

Drought management in Southland options and constraints

This document is a summary of the report which forms the fourth and final stage of the Southland Water Resources Study, a project managed by Venture Southland and funded by the MAF Sustainable Farming Fund. The earlier work (Stages 1–3) quantified water availability and potential future water resource development and was reported on in August 2003.

This report documents the occurrence and economic impacts of drought in the Southland Region and assesses the economic viability of irrigation transition as a means to mitigate drought impacts. The economics and feasibility of water harvesting and storage, including practical and regulatory constraints, as a means to address projected shortfalls in water supply are also considered.

Earlier work

Stages 1–3 of the project provided background to:

- Develop a framework for assessment of the region's surface and groundwater resources (17 water resource zones and 26 groundwater areas).
- Quantify potential future demand for water at planning horizons for the years 2020 and 2050.
- Identify areas of shortfall where water available from groundwater and surface water sources was unlikely to be sufficient to meet projected demand.

Key conclusions of the Stages 1–3 report were:

- The Southland Region has enough water to meet reasonable, foreseeable water demands, but the water is not always in the right place at the right time.
- The water resource zones of the Matura catchment will experience the greatest shortfalls in the immediate future.
- Irrigation is predicted to be the major source of future water demand.
- Given the increasing demand, there needs to be a strong regional water allocation framework in place.

Dry event

Shortly following the completion of Stages 1–3 of the Southland Water Resources Study parts of the Southland Region experienced a significant dry event over the 2003–04 summer. This event resulted in significant impacts on agricultural production, particularly in areas of Northern Southland which were identified as likely to experience the greatest future shortfalls in water availability. In light of the limited information available to quantify the economic impact of such dry events, Stage Four of the Southland Water Resources Study was commissioned to:

- Identify the spatial extent and economic impact of the 2003–04 dry event.

- Assess the economics of irrigation as an option for drought mitigation in the Southland Region.
- Assess the economics and feasibility of water harvesting and storage as an option to meet projected increases in future water demand.

Objectives

The following objectives were adopted:

- Review the magnitude and recurrence interval of drought events in the Southland Region and their resulting impacts on agricultural production.
- Quantify the hydrology and meteorology of the 2003–04 drought event and resulting economic impact on farm gate returns as well as the wider Southland economy.
- Review the applicability, limitations and overall economics of irrigation in the Southland Region.
- Reassess earlier estimates of the expansion of irrigated agriculture in Southland based on an updated assessment of costs and likely productive benefits to agricultural production.
- Identify options for water harvesting to meet projected irrigation demand, given likely technical and regulatory constraints.

Scope

The scope of the report predominantly addresses the economic impact of drought and viability of irrigation transition (including storage development) in the Southland Region. The report does not examine in detail the full range of farm management options available to offset drought impacts.

Methodology

The following methodology was adopted for development of the report:

- Local agricultural consultants were engaged to provide an assessment of the impacts of the 2003–04 drought on agricultural production in the Southland Region. This assessment involved a review of on-farm management responses and financial impacts of the drought event as well as interviews with agricultural enterprises and meat and dairy processors.
- By applying appropriate economic multipliers to the data provided by the agricultural consultants, an estimate of the regional economic impact of the 2003–04 drought event was completed.
- Based on pasture growth modelling completed for the Stages 1–3 report, an assessment of the economic viability of irrigation was undertaken using the MAF model farms as a basis for estimating development and ongoing costs as well as potential incremental gross margin returns achievable by irrigation transition.

- Based on the assessed economic viability of irrigation, as well as future price assumptions and productivity gains, the potential areas of irrigation development at the 2020 and 2050 planning horizons were forecast utilising conservative and accelerated growth assumptions.
- Potential storage requirements were assessed for the forecast increase in irrigation development by comparing available groundwater and surface water allocation against the calculated increase in demand resulting from the projected increase in irrigated area.
- The economics and technical feasibility of using water harvesting and storage as a mechanism to service the projected increase in irrigation demand were assessed against relevant technical and regulatory constraints.

