regional input coefficients by adjusting national input coefficients for estimated regional self-sufficiency by industry. The process has been widely used in New Zealand for more than 20 years[15]. Individual industry multipliers (income, output and employment) were calculated for each region and for New Zealand.

Changes in farm output by category and drought-related farm expenditure by category were calculated for each farm type within each region, and then the results were combined for all farm types in that region[16]. Regional expenditure within a category was then allocated to the appropriate industry groups[17], and for each industry group a decision was made[18] as to what proportion of the production was likely to take place within the region. Where appropriate, some or all of this production was allocated to other regions according to their share of national output of that industry. For example, Southland does not produce agri-chemicals, so an increase in demand for these was allocated to the regions that do produce them.

Appropriate multipliers were applied to each expenditure and output value to estimate total regional economic impacts of the changes in farm output and expenditure.

National economic impacts were also calculated by applying national multipliers to the various changes in outputs and inputs. Individual regional multipliers are lower than national multipliers because some of the multiplier effects are felt beyond the region. Having calculated regional impacts using regional multipliers, we summed the impacts and compared them to the national impacts calculated using national multipliers. The difference between the two figures represents effects which have been “exported” from the regions to other regions, and this difference should be included in the total impacts on those regions. We allocated the difference across regions on the basis of regional shares of GDP. Given the relatively modest

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[14] Unpublished tables developed as part of a FoRST project, and using the resources of the Statistics New Zealand data lab.

[15] The non-survey process was developed by Jensen and West at Queensland University. For details, see Butcher, G. Regional Income, Output and Employment Multipliers: Their Uses & Estimates of Them. Vol.4 of Cost Benefit Handbook; Ministry of Agriculture and Fisheries, Wellington, 1985.

[16] So for example fertiliser use per hectare was calculated for each farm type, it was grossed up to the total amount of fertiliser on all the hectares represented by that farm type, and then fertiliser use was combined over all the farm types to get total fertiliser use for the region.

[17] For example, fertiliser is allocated to a combination of fertiliser production, wholesale trade, transport and farm contracting.

[18] Using a simple location quotient as a measure of regional self-sufficiency.

sums involved and the error margins inherent in any distribution process, it was not considered worthwhile to use a more sophisticated regional impact distribution algorithm.

Processing Impacts

The level of physical activity and hence employment and household income at meat works is strongly dependent on the number of head of stock killed. The level of value added depends primarily on the value of meat processed. We have assumed that in year one of the drought (2007/08), the value of the change in meat works livestock inputs for the purpose of calculating employment and household income effects is equivalent to the change in value of capital stock in the farm models over that year[19]. The change in livestock inputs for the purpose of calculating value added effects is equivalent to the change in the value of farm gate sales of livestock. In the post-drought year 2008/09, the value of the change in meat works stock inputs is equivalent to the decline in farm sales of sheep and beef. This reflects the lower number of lambs and calves born, but at this stage does not assume any restocking on farms.

The change of meat processing industry outputs is based on the average ratio between stock inputs and meat processing outputs, which is 0.49. We have allocated a proportion of the change in processing activity to the region in which the change in livestock production took place, where the proportion reflects the assessed regional self-sufficiency in meat processing of that region. Any remaining proportion was spread across other regions according to their share of national meat processing capacity.

We followed a similar process for dairy processing, except that in that case the ratio between inputs and outputs is assumed to be 0.6.

[19] NZ Meat and Wool Economic Service suggest that 40 percent of the decline in stock numbers in that year was due to a change in farming policy. However, the farm model stock number changes are likely to relate primarily to the drought, because the MAF Farm Monitoring models are for a “typical average” or median farm, and as such are likely to exclude farms which have substantially changed land use. Hence it is appropriate to use the change in farm model breeding stock as an approximation of the increase in stock going to meat processing.

5. Drought impacts at farm gate

5.1 MAF early estimates

In March 2008 a MAF news release suggested that the 2007/08 drought had cost $1.24 billion at the farm gate as a result of decreased income and increased expenses. The drought continued, and a later MAF estimate put the figure at $1.4 million for the dairy industry alone.

5.2 Study estimates of direct output and value added impacts

We estimate that for the combined 2007/08 and 2008/09 seasons, the drought will have cost approximately $1.9 billion in lost production and increased costs, and a further $0.1–$0.2 billion in rundown of on-farm stored feed. This net cost is the reduction in direct value added or GDP.

