IRRIGATION NEW ZEALAND

Summer Student Irrigation Efficiency Program 2017–18

Contents

Report Authors:
Steven Breneger – Technical Manager, IrrigationNZ
Jason Bryant – Summer Intern, IrrigationNZ
Joshua McDonald-Davis – Summer Intern, IrrigationNZ

Project partners

Executive summary

Irrigation in New Zealand is, now more than ever, heavily scrutinised by the public and the government. The expectations and targets around water use efficiency are often spoken about without context of how irrigating farmers in New Zealand compare with irrigating farmers in other developed countries like Australia and the USA. IrrigationNZ recently held its 2018 conference and expo in Alexandra, where both national and international experts gave their opinion on the overall performance of irrigation in New Zealand.

One of these speakers was Dr Stuart Styles, executive director of the Irrigation Training and Research Centre (ITRC) at California Polytechnic University. He stated that New Zealand irrigators continue to push the limits of technology innovation and water use efficiency. "Irrigators in New Zealand are investing in modern irrigation systems, future proofing through modern scheme design, and setting high environmental standards through the collaborative processes. Compared to the USA, New Zealand is well advanced in regulation, irrigation system performance benchmarking, and on-farm practices".

One of the initiatives Dr Styles referred to was the Summer Student Irrigation Efficiency Pilot program that was run over the 2016–17 irrigation season. This showed:

- 73% of participants irrigating with highly efficient irrigation systems and,
- 80% of participants used soil moisture monitoring technologies.

For 2017–18 IrrigationNZ, with funding from project partners Environment Canterbury, DairyNZ, Foundation for Arable Research, Beef+Lamb NZ, Horticulture NZ, Ballance Nutrients, Synlait, Fonterra, and Central Plains Water, moved the Summer Student Irrigation Efficiency program into the Selwyn district. Irrigation in the Selwyn district has been under the spotlight for many years and the projects intention was to look at how irrigation practices were changing.

Two students were employed and trained by IrrigationNZ to perform basic on farm irrigation performance testing. The program ran from November 2017 through to mid-February 2018. The students, alongside performance testing, conducted a survey to investigate drivers for change, technology uptake, and barriers to irrigating farmers achieving industry agreed Good Management Practice (GMP).

The project targets were to capture data from 100 irrigating farms and a total of 150 irrigation systems. The students completed testing on 56 farms and captured performance data from 118 irrigation systems, as the project was hampered by unfavourable testing conditions. Early morning high or gusting winds and rain events greatly reduced the amount of testing days that could be achieved by the students.

The project found that 51% of participants were taking water from the Central Plains Water irrigation scheme. These were both existing irrigators moving away from ground and surface water takes, and newly developed farms taking the opportunity of access to irrigation water. Reliability of water supply and unknown future regulation changes were the driving forces to the uptake of scheme supply.

68% of all the irrigation systems tested were modern highly efficient centre pivot or linear move systems. Of these, 20% (16) had variable rate technology fitted, and 66% (78) of the tested irrigation systems were less than five years old. 65% (75) of the systems tested achieved the industry agreed 0.8 or higher benchmark for distribution uniformity. Of the participating farmers, 61% (34) had installed soil moisture technology and 46% (24) of these were using more advanced monitoring and forecasting services.

The widespread use of modern efficient irrigation systems coupled with other control and decision-making technologies is consistent with the original 2016–17 study. Across the two years of data;

- More than 60% of irrigating farmers in the two studies use modern highly efficient irrigation systems.
- More than 60% of irrigating farmers use soil moisture monitoring technologies to improve the accuracy and timing of irrigation events.
- Around 20% of new irrigation systems being fitted with advanced variable rate control systems allowing more spatially accurate placement of their irrigation water.

