Grower perceptions of Waterlogging & Subsurface Drainage

An analysis of knowledge change over time in the Esperance Port Zone

Figure 1. Aerial shot of cropping systems across the Dalyup region of the Esperance Port Zone, demonstrating the extent of waterlogging during July 2023. Photo Credit: Rosie Henderson

This survey report is an activity for the Subsurface Drainage Return on Investment Trial
an Investment by the Grains Research and Development Corporation.
Produced by South Coast Natural Resource Management in November 2023.

Background

The subsurface drainage return on investment trial is an investment by the Grains Research and Development Corporation (GRDC) that aims to assist growers and advisors in making more informed management decisions to plan for and install subsurface drainage to alleviate the impacts of waterlogging on farm. To do this, the project developed two subsurface drainage demonstration sites in the Esperance and Albany Port Zones that will produce a final cost benefit analysis to inform growers on the economic costs and benefits of subsurface drainage and it's time to return on investment.

To evaluate how the trial has supported knowledge growth for growers and advisors a pre and post survey were conducted in February 2021 and August 2023. The surveys directly deliver on output three of the project,

By 15 March 2024, Pre and post surveys will assist in determining if the project has increased grower knowledge and ability to implement on-farm subsurface drainage and whether this has led to on-farm practice change that addresses areas of the farm impacted by water-logging and saline seepage.

Methods

The pre and post survey were distributed via SurveyMonkey directly following grower field events at the Esperance demonstration sites. The surveys were then more widely circulated through the South Coast NRM Twitter account. The pre survey gathered 9 respondents out of the 24 attendees whilst the post survey gathered 11 from the 50 attendees. This converts to a response rate of 37.5% for the pre survey and 22% for the post survey. Of the cumulative 20 respondents, only two respondents indicated that they had completed both the pre and post survey.

Results

Section 1: Grower's perceptions on waterlogging and its impact on farm profitability.

01. What is the estimated percent area of your productive land, that is negatively affected by waterlogging in a:
    - Dry (decile 1,2) year
    - Average rainfall year
    - Wet (decile 9,10) year?

Table 1. Respondent perceptions of area of productive land negatively impacted by waterlogging in varying rainfall decile years.

Year	Dry year (Decile 1, 2)	Average rainfall year	Wet year (Decile 9, 10)
2021	3.75	11.38	42.50
2023	6.69	12.45	20.82

In 2021, respondents perceived the area of their productive landscapes negatively affected by waterlogging to increase significantly in line with increased rainfall, with the average respondent perceiving up to 42.5% of their productive land to be negatively impacted by waterlogging in a decile 9 or 10 year (table 1).

Perceptions in 2023 are far more conservative but follow a similar trend between annual rainfall deciles. Compared to the 42.5% impacted area in a decile 9 or 10 year in 2021, respondents on average felt that only 20.8% of their productive landscapes were impacted negatively by waterlogging in the same rainfall conditions in 2023.

02. What are your estimated losses due to waterlogging on a percentage (%) or gross margin basis ($/ha)? (Please enter % sign or $ sign for appropriate basis).

Estimated losses, increased with rainfall deciles, both on a percentage and gross margin basis for both survey years (table 2). Estimated losses were significantly lower in 2023, than in 2021, which is consistent to perceived waterlogging impact, observed in question one.

In particular, in an average rainfall year, on a gross margin basis, estimated losses in 2023 were 67.8% less than the estimated losses in 2021.

Similarly, losses were estimated at 37.5% less in 2023 than in 2021 for a decile 9 or 10 year, but interestingly, were over 120% higher than 2021 estimates for a decile 1 or 2 year. This is not reflected when considering estimated losses between 2021 and 2023 for a decile 1-2 year on a percentage per hectare basis, where the difference between estimates was only 0.4%.

Table 2. Respondents estimated losses in percentage of yield or on gross margin basis of their cropping system due to waterlogging.