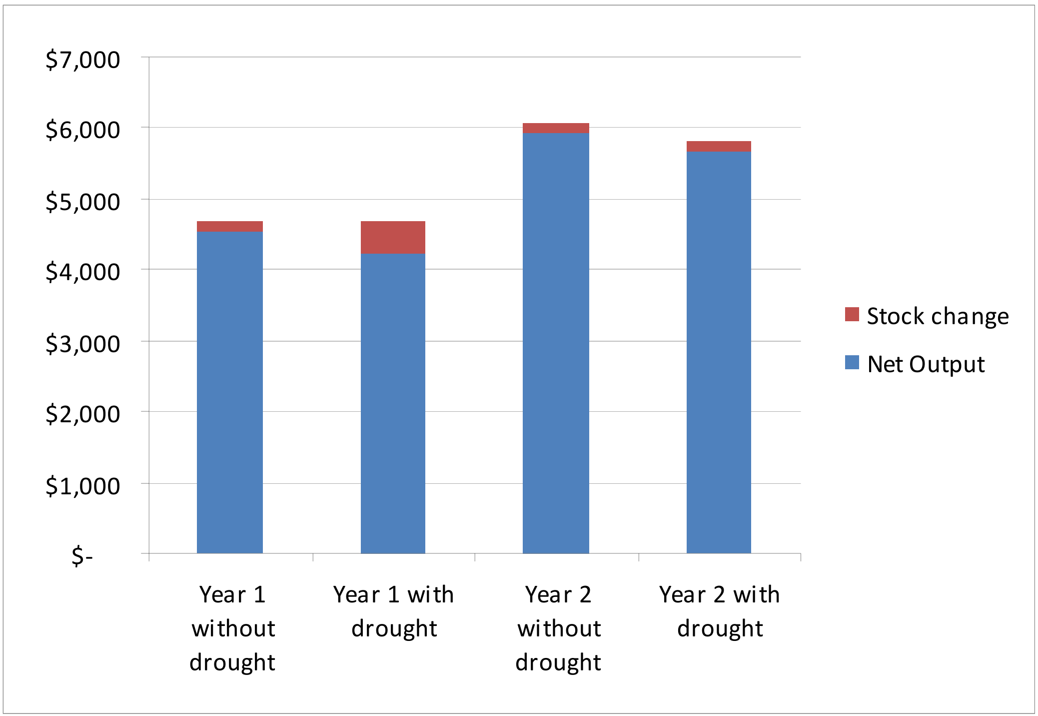
Table 5.1: Cost of the drought by farm type by year

	Dairy	Sheep & Beef	Deer	Total
2007/08				
Loss of income ($m)	(647)	(1)	(1)	(649)
Decline in Capital Stock Value ($m)	-	(303)	-	(303)
Loss of Output	(647)	(304)	(1)	(952)
Increased Expenditure ($m)*	(443)	203	(4)	(244)
Total Drought Cost ($m)	**(1 090)**	**(101)**	**(5)**	**(1 196)**
2008/09				
Loss of income ($m)	(280)	(262)	-	(541)
Decline in Capital Stock Value ($m)	-	-	-	-
Loss of Output	(280)	(262)	-	(541)
Increased Expenditure ($m) *	(107)	(41)	0	(148)
Total Drought Cost ($m)	**(387)**	**(303)**	**0**	**(690)**
Combined Period				
Loss of income ($m)	(927)	(262)	(1)	(1 190)
Decline in Capital Stock Value ($m)	-	(303)	-	(303)
Loss of Output	(927)	(565)	(1)	(1 493)
Increased Expenditure ($m)*	(550)	161	(4)	(392)
Total Drought Cost ($m)	**(1 476)**	**(404)**	**(5)**	**(1 885)**
Sector Share of Total Cost	78%	21%	1%	100%
As % of output over 2 years	8%	4%		

*A negative value implies an increase in expenditure. Excludes run-down in on-farm stocks of feed.

The reduction in farm output is equivalent to the loss in income plus the decline in capital livestock values. This reflects the fact that it is possible to maintain sales by selling capital stock, but the capital stock component of the sale is just a transfer of asset ownership and does not represent actual production.

Figure 5.1: Sheep and beef total sales and net output



5.2.1 On-farm feed reserves

The cost related to consumption of on-farm feed reserves does not typically show in farm accounts unless there is trade between farms. We are unable to put an accurate value on the cost of this run-down, because to do so requires on-farm surveys which were not a part of this project. However, in an analysis of the 1995-97 Canterbury drought, we estimated this cost to be more than a quarter of the direct production and expenditure costs. That drought affected primarily sheep and beef farms which, unlike Waikato dairy farms, expect frequent drought and hold substantial feed reserves for such purposes. The 2007/08 drought affected dairy farms most heavily, and hence the run down of feed reserves will be a much smaller proportion of direct drought costs than was the case in 1995-97. It could be of the order of $100-200 million. Some of the run-down of fees may have been reversed in 2008/09 when fewer capital stock and progeny could have created the conditions for shutting up paddocks and making greater feed. However, the farm budgets do not reflect a significant amount of rebuilding of feed stocks.