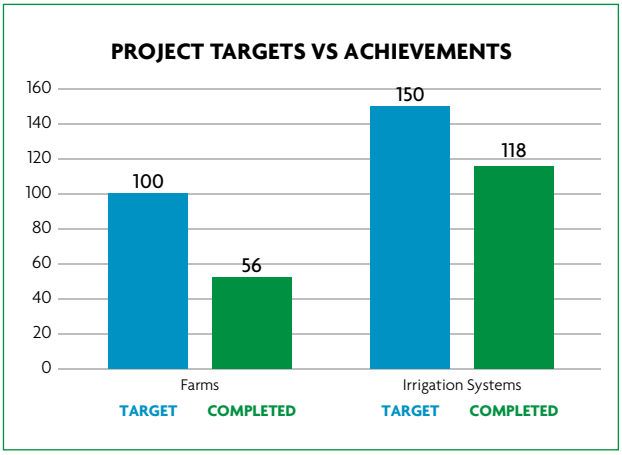
The project survey highlighted the changing nature of the irrigation service industry, from a predominate "*new sales-based*" model to a more "*service*" or "*value-add model*". The driver for this has been the completion of the "*big water infrastructure*" projects like Central Plains Water Ltd and the restriction on intensification and land use change. This has lead to an industry focus on education and professional development of staff to better understand and enable on-farm performance drivers.

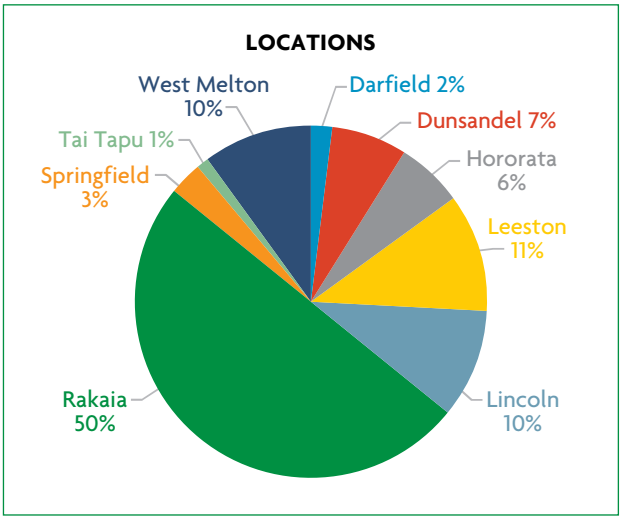
Farmer engagement

IrrigationNZ, with project partner consultation, set the survey targets to achieve 100 irrigating farms in the Selwyn-Waihora zone. This would allow for two irrigation systems per farm to be tested for a total of 200 systems. This was revised down to 150 systems before the start of the project allowing for more, older-time consuming systems to be tested.

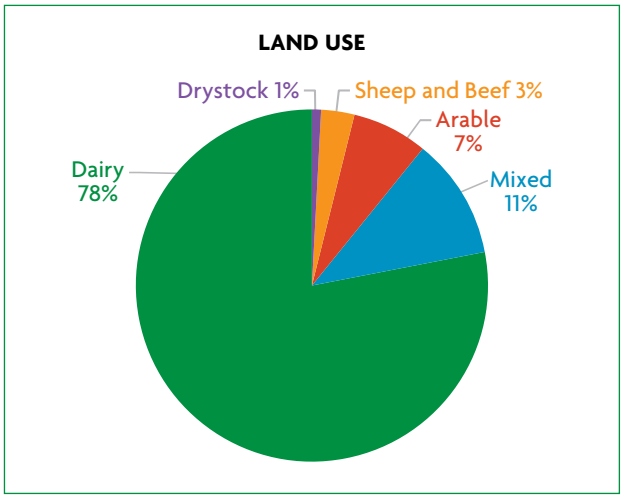
The students completed 56% (56) of the 100 target farms and 79% (118) of the 150 target systems. The project was rescoped in early December after the students noted, that due to weather constraints, they were not likely to achieve the target number of farms by the projects completion. A decision was made to open the project up to any number of systems per farm allowing the data set to reflect system type performance.

The students were challenged to cover as much of the target zone as possible and this was reflected in the data set.