Estimated loss to waterlogging ($/ha)			
	Dry year (Decile 1, 2)	Average rainfall year	Wet year (Decile 9, 10)
2021	$22.67	$466.67	$800.00
2023	$50.00	$150.00	$500.00
Estimated loss to waterlogging (%/ha)			
	Dry year (Decile 1, 2)	Average rainfall year	Wet year (Decile 9, 10)
2021	4.00%	15.20%	39.00%
2023	4.40%	8.76%	33.37%

Section 2: Tools and techniques to manage waterlogging.

03. Have you tried any technologies or techniques to manage waterlogging?

In 2021, all respondents had tried shallow or trafficable drains, with a further 78% of respondents having also tried vegetation (figure 2). Moles drains had not been tested at all by respondents, and evaporation ponds and sub-surface drainage systems had only been trialled by 22% of respondents accordingly. All respondents bar one, had tried at least two different management techniques with 22% of respondents trialling up to four different techniques in conjunction.

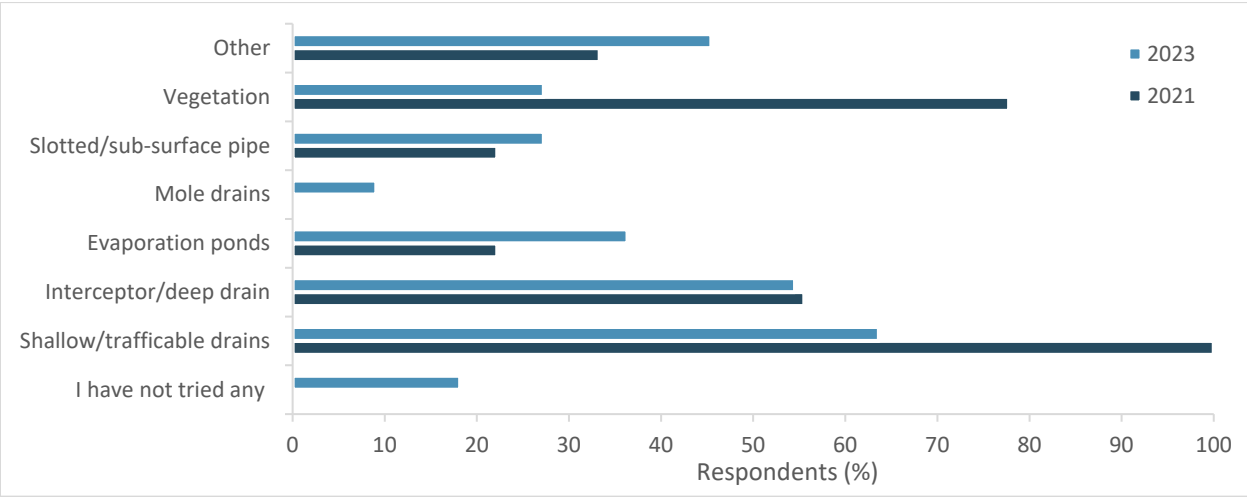

Figure 2. Tools and techniques employed to manage waterlogging conditions on farm tested by respondents in 2021 and 2023.

In 2023, only 63% of respondents had tried shallow or trafficable drains although this was still the most commonly tried tool across both survey years. The number of untried responses increased from 0% in 2021, to 18% in 2023, possibly due to external advisors participating in the post survey. Vegetation was significantly less tested in 2023, with only 27% respondents having tested vegetation compared to the 77% from 2021.

63% of respondents had tried more than one management tool in 2023, 25% less than the 88% of respondents in 2021. However, 54% of respondents had tried more than three tools in 2023, compared to only 22% in 2021. Two respondents had tested subsurface drainage as a management tool in 2021, which increased to three respondents in 2023. Respondents who selected the "other," tool option listed various tools including, lucerne, deep ripping and raised beds.

Section 3: Knowledge of sub-surface drainage.