5.3 Location of drought

The 2007-09 drought was strongly focused on the Waikato, where more than 40 percent of total losses occurred. The predominance of Waikato effects reflects the huge dairy production base of the Waikato as well as the infrequent nature of drought in the region.

This latter factor leads to a rational farmer response of adopting less conservative stocking rates and higher risk farming systems than occur in the areas where drought is more common, and hence losing more when drought does occur. Farmers in the Waikato are also not as well prepared to cope with drought when it does occur, so their probable slower management responses may also lead to higher losses than would occur in an area where management responses were better practiced.

Table 5.2: Cost of drought by location

	Dairy	Sheep & Beef	Deer	Total	Share
Northland	-	-	(0.0)	(0)	0.0%
Auckland	(14)	5	(0.1)	(9)	0.5%
Waikato	(799)	(37)	(0.6)	(836)	44.4%
Bay of Plenty	(155)	(9)	(0.3)	(164)	8.7%
Gisborne	(1)	-	(0.1)	(1)	0.0%
Hawkes Bay	(14)	(61)	(0.5)	(76)	4.0%
Taranaki	(181)	(26)	(0.1)	(207)	11.0%
Wanganui/Manawatu	(91)	(133)	(0.5)	(225)	11.9%
Wellington	(21)	(43)	(0.1)	(64)	3.4%
Tasman	(17)	(2)	(0.1)	(19)	1.0%
Marlborough	(1)	1	(0.1)	0	0.0%
Canterbury	(35)	(6)	(1.6)	(43)	2.3%
West Coast	(51)	(1)	(0.1)	(53)	2.8%
Otago	(26)	(35)	(0.7)	(62)	3.3%
Southland	(71)	(56)	(0.7)	(127)	6.8%
New Zealand	**(1 476)**	**(404)**	**(5.4)**	**(1 885)**	**100.0%**

5.4 Effects on stock weights and stock numbers

Droughts lead to lower stock weights for both store stock and prime stock (those going direct to slaughter). They can also lead to lower prices for any grade of animal because of the drop in demand and/or the increase in supply compared to a normal season. The drop in price due to a change in the demand and supply balance is a transfer of wealth between buyers and sellers rather than a loss of value. Hence it is ignored in this analysis. The drop in weight is in the case of both prime and store stock a loss of gross and net income to the seller, and there is no benefit to the buyer. A farmer who buys light store stock has to put more feed into them to get them up to the desired weight, while the meat company buying lighter stock has less produce to sell.

5.5 Effects on farm expenditure

The 2007-09 drought was unusual in that it appears not to have led to a decline in farm input spending. In fact quite the reverse happened. As is shown in Table 5.1, if one excludes the reduction in spending on livestock purchases on sheep and beef farms, this drought was accompanied by a very significant increase in farm expenditure on inputs, including imported feed. The only area where there was a significant decline in spending was on sheep and beef farms where spending on shearing, repairs and maintenance and contracted feed preparation declined in 2007/08. Appendix 3 shows the detailed worksheets of changes in spending on farm inputs by input type.

We put this lack of decline in farm spending down to a number of factors including:

- The drought began to hit in the later part of the season, by which time many sheep and beef farmers had earned a significant part of their income and made many expenditure decisions.
- Sheep and beef farming was already at a very low ebb and farmers had already cut expenditure as far as was sensible. Further cuts would have resulted in a loss of production that exceeded the savings in expenditure.
- In the first year of the drought, cash flow for sheep and beef and deer was actually improved by the sale of capital stock to the point that farmers could maintain spending. In the second year of the drought product prices improved so that cash flow remained at levels which could sustain “normal” farm spending, even though debt that would otherwise have been repaid was not.
- The losses, while severe in aggregate, are spread across a very substantial number of farms and hence in terms of a percentage of revenue are less severe than in some of the other droughts that have occurred.
- The dairy industry had an exceptionally high payout in the 2008/09 year, and could afford to keep spending at “normal” levels. Moreover, dairy farming was so profitable that the marginal value of production was sufficient to make it worth purchasing feed to maintain production.
- The equity position of farms made borrowing possible. This may well be reversed in 2009/10 to the point that some dairy farmers may face great financial pressure. Nonetheless, the effects are likely to be felt primarily in reduced capital expenditure, fewer farm expansions and slower debt repayment rather than a reduction in spending on operating inputs.
- Any changes in spending on capital equipment and the economic impacts of this have not been included in our analysis of off-farm impacts.

The normal short-term drought-related flow-on negative impacts on the region arising from reduced spending on farm inputs hence did not eventuate. There are likely to be long-term effects arising from either lower capital spending or lower drawings and lower off-farm investment as farm surpluses are used to slowly repay debt and interest on the increased debt. This may not happen until the farm is finally sold, when the farmer will leave with a smaller cash payout than would otherwise have been the case.