Limitations

The report is intended to provide a regional-scale assessment of drought impacts and likely economic viability of irrigation transition. As such, a large number of assumptions have been made to derive representative figures applicable for high level assessment.

The report uses the water resource framework developed for the Stages 1–3 report (17 water resource zones and 26 groundwater areas) and draws extensively from the pasture growth modelling undertaken for this report to derive an assessment of the economic viability of irrigation transition in the Southland Region. Figures for irrigated pasture growth derived from this modelling are typically higher than previously published pasture yield figures but reflect both improvements in pasture and fertiliser technology and an assumption that pasture growth is not constrained by soil moisture availability.

Uncertainty is inherent in all modelling analysis. Wherever possible, assumptions made in the modelling undertaken for the report are acknowledged and results presented as an indicative range using realistic model parameters.

Assumptions made for purposes of economic assessment include:

- Adoption of the MAF Southland Dairy, Sheep and Beef and Hill Country models as representative of typical farming enterprises in Southland
- Regional economic multipliers
- Productivity assumptions
- Future price assumptions
- Discount rate

Assumptions are also inherent in estimation of water availability based on technical and regulatory constraints. These assumptions include both the volume of water available and the order in which supplies will be developed.

Drought in Southland

The Southland Region generally experiences a temperate climate with rainfall evenly distributed throughout the year. However, parts of the Region, particularly Northern Southland and the Te Anau basin, on occasion experience periods of below average rainfall during which agricultural production is adversely impacted by resulting soil moisture deficits.

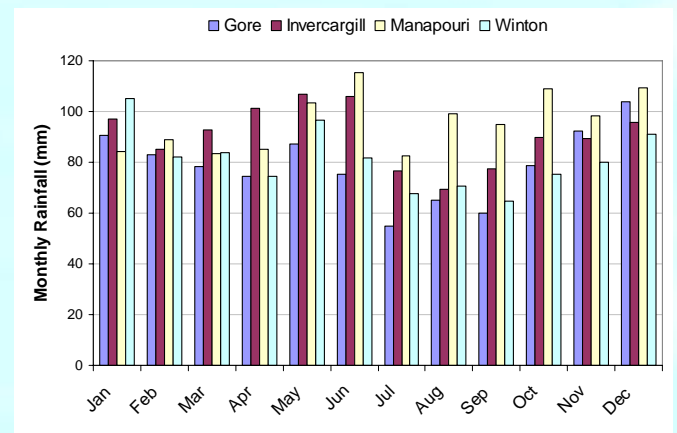


Fig. 1: Monthly rainfall at selected sites in Southland.

In general, drought events in Southland tend to be of restricted duration, impacting on only a portion of the growing season. Examination of historical drought events indicates two typical drought scenarios that impact on agricultural production in different ways. Summer drought events impact significantly on stock finishing and peak milksolids production whereas autumn drought events have a greater impact on winter feed supplies and reproductive health. On-farm management strategies adopted to deal with drought events vary significantly depending on overall farm structure (debt, stock type, stocking rate).

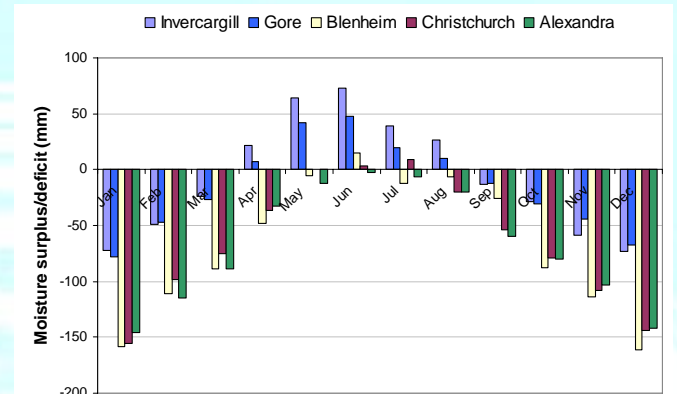


Fig. 2: Monthly water balance at representative South Island locations.