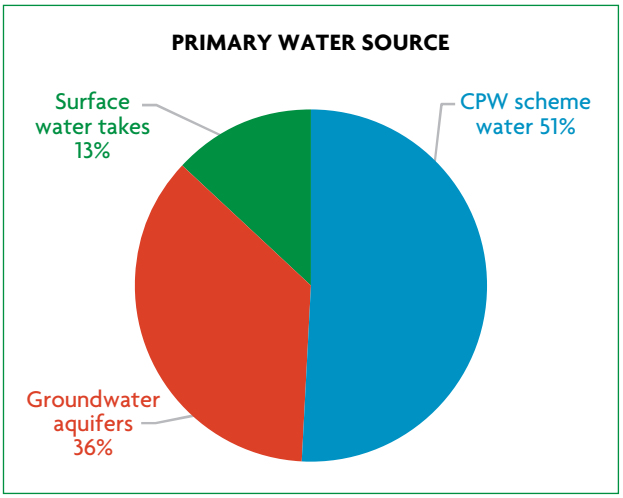




Land use and water source



The project looked at all land use types and production systems within the Selwyn-Waihora zone. Irrigated dairy was the dominant irrigated land use within the zone, with mixed farming and arable/horticulture being second. Dairy has taken over from the more traditional mixed arable/horticulture farming systems, as it has a lower risk profile.



The survey found that the main water source was irrigation scheme water (51% of participants) supplied from Central plains Irrigation Ltd. This has had a positive impact, both on the natural environment through the reduction of ground and surface water takes in the catchment and Central Plains Water ability to supply high reliability water through a modern piped/pressurised irrigation scheme. 36% of participants were still actively sourcing their irrigation water from ground water aquifers at a depth not exceeding 100m and only 13% of respondents still actively sourcing irrigation water from surface water takes.

Irrigation systems tested

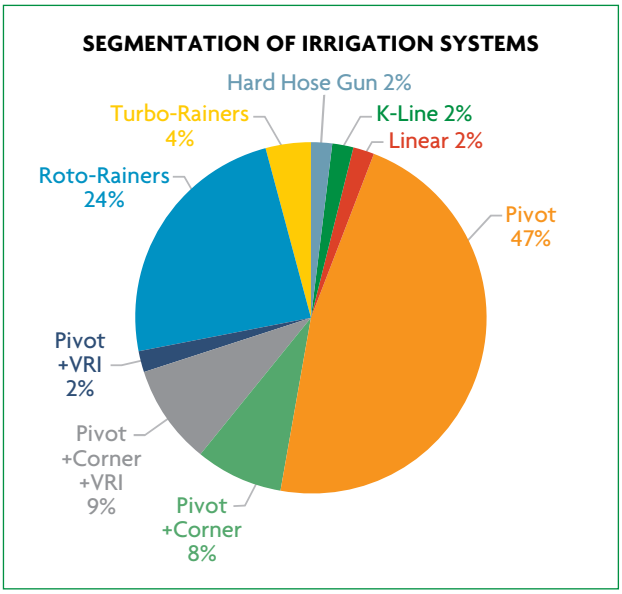
The project goal was to test all system types with the exclusion of border dyke, as this system requires considerable expertise. Systems tested ranged in both age and functionality, with older systems less likely to be capable of technology upgrades. System testing was conducted in accordance with the IrrigationNZ Code of Practice (CoP) for Irrigation Performance Assessment. Although, the students did not carry out a full evaluation, they followed the processes in the CoP that govern the use of the 'Bucket Test App'.

The study found that 68% (80) of the irrigation systems tested were modern, highly efficient spray system (centre pivot or linear move). Of these highly efficient systems, 20% were fitted with variable rate irrigation (VRI) technology. This technology allows irrigation to be applied more accurately spatially, accounting for uneven terrain or variation in soil types and soil depth.

Older system types like Roto-Rainers and Turbo-Rainers still represent around 28% of the sample area within the zone. These systems are slowly being replaced as they reach the end of their effective operating life. The simplicity and the low level of technical knowledge required to maintain these systems remains attractive to many farmers.

Hard Hose guns, K-Line, and Long Laterals all remain systems of choice for hard-to-fit areas or corner in-fill. These systems are cost effective per hectare as opposed to a fixed grid option.

Regulation and scheme requirements are still the biggest drivers for irrigation system change. As many primary commodities have struggled to attract high international prices so has the willingness to invest capital into an irrigation system upgrade based solely on water use efficiency.