04. On a scale of 1 to 5, how would you rank your current knowledge on sub-surface water management options?

Figure 3 demonstrates respondents' current knowledge of sub-surface water management options, which follows a bell curve or normal distribution. Most respondents (16 of the total 22) recorded some degree of moderate knowledge.

The bell curve for 2021 is positively skewed, with most respondents recording higher knowledges, from moderate to completely understood. Only 11% of respondents indicated they had no knowledge of management options in 2021.

Comparatively, the bell curve for 2023 was negatively skewed, with the majority of respondents recording, between no knowledge at all and moderate knowledge. Only 9.09% of respondents indicated they completely understood the topic.

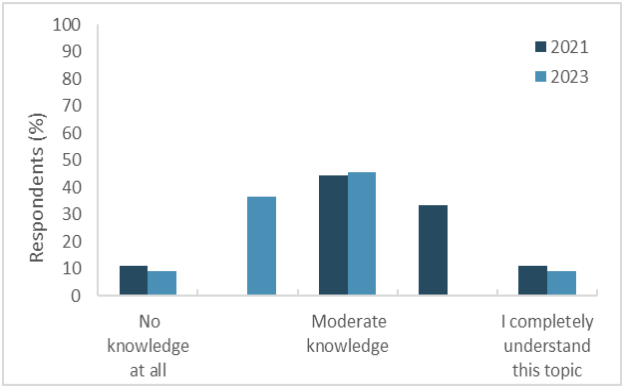

Figure 3. Respondents' current knowledge on sub-surface water management options in 2021 and 2023.

05. On a scale of 1 to 5, how difficult do you think planning and installing sub-surface drainage would be?

In 2021, majority of respondents (44%) believe that planning and installing subsurface drainage will be either moderately or very difficult, whilst an additional 33% believe planning and installing subsurface drainage will be neither easy nor difficult (figure 4).

In 2023, the curve positively shifted slightly, with fewer respondents perceiving planning and installing subsurface drainage to be very hard. Although respondents in 2023, did overall perceive the process to be easier, no respondents indicated that planning and installation would be very easy.

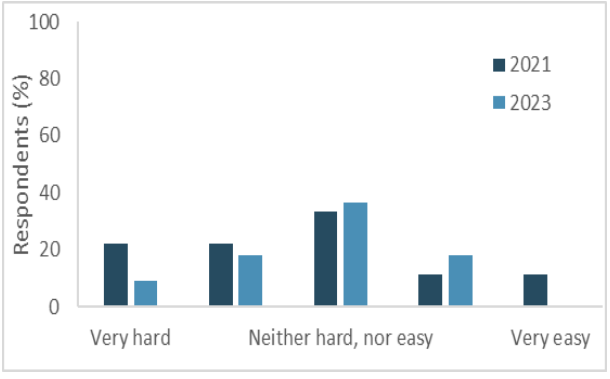

Figure 4. Respondents' perception on the difficulty to plan for and install sub-surface drainage in 2021 and 2023.

06. Are you aware of your legal obligations when designing and implementing drainage systems?

81% of respondents indicated they were aware of their legal obligations when designing and implementing drainage systems in 2021. This reduced only slightly by 2023, with 82% of respondents indicating their awareness. Overall, this translates to 18 of the 21 respondents indicating their awareness of the legal obligations.

Section 4: Sub-surface drainage profitability.

07. On a scale of 1 to 5, how much do you think sub-surface drainage will improve your profitability?

As shown in figure 5, respondents perceived profitability has shifted negatively between 2021 and 2023. 67% of respondents perceived subsurface drainage to be a most profitable on farm sub-surface water management tool. However, by 2023, only 27% of respondents agreed with this statement.

Further, whilst no respondent perceived any net losses from subsurface drainage in 2021, 27% of respondents in 2023 perceived a slight net loss from the management tool. In both years, roughly 20% of respondents perceived that the subsurface drainage systems would recover costs.