Rainfall patterns and the overall occurrence of drought in the Southland Region vary over time in response to decadal-scale changes in atmospheric circulation patterns in the western Pacific. This phenomenon, termed the Interdecadal Pacific Oscillation (IPO), appears to influence the relative frequency of occurrence of El Niño and La Niña events, which in turn have a significant influence on rainfall in Southland.

Although not conclusive, assessment of the current IPO phase indicates the potential for a return to on-average drier conditions over the medium-term, similar to those experienced during the 1960s and 70s. As a result, management of drought events should feature as part of long-term planning for any farming enterprise located in parts of the Southland Region more susceptible to drought.

The 2003–04 dry event

The 2003–04 dry event resulted from three months of below average rainfall from November 2003 to January 2004. Over this period soil moisture deficits were exacerbated by windy conditions that significantly increased evapotranspiration rates. These climatic conditions resulted in a relatively significant

drought event in Northern Southland extending to central and western areas as the event proceeded. Over the December 2003 to January 2004 period pasture growth rates across much of the affected area fell below 50 percent of normal, resulting in a severe feed “pinch” across a significant portion of Southland.

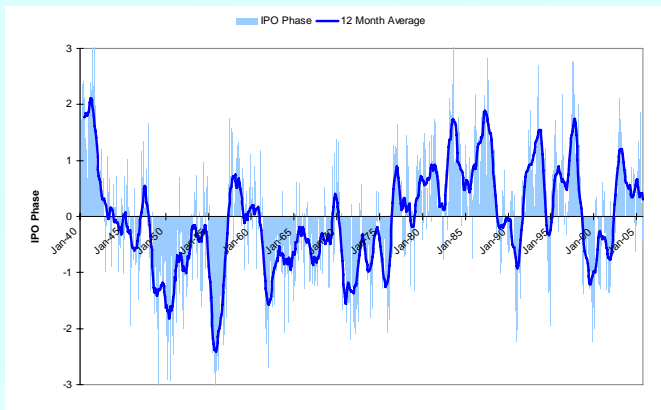


Fig. 3: Interdecadal Pacific Oscillation (IPO) phases 1970–2006.

The drought conditions experienced during the 2003–04 event had a significant impact on stock finishing and milksolids production in affected areas. However, other parts of the Region, particularly coastal and eastern areas, benefited from the drier than normal conditions and enjoyed significantly above average pasture growth. Drought conditions were alleviated by good rains in early February, which allowed significant recovery in agricultural production over the remainder of the year. The timing of this rain was crucial to reducing financial impacts of the drought, with most enterprises being able to retain capital stock. If the dry conditions had persisted into late summer, the resulting economic impacts would have been significantly greater.

Irrigation development

Irrigation development enables increased rates of pasture growth where natural rainfall is unable to meet the crop water requirements for full growth potential. For the Southland Region, rainfall deficits are typically experienced during the summer months of December, January and February but may, on occasion, occur through to late autumn.

The increased reliability and yield of irrigated pasture production during periods of soil moisture deficit provides for significant changes in the operation of a farming system where feed reserves are no longer constrained by soil moisture levels. This transition allows greater flexibility in stocking rates and types, avoids adverse impacts of drought on pasture and stock condition and decreases exposure to external factors that may impact on farm profitability (price schedules, availability and cost of supplements, availability and pricing of grazing). However, irrigation development also requires considerable capital investment to secure resource consent for water abstraction, purchase irrigation plant and meet infrastructure costs as well as ongoing labour, maintenance and running costs.