Table 5.3: Change in inputs by farm type (2007-2009)

	Dairy	**Sheep & Beef**	**Deer**	**Total**	**S&B excl livestock**
Northland	-	-	0.0	0.0	-
Auckland	9.7	0.7	0.0	10.4	4.9
Waikato	218.1	(5.7)	0.2	212.6	14.8
Bay of Plenty	58.2	(1.3)	0.1	56.9	2.0
Gisborne	0.4	-	0.0	0.4	-
Hawkes Bay	8.4	(32.7)	0.2	(24.1)	(6.2)
Taranaki	62.4	(9.5)	0.0	53.0	0.9
Wanganui/Manawatu	63.4	(50.0)	0.2	13.5	0.2

Wellington	15.4	(13.5)	0.0	2.0	(0.1)
Tasman	12.5	(2.3)	0.1	10.2	1.3
Marlborough	1.2	(2.2)	0.1	(0.9)	0.4
Canterbury	35.3	(37.5)	1.6	(0.7)	3.0
West Coast	35.8	(1.7)	0.1	34.1	1.0
Otago	12.9	(6.8)	0.7	6.8	1.9
Southland	15.9	1.4	0.7	18.0	3.4
New Zealand	**549.6**	**(161.3)**	**3.9**	**392.2**	**27.4**

Note that increased spending on stock feed will have had little flow-on economic impact. This is because the feed was either imported, was taken out of existing stocks, or transferred away from other uses. The increased purchases of feed had very little effect on domestic production of stock feed.

5.6 Impacts on direct employment and household incomes

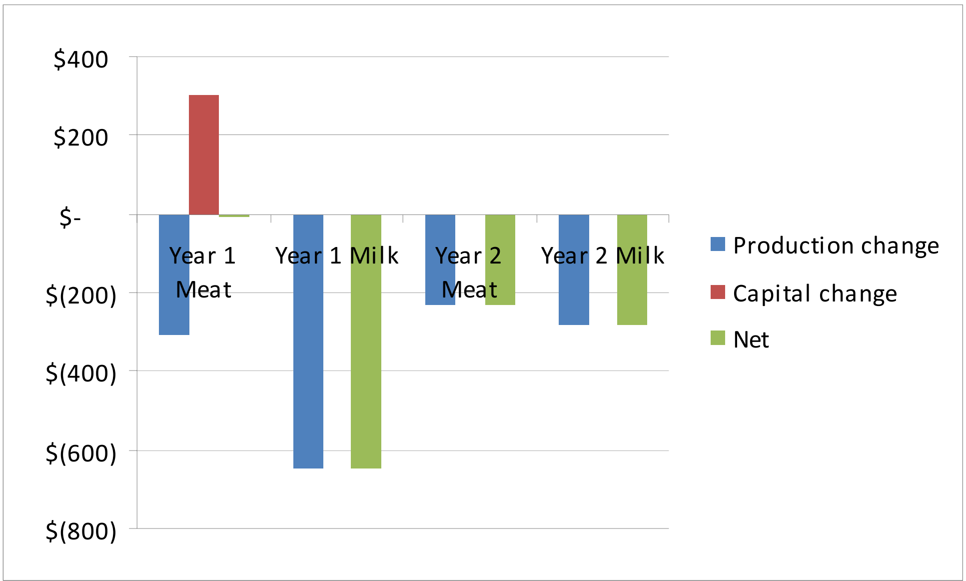
Financial models for all farm types showed no change in spending on wages, and hence we assume no change in direct farm employment. We are unable to quantify the impact on drawings (the models do not measure drawings specifically, but show the surplus available for drawings). We speculate that all farms needed the employed labour they had, while drawings on sheep and beef farms that were facing such poor prices had already been cut as far as was sustainable and dairy farms had sufficient income from the very high prices not to need to cut drawings.

We are aware anecdotally that some families were under very significant pressure and cut drawings significantly, but at the aggregate level it seems that these effects were not significant.

6. Off-farm and total impacts

As described in section 4.2, we incorporated the changes in farm spending into the regional economic models we developed for this project and estimated off-farm impacts of the drought at both the regional and national level. We also estimated processing impacts by estimating changes in inputs of milk and livestock into processing works (see Figure 2), calculating the implied changes in processed output values, and applying processing multipliers to these.

Figure 6.1: Sales to processors



Detailed worksheets relating to the off-farm impacts are included in Appendix 3. Summary results are shown below. The drought reduced direct output on farms by almost $1.5 billion (see third to last column in Table 6.1), including a decline in sales of $1190 million and a decline in livestock capital values of $303 million. Off-farm output declined by $2.07 billion, which including a $2330 decline related to processing of meat and dairy products and a $260 million increase related to farm inputs. Hence the total decline in output in New Zealand was $3.6 billion. Note that off-farm output is not a particularly useful measure of activity because it can reflect transactions in industries where the value added (income) to output (sales) ratio is very low. The more relevant measure is value added, and we turn next to this measure.