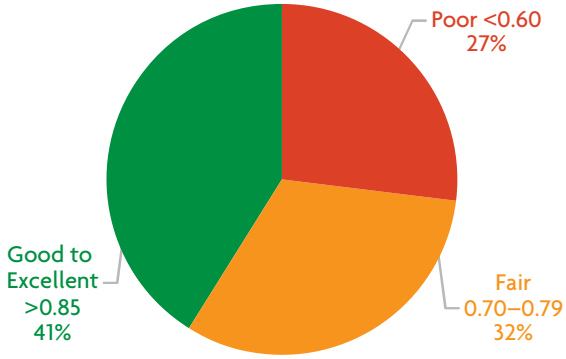


Irrigation systems performance

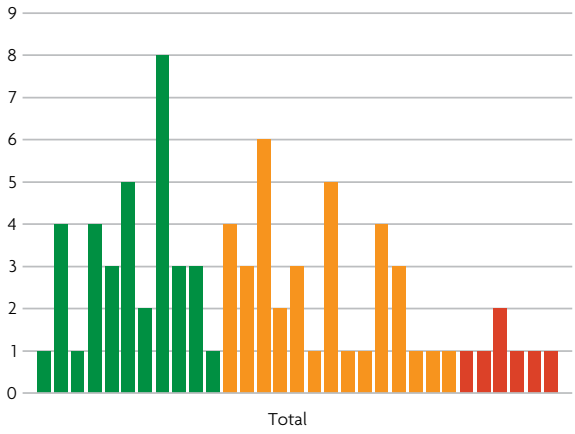
Distribution Uniformity (DU) is a measure of how evenly the irrigation system can distribute the water along its wetted width. The aim is for an irrigation system to be designed to perform at an industry agreed standard of 0.8 DU or higher. Poor distribution uniformity often creates areas of gross over/under watering and reductions in crop performance. In Canterbury, there is an expectation through the Farm Environment Plan (FEP) program, the majority of irrigation system perform to the industry agreed standard.

The study showed that around 40% of all systems tested meet the industry agreed standard of 0.8DU or higher. Compared to the previous years study, this is around 10% higher. This result can be attributed to the additional work done through irrigator awareness campaigns and industry training over the past three to five years.

DISTRIBUTION UNIFORMITY (ALL SYSTEMS)



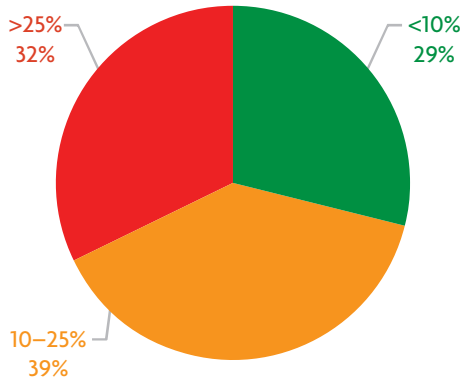
DISTRIBUTION RANGE (PIVOT ONLY)



The data set was interrogated further for centre pivots.

43% of all centre pivots achieved the industry standard of between 0.8 and 0.9 DU, 47% achieved a range between 0.79 and 0.7, with only 10% recording well below the industry agreed standard of <0.7.

APPLIED DEPTH (MEASURED)



A critical performance factor is application depth. Applying the right amount of irrigation to the soil is critical to efficient water use. Over irrigation wastes a precious resource, while under irrigation effects crop production and overall farm profitability.

The industry agreed performance benchmark for application depth is +/-10% of the intended application depth.

Of the systems tested, 29% achieved the industry agreed benchmark. 39% achieved a range between +/-10–25%. 32% of all systems tested achieved an application depth greater than 25% of the intended application depth. This highlights the ongoing push for better commissioning processes from the irrigation service industry.

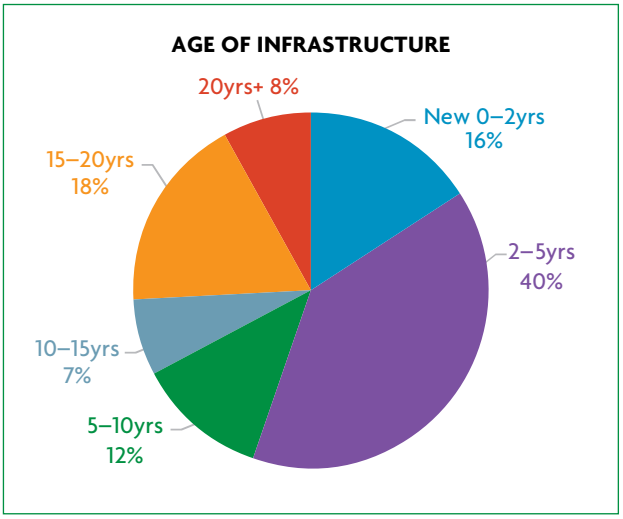
Again, the study found that the main reasons for this were:

- Worn componentry
- Incorrect setup
- Poor maintenance.