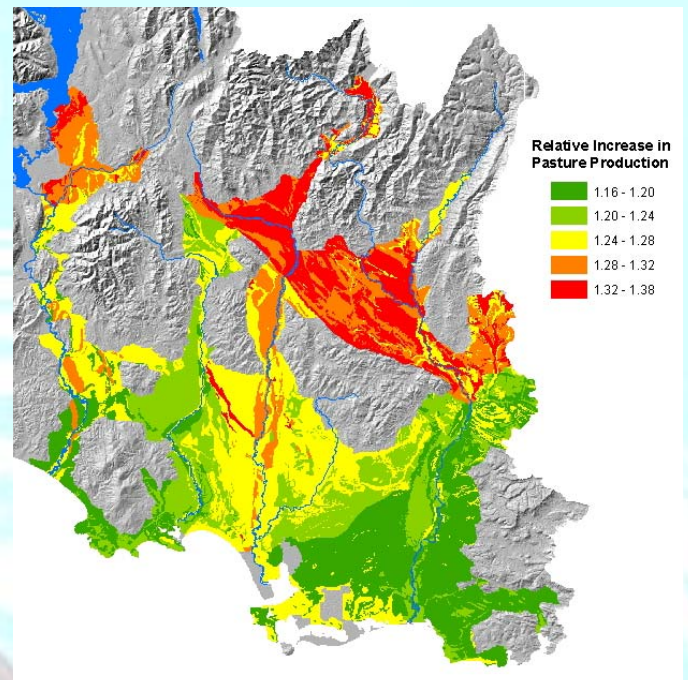


Fig. 5: Estimates of the increases in average annual pasture growth achievable through irrigation on the intensively farmed soils of Southland.

A range of productive benefits resulting from irrigation were identified across the region, the most significant occurring on lighter soils on the Waimea Plain and in the Te Anau and Upper Maitara areas. When the estimated costs of irrigation development are compared with the projected incremental gross margin returns, it is clear that irrigation transition would be economically viable for a range of enterprise types in areas where irrigation enables the greatest increases in average annual pasture growth.

Future irrigation development

Estimates of potential future irrigation development made in the report on Stages 1–3 of the study were recalculated based on an updated assessment of the economic viability of irrigation and regulatory constraints on water availability. This reassessment significantly reduced previous estimates of likely future irrigation development.

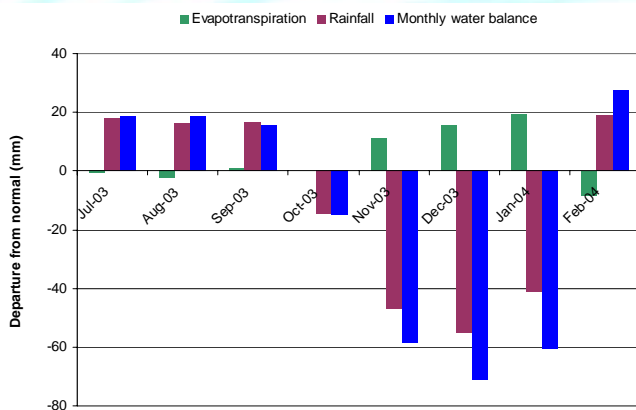


Fig. 4: Monthly water balance for Lumsden, July 2003 to February 2004.

Typical impacts of the 2003–04 drought event on farmgate returns ranged from \$420/ha for dairy production in Northern Southland to \$20–\$25/ha for sheep and beef farms averaged over central and western areas. The overall decline in farmgate income resulting from the 2003–04 dry event was estimated to range between \$28 and \$35 million, with a further \$28 million incurred through extra expenses (feed, transport, grazing). The direct economic impact of the 2003–04 drought event was estimated to range between \$45 and \$52 million dollars and may have reached an upper bound of \$57–\$70 million when indirect impacts are considered.

Under the conservative growth scenario the current irrigated area of approximately 7,500 ha is projected to expand by another 4,000 ha to 2020 with a further 1,600 ha to 2050. The main areas of anticipated irrigation development occur in the Mid-Mataura, Upper Mataura and Upper Oreti water resource zones. In contrast, the expansion estimated under the 'Accelerated Growth' scenario is much more significant, with around an extra 45,000 ha under irrigation to 2020, and further development of 25,000 ha over the following 30 years.

Although the estimated areas of irrigation transition are based on maximum viability (transition to irrigated dairy) the analysis shows a significant portion of the estimated area would also provide a viable transition to irrigation for sheep and beef enterprises provided infrastructure development costs remain in the mid to lower range.