We estimate that the total loss of off-farm value added as a result of the drought was -$887 million (see Table 6.2). This was predominantly due to the impacts of the drought on dairy (2007/08 and 2008/09) and meat processing (2008/09), the negative impacts of which completely swamped the positive effect associated with increased farm spending on such items as pasture restoration. Hence the total loss of value added/national income was $2.77 billion.

Table 6.1: Direct, off-farm and total output impacts of drought by region

Region	2007/08 ($m)			2008/09 ($m)			Combined ($m)		
	Direct	Off-Farm	Total	Direct	Off-Farm	Total	Direct	Off-Farm	Total
Northland	-0	-15	-15	0	-19	-19	-0	-34	-34

Auckland	9	-37	-27	-8	-95	-103	1	-132	-130
Waikato	-382	-856	-1 238	-242	-594	-835	-624	-1 449	-2 073
Bay of Plenty	-55	-117	-173	-52	-113	-165	-107	-230	-337
Gisborne	-0	-0	-1	-0	-3	-3	-0	-3	-4
Hawkes Bay	-58	96	38	-42	-114	-155	-100	-17	-117
Taranaki	-106	-154	-260	-48	-124	-172	-154	-278	-432
Wanganui/Manawatu	-128	165	38	-84	-212	-296	-211	-46	-258
Wellington	-36	9	-27	-26	-49	-75	-62	-40	-102
Tasman	-8	-6	-14	-1	-4	-4	-9	-10	-18
Marlborough	1	3	4	-2	-5	-6	-1	-2	-3
Canterbury	-36	250	214	-8	-64	-71	-44	186	143
West Coast	-16	-15	-31	-2	-7	-9	-19	-21	-40
Otago	-41	76	35	-14	-60	-75	-55	15	-40
Southland	-96	41	-55	-14	-47	-61	-109	-6	-115
New Zealand	-952	-560	**-1 512**	-541	-1 508	**-2 050**	-1 493	-2 068	**-3 561**

Table 6.2: Direct, off-farm and total value added impacts of drought by region

Region	2007/08 ($m)			2008/09 ($m)			Combined ($m)		
	Direct	Off-Farm	Total	Direct	Off-Farm	Total	Direct	Off-Farm	Total
Northland	-0	-7	-7	0	-7	-7	-0	-14	-14
Auckland	3	-37	-34	-12	-39	-50	-9	-76	-85
Waikato	-535	-226	-761	-301	-159	-460	-836	-384	-1 221
Bay of Plenty	-97	-36	-133	-67	-32	-99	-164	-68	-232
Gisborne	-1	-1	-2	-0	-1	-1	-1	-2	-3
Hawkes Bay	-38	-16	-54	-38	-33	-71	-76	-49	-125
Taranaki	-128	-59	-187	-79	-31	-111	-207	-91	-298
Wanganui/Manawatu	-114	-31	-145	-111	-58	-169	-225	-89	-314
Wellington	-36	-23	-59	-28	-18	-46	-64	-41	-105
Tasman	-14	-2	-16	-4	-1	-5	-19	-3	-21
Marlborough	2	1	3	-2	-2	-4	0	-1	-1
Canterbury	-32	21	-11	-11	-18	-30	-43	3	-40
West Coast	-46	-4	-50	-7	-1	-8	-53	-6	-59
Otago	-47	-9	-56	-15	-18	-33	-62	-27	-89
Southland	-113	-26	-139	-14	-12	-26	-127	-38	-165
New Zealand	-1 196	-457	**-1 652**	-690	-430	**-1 120**	-1 885	-887	**-2 773**

We also estimate that the drought led to a potential loss of almost 3000 job-years[20] of work off-farm and a loss of $143 million of household income (see Tables 6.3 and 6.4). Given that there are 9500 people employed in milk processing, 24 000 in meat processing and probably as many again in the various support industries for these sectors, the numbers seem reasonable.