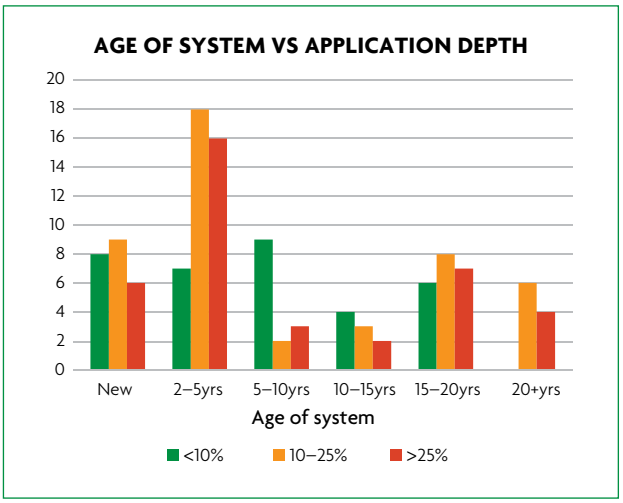
Age of infrastructure

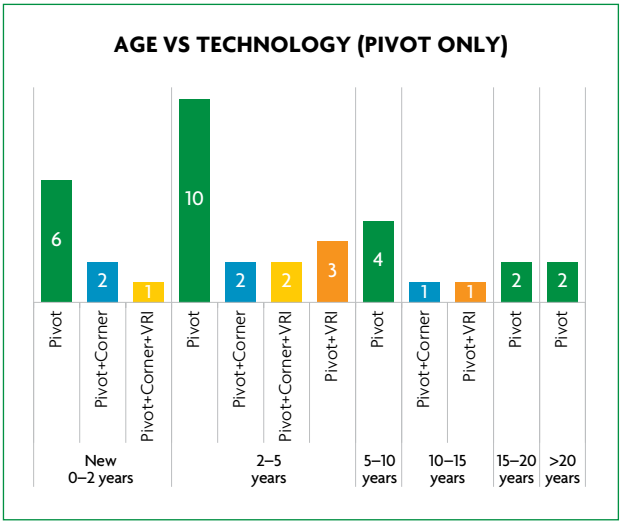
Age of the tested infrastructure is also a critical factor as all systems performance will deteriorate over time.

From the tested farms, the study found that 56% of all systems tested were less than five years old and 68% less than ten years old. This is a consequence of the development of the Central Plains Irrigation Ltd scheme and additional pressure from regulation.



The study graphed the measured application depth vs the age of the system. The amount of systems that achieve the industry agreed performance standard does not differ significantly from new to ten years. However, of concern, is the significant percentage of machines less than five years old of average or poor performance. This is an area that the service industry must address through improved commissioning processes.