Water harvesting and storage

Storage construction to support irrigation may be pursued at a range of scales, each of which has different technical, regulatory and economic considerations. In terms of irrigation development, storage provides a mechanism that ensures that a supply of water can be maintained during periods when hydrological conditions and/or regulatory constraints (minimum flows, flow allocation restrictions, minimum groundwater levels) would otherwise have reduced the availability of water.

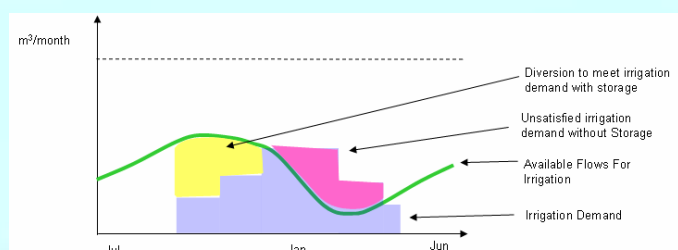


Fig. 6: Conceptual application of water harvesting to irrigation development.

The potential for utilisation of on-farm storage in Southland is limited by technical considerations related to topography and geology in areas where irrigation development is most likely to occur. The volumetric storage requirements (and hence costs) for storage development are also influenced by available water allocation, particularly in the Mataura catchment. Due to the limited allocation available in the Mataura catchment, the costs of constructing storage to ensure a reliable supply are likely to increase significantly with relatively small increases in irrigated area, significantly reducing the economic viability of irrigation transition.

Options for medium to large-scale storage construction are constrained by the current regulatory framework that controls storage development in the headwaters of the Mataura catchment. If proposed controls are implemented, similar constraints are likely to apply to the headwaters of the Oreti River and the entire Waiau catchment.

Copies of this summary report, and the full report on which it is based, can be downloaded as PDF documents from the Venture Southland website at:

<http://venture.southlandnz.com/sections/Venture/majorprojects/waterdemand>

Summary and overall conclusions

- Drought events are a natural part of climate variability in Southland and have a significant impact on agricultural production, particularly in Northern Southland and the Te Anau Basin.
- The severity of the economic impact resulting from drought conditions depends on the overall approach to drought mitigation adopted by an individual farming enterprise as well as the timing and duration of the drought event.
- Geographical location also has a significant influence on drought impacts in Southland. While pasture production in inland areas may be significantly reduced by drought, coastal and eastern areas commonly derive significant benefit from drier than average conditions.
- The regional economic impact of the drought is relatively significant. The 2003–04 drought event, although of relatively limited duration, was calculated to have taken \$63 to \$72 million out of the regional economy. If drought conditions had persisted through late summer the overall economic impact would have been significantly greater.
- The occurrence of drought conditions in Southland appears to correspond to variations in the Interdecadal Pacific Oscillation (IPO), a large-scale atmospheric circulation pattern in the Western Pacific. The current IPO phase appears to have returned to that which prevailed during the 1960s and 70s, when drought events were a regular feature of the Southland climate. While not conclusive, this observation suggests that farmers in areas of Southland prone to drought should be including options for drought mitigation and management in their long-term planning.
- A range of options exist for proactive drought management including selection of pasture/crop types, changes to stock trading criteria, strategic utilisation of feed and supplements as well as pasture irrigation.
- While irrigation transition provides a viable option for drought mitigation and productivity increase in some parts of the Southland Region, the overall economic viability of irrigation is significantly lower than in other areas of New Zealand.
- Future increases in demand resulting from irrigation transition are forecast in the Mid-Mataura, Upper Oreti and Upper Mataura water resource zones. However, the amount of water available from groundwater and surface water sources in these areas is unlikely to be sufficient to meet the projected demand.
- Options for water harvesting and storage in Southland, at both an on-farm and catchment scale, are significantly constrained by technical and regulatory considerations. In particular, options for water harvesting and storage are unlikely to be sufficient to service projected shortfalls in water availability in the Mataura catchment.

For further information, please contact:

Nick Round-Turner
Venture Southland
143 Spey Street
PO Box 1306
Invercargill

Phone: 03 211 1413
Fax: 03 211 1401

Email: waterstudy@venturesouthland.co.nz