Table 6.3: Direct, off-farm and total employment impacts of drought, by region

Region	2007/08 (job-years)			2008/09 (job-years)			Combined (job-years)		
	Direct	Off-Farm	Total	Direct	Off-Farm	Total	Direct	Off-Farm	Total
Northland	0	-37	-37	0	-63	-63	0	-100	-100
Auckland	0	-83	-83	0	-377	-377	0	-460	-460
Waikato	0	-1 361	-1 361	0	-1 367	-1 367	0	-2 728	-2 728
Bay of Plenty	0	-186	-186	0	-253	-253	0	-438	-438
Gisborne	0	-0	-0	0	-13	-13	0	-13	-13
Hawkes Bay	0	415	415	-0	-482	-482	-0	-67	-67
Taranaki	0	-148	-148	0	-248	-248	0	-395	-395
Wanganui/ Manawatu	0	845	845	-0	-739	-739	-0	106	106
Wellington	0	45	45	0	-190	-190	0	-144	-144
Tasman	0	21	21	0	-1	-1	0	20	20
Marlborough	0	13	13	0	-17	-17	0	-4	-4
Canterbury	0	1 009	1 009	0	-191	-191	0	818	818
West Coast	0	58	58	0	9	9	0	67	67
Otago	0	346	346	0	-203	-203	0	143	143
Southland	0	373	373	0	-134	-134	0	240	240
New Zealand	0	1 310	**1 310**	0	-4 269	**-4 269**	0	-2 959	**-2 959**

In many cases the impacts on jobs will have been felt in shorter working periods in the seasonal industries or on fewer hours per day. It is also undoubtedly the case that the estimates of lost household income and employment overstate the true impacts because average multipliers will not be the same as marginal multipliers. For example, tanker drivers may still drive the same route and work much the same hours, even if they are picking up 10 percent less milk at each farm. It is also likely that the loss of off-farm value added is understated, because some costs are fixed overheads and the marginal value added: output ratios are higher than the average ratio.

[20] A job-year of work is equivalent to one full-time person working for one year, 1500 people full time for two years, etc.

Table 6.4: Direct, off-farm and total gross household income impacts of drought, by region

Region	2007/08 ($m)			2008/09 ($m)			Combined ($m)		
	Direct	**Off-Farm**	**Total**	**Direct**	**Off-Farm**	**Total**	**Direct**	**Off-Farm**	**Total**
Northland	0	-2	-2	0	-3	-3	0	-4	-4
Auckland	0	-5	-5	0	-16	-16	0	-21	-21
Waikato	0	-65	-65	0	-61	-61	0	-126	-126
Bay of Plenty	0	-9	-9	0	-11	-11	0	-20	-20
Gisborne	0	0	0	0	-1	-1	0	-1	-1
Hawkes Bay	0	18	18	-0	-21	-21	-0	-3	-3
Taranaki	0	-6	-6	0	-12	-12	0	-18	-18
Wanganui/Manawatu	0	36	36	-0	-35	-35	-0	1	1
Wellington	0	2	2	0	-9	-9	0	-7	-7
Tasman	0	0	0	0	-0	-0	0	0	0
Marlborough	0	1	1	0	-1	-1	0	-0	-0
Canterbury	0	45	45	0	-9	-9	0	36	36
West Coast	0	2	2	0	-0	-0	0	2	2
Otago	0	15	15	0	-9	-9	0	6	6
Southland	0	18	18	0	-6	-6	0	12	12
New Zealand	0	52	**52**	0	-194	**-194**	0	-143	**-143**

Appendix 1: Details of farm budget modelling process

The work relied on analysis of MAF Farm model budgets as expected before the drought occurred, and as experience with the drought. Adjustments were made to express the budgets in constant prices.

A1.1 Dairy

A1.1.1 Land area - dairy

The land area under dairy farming in the 2007/08 season by Territorial Local Authority (TLA) was taken from LIC data[21]. This was consolidated into regional data according to the TLA maps provided by Local Government New Zealand. It was assumed that the drought had not effect on the land area in dairying. Information on new conversions was not available for the next year by regional council. The assumption was made that any new conversions would not have been affected by the drought in the 2008/09 year as there were very few follow through impacts.

A1.1.2 Production impacts - dairy

2007/08 without drought: The methodology was to use the 2006/07 production as a base and then assume a normal level of annual productivity growth for the 2007/08 year. In order to check that the 2006/07 year was an adequate base year, regional data for the four previous seasons on production per cow was analysed to determine the average production over that period. The average figure was compared with the 2006/07. On average 2006/07 was 5 percent greater than the average of the four previous seasons, although some regions were well below, including Central Auckland and the East Coast North Island regions. The base year data for these regions was adjusted to the four-year average. The adjusted 2006/07 base year data was then multiplied by 1.01 to reflect the fact that we would have expected a 1 percent annual increase in production in an average year.

2007/08 with drought: Dairy production for the first drought year is the actual data from the LIC report as production per hectare.

2008/09 without drought: Set equal to 1 percent above the 2007/08 "without drought" productivity.