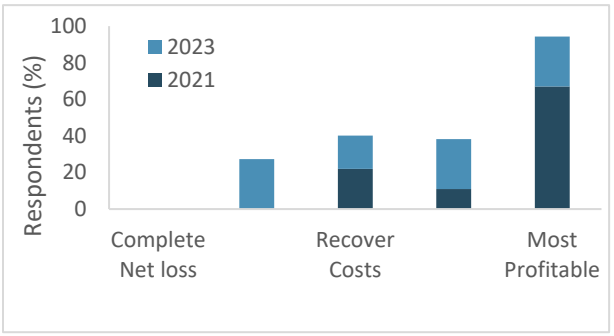

Figure 5. Respondents perceived profitability on farm from sub-surface drainage systems in 2021 and 2023.

08. How many years do you perceive it will take to receive a return on investment from installing sub-surface drainage?

Perceived pay back periods have remained largely consistent between 2021 and 2023, demonstrated in figure 5. The majority of respondents from both years perceive a return on investment within 3 – 4 years from installation (56% in 2021 and 45% in 2023).

A significant portion of respondents (33% in 2021, and 27% in 2023) also perceived the payback period to take at least five or more years.

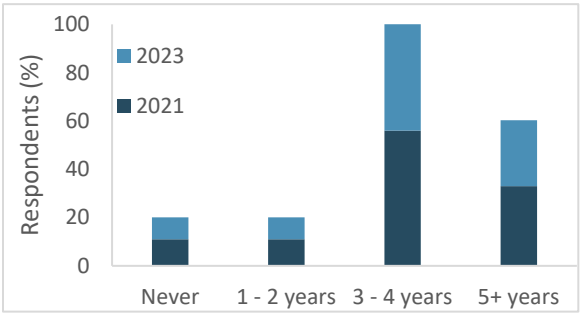

Figure 6. Respondents perceived return on investment period for sub-surface drainage systems in 2021 and 2023.

09. On a scale of 1 to 5 and assuming a positive pay-back period, how likely are you to install sub-surface drainage at the current moment?

Most respondents were certain to install subsurface drainage on their farm between both years of the survey, with the percentage of respondents who were certain increasing from 44% in 2021, to 54% by 2023 (figure 6). "Certainly will," was overwhelmingly the highest response, doubling the next highest response "Unsure," in both survey years.

Respondents who were not at all considering installing sub-surface drainage on farm decreased from 11% in 2021 to 9% in 2023.

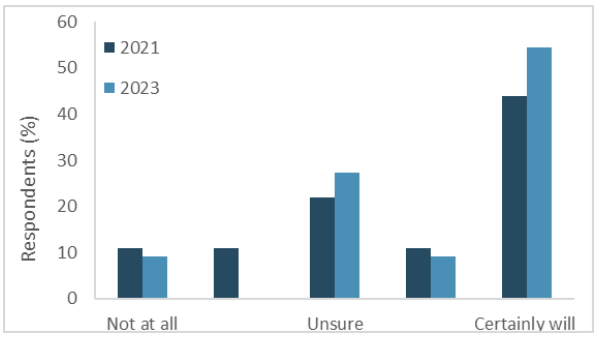

Figure 7. Respondents' likelihood to install subsurface drainage assuming a positive payback period in 2021 and 2023.

Figure 8. Aerial photograph of a cereal crop in Dalyup in July 2023, where the impact of waterlogging is visible in the grey patches of the paddock. Photo Credit: Rosie Henderson.

Discussion

The pre and post surveys aimed to understand how growers' knowledge changed throughout the subsurface drainage return on investment trial, as a results of extension and engagement activities. Both the pre and post surveys were circulated directly following community field days and received low response rates. Of the 22 respondents, only two respondents had completed both the pre and post survey, and as a result, quantifying the degree of knowledge change over time is a challenge due to inconsistent sample pools.

