

IRRIGATION IN BRIEF

A farmer-friendly guide on how to achieve optimum production and profitability with available water



Centre-pivot irrigation

Over recent years, several projects have been completed or are underway with the aim of providing information to farmers on how to improve irrigation efficiency and productivity. In particular, the “*Water it better, water it right*” project in Central Otago (Ida Valley and Hawkdun) has provided invaluable information.

This handout summarises key information from the Ida Valley and other projects, and presents it in a format that can be easily referred to and used.

Objective of Irrigation

Before embarking on a significant programme of change (new irrigation or improvements to existing irrigation), you should consider why are you irrigating and what you want to achieve from the changes. Possible reasons may include:

- Improving reliability of existing production systems;
- Diversifying or intensifying;
- Wishing to expand;
- Increasing profitability and net asset value of the farm;
- Maintaining a more constant income.

Reliable production, which requires a reliable water supply, is critical as it allows a planned approach to be taken with more certainty. An integral part of this

is ensuring efficient water use, which underpins all irrigation objectives.

Understand your existing system performance and expectations

This requires knowledge of the following information and how it applies to each property:

- Climate – rainfall, evapotranspiration, wind, etc.;
- Crop types and their water demands;
- Soil properties – water holding capacity within the root zone, crop root depth, soil pans, drainage issues;
- Irrigation system capacity, depths of water applied and return intervals, flexibility of operation, evenness of watering;
- How well the irrigation system is, or can be, managed;

- What risks of losing production you are prepared to take;
- How reliable your water supply is (allocation and timing).

If this information is not available or understood, steps should be taken to obtain and understand it. If there is no nearby climate station, install a rain gauge and record the readings daily.

The importance of irrigation design

The design of an irrigation system sets the platform for efficient management of the system. Without an effectively designed system, it is impossible to achieve high water use efficiency.

General design recommendations

- Design the layout of the farm around the irrigation system. Be prepared to move fences, farm buildings, access roads and trees. Replant trees and irrigate them – they will grow much faster than if not irrigated.
- Make sure that the application rates, depths and frequency match soil and crop requirements as much as possible. Understand soils and irrigator performance. See Figure 1 for an example of soil moisture monitoring.

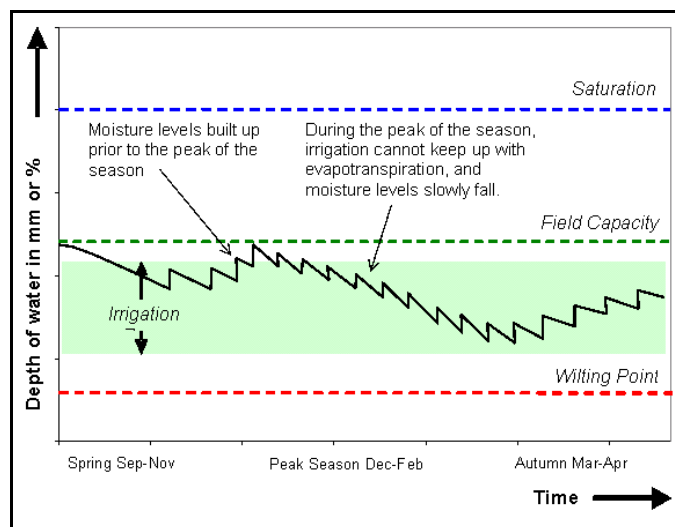


Figure 1: Example of soil moisture monitoring

- Pay special attention to irrigation return periods – often they are too long.
- It is usually uneconomic to design systems to meet peak water demand unless very high value crops are being grown. Compromise is required.
- Resolve any drainage problems first. Effective irrigation requires adequate drainage.

- Consider water use efficiency, energy efficiency, labour requirements, use of capital and suitability for crop grown when choosing irrigation methods. All are important.
- Understand the advantages and disadvantages of different irrigation methods and how they relate to your property.
- Focus on production and profitability first.
- Utilise gravity as much as possible and minimise energy losses (pipe friction, etc.). Energy costs will always increase.
- Carry out a full cost-benefit analysis before any irrigation upgrade or new development.
- For existing systems, have the system professionally evaluated by independent or certified assessors to determine existing performance and to identify any deficiencies (refer to MAF Sustainable Farming Fund project 02-051).

Key design recommendations for spray irrigation

- If you have insufficient water to fully irrigate a property, allow for spreading water over larger areas during spring and autumn, but reduce the irrigated area in summer.
- Plan to irrigate higher water holding capacity, more fertile soils in preference to low water holding capacity or poor fertility soils.
 - Choose a system that applies water as evenly as possible. Uneven watering is the biggest cause of low application efficiency on spray systems. Take particular care in windy areas.
 - Use electricity rather than diesel to drive pumps if operating time exceeds about 1,500-2,000 hours per year.

With all systems, application uniformity has the greatest effect on irrigation performance. Poor application uniformity may be relatively easy to correct on spray systems (sprinkler maintenance, changing nozzles, lane spacing or pressure), but more difficult on border-strip systems.