2008/09 with drought: Production is based on 2008/09 "without drought" adjusted for the predicted production cuts in the MAF Forecast budgets. (7 percent in Waikato/Bay of Plenty and 3 percent in Taranaki)

Table A1: Milksolids production (kilograms of milksolids) in New Zealand

	With	Without
2007/08	1 287 442 256	1 380 978 747
2008/09	1 351 406 905	1 394 788 534

A1.1.3 Input impacts - dairy

Because the drought year was a record payout year (and the probability of a high payout was already known at the time that the drought hit), most dairy farmers reacted by trying to

[21] Livestock Improvement Corporation (2008): New Zealand Dairy Statistics 2006-2007.

maintain production by purchasing extra feed. This strategy was successful up to the point where on-farm pasture reserves were insufficient to support a supplementary feeding regime and production was halted. The commentary in the MAF Farm Monitoring[22] report is quite specific about drought related expenditure assumptions in the models.

2007/08 without drought budgets: The expenditure pattern in the actual budgets was adjusted to remove drought-related expenditure as indicated in the report commentary and by reference to the 2007/08 forecast budget to reference volumes and types of expenditure patterns.

2007/08 with drought budgets: The MAF Farm Monitoring expenditure pattern as shown in the 2007/08 actual budgets.

2008/09 without drought budgets: 2008/09 forecast budgets adjusted for expected payout profile for this season with expenditure adjusted to remove drought related expenditure as indicated in MAF's Farm Monitoring commentary and by reference to previous budgets.

2008/09 with drought budgets: 2008/09 forecast budgets adjusted for expected payout profile for this season.

A1.2 Sheep and beef

A1.2.1 Land area

The land area could have been apportioned by multiplying the number of farms represented in each model by the area of the model. However, the survey technique used in the monitoring data collection assumes only economic farms and therefore excludes other land areas and therefore the data would miss a significant area of small land holdings or farms where farming is not the principle income source or main occupation.

For this reason the following alternative method of land area calculation for sheep, beef and deer was used:

- Statistics NZ data on the June 2007 land use by TLA was totalled for land in Tussock/Danthonia and in pasture. The area of dairy land was deducted from this figure to give the area in sheep, beef and deer.
- Livestock statistics by TLA were used to calculate the relative proportions of sheep, beef and deer on a stock unit basis. The proportion of deer was deducted from the total non-dairy land to give the land area in sheep and beef.
- Visual assessments of the TLA maps were made to allocate the land area in each district to either high country/hill country or finishing country in order to estimate the area in each farm model type. The assessments were done on a proportionate basis eg: Kaikoura was assessed as 50 percent high country, 40 percent hill country and 10 percent Breeding/Finishing.

A1.2.2 Production impacts – sheep and beef

The drought impacted on sheep and beef farms from late December 2007 onwards at a time when there was a general industry retreat from sheep production, following a number of years of unsatisfactory financial returns when compared to alternative options like dairy support, cropping and beef finishing. Some farms were lost to dairy conversion.

[22] MAF (2008): Pastoral Monitoring Report.

Because the dairy industry reacted early and was able to pay significant premiums for supplementary feed and buy up all surplus feed, there was lack of supply of affordable feed for other pastoral farmers. Therefore their options were to destock either by quitting trading stock early (prime at lighter weights or as stores at lighter weights) or capital stock reductions (either selling ewe hoggets that would have been kept for breeding or breeding ewes). Often the choice of class of capital stock sold was determined by the availability of killing space, which was severely restricted for some classes of stock as a result of the increased kill. Therefore in the year of the drought, slaughter numbers increase and revenue increases as a result. Offsetting the revenue increase in the profit and loss account was a loss of capital stock value.

It is difficult to determine the impact of the drought on stocking rates from macro data in an environment where there was an increased slaughter of breeding stock as a result of the retreat from the sheep industry. Meat and Wool New Zealand[23] has estimated that 60 percent of the adult sheep slaughter was drought induced. Our understanding is that the farm models we have used do not assume a change in land use, and hence the stock changes are related to the drought. Note that stock slaughter increases farm cash income but reduces the capital stock by an off-setting amount. Hence destocking does not affect net farm income in the year of destocking, although it does affect it in a subsequent year when the number of progeny will be reduced.

It should also be remembered that farms that sold stock as stores instead of finishing them passed them onto other farmers who were able to finish them. Therefore to the extent that stock prices, adjusted for weight and condition, were lower than normal, one group’s loss was the other group’s gain. The net affect of the drought at the national level was that carcass weights and live animal weights were lower than they would have been in an average season.

Impacts on the sheep and beef sector are as follows:

2007/08

- Higher capital stock slaughter (ewes and ewe hoggets).
- Lower carcass weights for slaughter lambs. Meat and Wool NZ[24] estimate that the average carcass weight in the 2007/08 killing season is 16.49 kg c.f. a medium-term average of approx 17.2 kg.
- Lower weights of store stock.
- Lower wool production. Because wool prices were low, a number of farmers sold stock woolly rather than shorn and therefore the production effect is hard to determine.