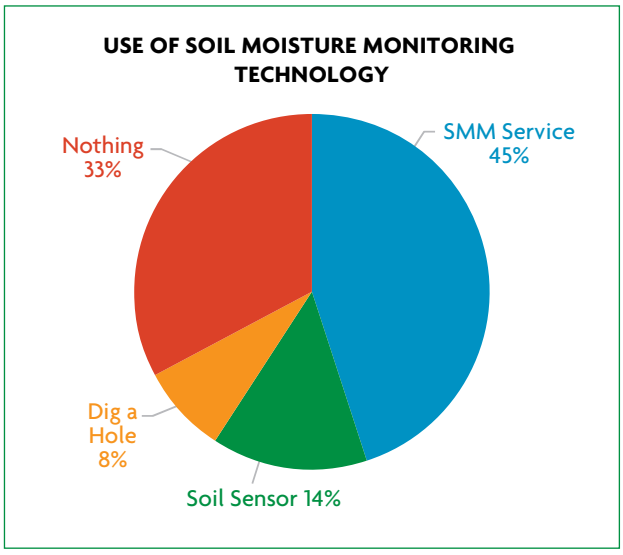




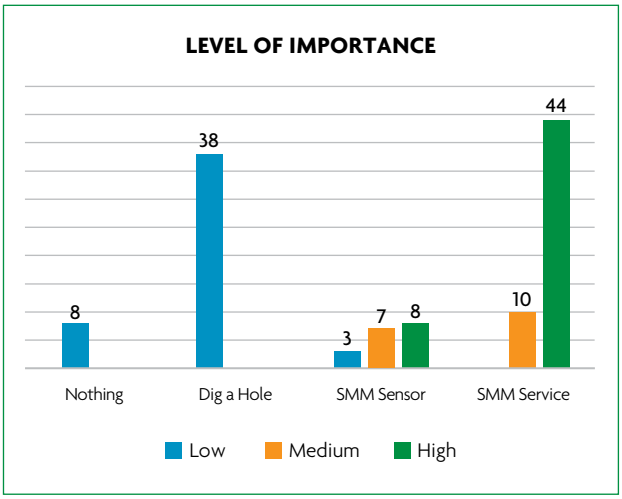
From the data we were also able to investigate further the different technologies that could be adapted to modern centre pivot irrigation compared with the age of the machine. Of the participating farms, only 43% of all new centre pivots, regardless of technology options, made the industry performance benchmarks, 45% of machines 2–5 years, 36% of machines 5–10 years and 40% of machines 10–15 years. The percentage improved as components of the systems past their operating life and were replaced. Machines in the 15–20 years and the >20 years categories achieving 66% and 100% respectively. It should be noted the sample size for these groups was small, but all respondents said their systems had undergone major upgrades from the original centre pivot system.

Use of soil moisture monitoring technology

Over recent years, the emphasis has been on irrigating farmers being able to justify the timing of the irrigation they apply. This can be achieved in serval ways. With each option there are levels of confidence around how accurate each method is compared to the alternatives. The survey asked participants what system they used to assess soil moisture and schedule their irrigation. 59% of respondents said they were using soil moisture sensing technologies. Of these, 45% of all respondents, were using a service company to provide expertise in interpreting the sensor data and advising on when best to irrigate. The numbers were consistent from the previous years report that showed around 40% still have to achieve good practice for irrigation scheduling and soil moisture management.



The survey asked participants about the level of importance they place on the method of soil moisture assessment they chose. The participants that used low investment methods also place a low level of importance on it. When the level of investment increased (a sensor was installed) the level of importance increased. But only 44% of participants with a self-managed sensor considered the data of high level importance. The other 56% either found that information was difficult to interpret, or they had a low level of confidence the information was accurate. A number had also invested solely for regulatory/scheme purposes. Those who invested in a consultant service had the highest level of engagement. 81% of respondents said that the information and insight the service provided was of high value to their business and 19% said it was part of their day-to-day decision making process.



Conclusion

The student programme has uncovered some consistent themes over the two years. Some of these are positive and some are areas that need to be addressed if irrigated agriculture is to win back its social license to operate.

On the positive, the project has found that around 70% of irrigation systems are modern, efficient systems capable of achieving the industry water use efficiency performance benchmarks. Also, around 20% of new irrigation systems are being coupled with advanced control and monitoring systems to further increase their efficiency. As older systems reach the end of their functional operating life these are being replaced with these modern, highly accurate system. Around 60% of irrigating farmers are using soil moisture monitoring technologies to better schedule the timing of their irrigation. These numbers are high in comparison with other developed country like Australia and the USA.

On the 'could do better list', the project has found that still only around 40% of new irrigation systems are meeting the industry agreed standard for performance. There are varied reasons for this, but the underlying theme is the substandard commissioning processes. Many of the faults uncovered by the project would have been picked up in a comprehensive commissioning process and are easily fixed.

Technology adoption is also being hampered by system support failures. Irrigating farmers are becoming more and more cautious when adopting new technologies as there are currently more failures than success stories. These areas of improvement require better understanding, education, and training for irrigators, but also for the irrigation service to lift its game.

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