Key design recommendations for border-strip

Efficient border-strip irrigation depends on optimising border length and flow rate according to border slope and soil infiltration rates to obtain high watering rates (hectares per hour). As it is very site-specific, optimum design is best obtained by using

local knowledge or using an irrigation simulation model. In general:

- Keep borders shorter rather than longer. A length of 200 m is a typical recommended maximum, except on low infiltration rate soils on steeper borders.
- Keep flow rates high. Typical rates range from 3-6 litres per second per metre width of border.
- If sufficiently high flow rates cannot be obtained directly from a water supply scheme, consider using buffer storage on-farm.
- Use laser grading to construct or upgrade borders to keep them as uniform as possible.
- Wide borders have some advantages, but border width is not a critical design factor.
- Border watering times should be less than 1 hour per set.
- Do not rely on border-strip irrigation or other flood irrigation to fill stock water ponds. Install a piped stock water system instead.

Water source and reliability

Being able to irrigate when needed is critical in obtaining efficient irrigation.

- Find out from experts what the optimum irrigation system capacity (mm/day or litres/second/hectare) and seasonal depth of water applied (mm/year) should be for your crop and soil type.
- If the optimum amount of water cannot be obtained reliably on demand, consider storage to improve reliability.
- Use an irrigation system type that is easy to adjust the application depths and the return interval, particularly if growing crops.
- If reliability is difficult to achieve or irrigation system capacity is low, use an irrigation method with a short return interval and therefore high catch-up ability.

Planning the season's irrigation

- During the winter, plan water use for the upcoming irrigation season. Consider a range of scenarios depending on whether the season turns out to be wetter or drier than average, and according to how much water you have available.
- Have a contingency plan for unreliable supplies.
- Continually update your plan – early decisions are often the best ones.



Border-strip irrigation

Managing the irrigation system

- Measure rainfall and soil moisture or have access to rainfall and crop water use data that you can use to manage the irrigation system.
- Do not rely on visual crop performance alone. If the crop looks as if it needs water, it will have already lost production.
- Measure flow rates or application depths so you know how much water your system applies.
- For border-strip or other surface irrigation systems, calculate the hectares per hour of watering. Then, from the volume of water used in an hour, calculate the depth of water applied.
- Target high water holding capacity soils rather than low water holding capacity soils. You will get a higher return per millimetre of water applied, subject to water being applied efficiently. It is easier to achieve high efficiency on heavy soils than on light soils, but watch out for water-logging on soils with drainage problems.
- For systems with reliable water supplies, where there is sufficient system capacity and fast catchup ability (such as centre-pivots), operate the system so that the soil moisture is not fully replenished (i.e. deficit irrigate) to maximise the benefit of rainfall for optimum soil moisture management. See Figure 1.
- For systems with limited capacity or water sources subject to restrictions, keep soil moisture as high as possible going into the summer to delay the time at which crops will come under stress.

- Maintain the irrigation system in good condition. Make sure sprinklers are operating correctly at the optimum pressure. Keep headraces clean and free of weeds.

For existing systems:

- Start measuring flows, applied depths, and measure or obtain information on rainfall and crop water use to establish system performance;
- Have the system evaluated by an independent expert.

For new systems:

- Plan well ahead – a minimum of 12 months is often required;
- Try to get three quotes from equipment suppliers;
- Get an experienced independent irrigation expert to evaluate the quotes, particularly if irrigation is new to you.



K Line irrigation

Scheduling irrigation

Soil moisture measurements or estimates of crop water use are absolutely necessary for scheduling irrigation. Some useful methods are:

- Use a hand-held probe for manual soil moisture readings;
- Install permanent soil moisture monitoring sites, which preferably should be logged for continuous readings;
- Subscribe to internet-based soil moisture monitoring systems (such as Irrinet);
- Contract a specialist to measure soil moisture and provide scheduling advice;

- Carry out a water budget using published evapotranspiration figures (or install your own climate station).

To understand and make best use of soil moisture readings:

- Measure rainfall daily and record the readings;
- Know how much water your irrigation system applies;
- Use this information to relate the amount of water applied (rainfall or irrigation) to changes in soil moisture;
- Schedule the irrigation to keep soil moisture in the optimum range.

Where to get help

In general:

- Talk to existing irrigators in the district about what works and what does not work;
- Talk to farm advisors who are experienced in irrigation matters;
- Talk to irrigation equipment suppliers about product performance and costs;
- Go to irrigation field days whenever the opportunity arises;
- Look out for and read relevant articles in farming newspapers.

Useful references

- *Irrigation in the Ida Valley – 2002/2004 Investigations*. Available from Sustainable Farming Fund MAF website publication library, <http://www.maf.govt.nz>.
- *The New Zealand Irrigation Manual*, prepared by Malvern Landcare Group. Available from Irrigation New Zealand.
- *The Irrigation Guide*, prepared for South Canterbury Farmers Irrigation Society. Available from Irrigation New Zealand.

Acknowledgements

Special thanks goes to the Ida Valley Irrigation Company and community and the MAF Sustainable Farming Fund (through Graeme Elliot), who initiated and funded this work.

Prepared by Aqualinc Research Ltd, and reviewed by Aaron Meikle of Meat & Wool New Zealand.