2008/09

Lambing percentage was down as a result of lower ewe condition at tupping and reduced number of ewe hoggets put to the ram as a result of poor body weight. On the other hand lamb carcass weights were expected to be higher than average as a result of lower stocking rates. Therefore the net effect may be the same kilogram of lamb being killed and exported. This could mean higher overall lamb returns as higher weights mean higher average schedule returns per kilogram.

[23] Meat and Wool New Zealand Economic Service (2008) Sheep and Beef new season outlook 2008-09. Paper No P08030.

[24] Meat and Wool New Zealand Economic Service (2009): Key Budget Prices 2009.

A1.2.3 Input impacts – sheep and beef

The changes in expenditure are well explained and documented in the pastoral monitoring report. They include:

- increased supplementary feed purchase costs;
- lower supplementary feed costs due to a lower volume of feed conserved;
- lower animal health as a result of lower stock numbers;
- lower fertiliser use due to less nitrogen application in dry conditions, but increased fertiliser use due to increased nitrogen use when rain came;
- higher freight costs due to extra animal transport;
- higher regrassing costs to replenish drought-damaged pasture;
- higher weed and peat control to replenish drought-damaged pasture;
- lower shearing expenses due to wool being sold on animals and fewer animals; and
- higher vehicle costs due to changes in supplementary feed and regrassing activity.

The extent and nature of these cost changes vary across the models.

The With and Without Farm Monitoring budgets were used in a similar fashion as discussed in A1.1.2.

2007/08 without drought budgets: Forecast budgets production parameters

2007/08 with drought budgets: Actual budgets production parameters.

2008/09 without drought budgets: Similar production parameters to long-term average (2007/08 forecast parameters)

2008/09 with drought budgets: Forecast budgets production parameters.

A1.3 Deer industry modelling

Calculation of the deer area has already been explained. Model farm assignment was simple as there are only two models: a North Island model and a South Island model.

Deer farmers tend to be in the summer rainfall safer areas and therefore the drought impacts on the industry were pretty marginal overall. Finishing farms experienced slower animal growth rates and so killed animals at target weights later in the season than normal. At the same time late season, schedule values lifted with the market and so actual returns were on a par or better than normal years. Those farmers that purchased feed were faced with increased feed costs. It was not expected that there would be much flow through effect into the 2008/09 season.

Budget and financial parameters were handled the same way as for the sheep and beef sector.

Appendix 2: Effects on breeding stock values

We have estimated the decline in capital stock values on the basis of the various farm models. We have allocated those values to the drought because our understanding is that the models do not incorporate any change in land use. Even if they did, presumably these were reflected in the forecast models, so any more rapid change in capital stock would have been a result of the drought.

Even if our assumption here is incorrect, this does not invalidate our estimate of the cost of the drought. This is because destocking does not cause a financial loss; it simply represents a change in the capital structure. Sales increase in the year of destocking, but closing stocks fall. Provided that the value per unit of stock is appropriate, there will be no effect on the profit and loss statement.

Our understanding is that dairy cattle and deer numbers were essentially unaffected by the drought. Any change that did occur was due to a change in land use, and occurred in both the "with drought" and "without drought" versions of the farm models.

We have not tried to estimate any increase in breeding stock values over the 2008/09 season, primarily because there is not yet sufficient data available to do so. This does not affect our estimates of the financial cost of the drought in this year, because had we assumed an increase in livestock numbers we would have had to assume an offsetting decrease in livestock sales to slaughter.

Table A2: Estimate of changes in livestock value in 2007/08 arising from drought

	Sheep ($m)	**Cattle ($m)**	**Total ($m)**
Auckland	0.5	3.5	4.0
Waikato	-6.6	6.9	0.3
Bay of Plenty	-1.5	0.7	-0.9
Gisborne	0.0	0.0	0.0
Hawkes Bay	-11.9	-15.5	-27.4
Taranaki	-10.1	-6.6	-16.7
Wanganui/Manawatu	-41.8	-31.9	-73.7
Wellington	-6.7	-8.3	-15.0
Tasman	-3.2	-1.6	-4.8
Marlborough	-2.1	-1.3	-3.5
Canterbury	-46.6	-30.5	-77.1
West Coast	-2.3	-1.2	-3.4
Otago	-23.0	-16.5	-39.4
Southland	-25.8	-19.5	-45.2
New Zealand	**-182**	**-125**	**-307**

Appendix 3: Detailed worksheets showing changes in expenditure by farm types, and sources of economic impacts by region

These tables are available to download under the heading Appendix 3 tables at www.maf.govt.nz/mafnet/rural-nz/emergency-management/droughts/impacts-drought-07-09/index.htm