The trial began in February 2021. At this time, waterlogging was estimated to affect nearly 1.6 million hectares across the South Coast region, and respondents perceived significant negative impacts, in an average of a $466.67 loss per hectare in an average rainfall year. By 2023 however, these estimated losses were far more conservative which may be reflection of the Esperance Port Zones record harvest years for 2021 and 2022. Although not captured in this survey, anecdotal evidence of waterlogging extent across 2021 and through to 2023, confirm that waterlogging remained a severe environmental factor for South

Coast growers, but the record grain prices, and rainfall for non-waterlogged landscapes, provided a profit buffer for growers against losses from their waterlogged country, potentially negating the negative impacts for respondents.

The number of surface water management tools and techniques tried on farm reduced as whole between 2021 and 2023. It is possible that respondents were testing less techniques by 2023, having already tested them, and determining what tool worked best for their farms in 2021. Although 2021 had a greater frequency of tools tried, 2023 had a wider and more even spread of drains tried, including mole drains which had not been implemented in 2021. This indicates that respondents are expanding their knowledge base of management options and exploring multiple tools in conjunction to address their waterlogging issues. The employment of multiple tools in conjunction was observed across both survey years and is in line with best practice surface water management. This report recommends continued promotion of this approach, to support respondents continued knowledge growth in surface water management techniques.

The implementation of subsurface drainage increased slightly between survey years, supporting the projects outcome of increasing the adoption of subsurface drainage on farm. Further, significant growth in respondents who were "certain," to install subsurface drainage from 2021 to 2023, contributes to the conclusion that extension and adoption activities were successful in this project. Most importantly across both survey years "certainly will," received more than double any other response and represented the majority of responses (54%) by 2023. It is likely that the rate of adoption will increase following the circulation of the final return on investment and cost benefit analysis of this project as it provides critical knowledge, and it infills key gaps for growers and advisers to make informed management decisions about the planning and installation on subsurface drainage.

These results demonstrate that subsurface drainage is very positively perceived by respondents in the South Coast, which is expedited when considering that respondents are very willing to implement the technique in both survey years despite the perceived profitability of subsurface drains decreasing significantly. Responses for perceived profitability became considerably more conservative by 2023 with some responses even indicating perceived net losses. Numerous global influencing factors, including post covid inflation, a global recession and international politics leading to increased costs to almost all farm inputs, machinery, and labor, could all contribute to lost confidence in the profitability of subsurface drainage. To this effect, at the time of install, subsurface drainage pipe and sock for the Dalyup trial site cost $3 per meter, but has since doubled, to $6 per meter in 2023. Considering external pressures, a decline in perceived profitability, but an increase in likelihood to install, shows the trial has effectively shared the realistic costs of planning and installing subsurface drainage in current economies.

Respondents had greater confidence in their knowledge of subsurface drainage in 2021 than by 2023. In the final community field day attendees were asked to brainstorm, "What next," with a wide and varying list of questions, such as what the relationship between subsurface drainage and waterlogging resistant crop varieties, generated. The decreased confidence reflects that as the trial has progressed and answered many questions, subsurface drainage is still a relatively new management technique for growers in the South Coast and there are still many knowledge gaps to fill. The survey interprets this result positively as it demonstrates that growers are far more realistic in their knowledge and capabilities pertaining to subsurface drainage.

Although many new questions have been uncovered, respondents' knowledge of subsurface drainage did increase, particularly in the planning and installation process. Respondents' perception of difficulty was highly variable in 2021, but condensed to "neither easy nor hard," for the majority by 2023. This is further seen as a reflection of transparent and realistic learnings from on ground demonstration being shared with local growers. It is also in line with best practice surface water management, to acknowledge that effective drainage design requires appropriate skills, knowledge, planning and resources, which is a process that with the right advisors, is not easy but should not be hard.

Respondents perceived time to return on investment remain constant between 2021 and 2023, likely as an outcome of macroeconomic influences from across the globe. The impacts of recession and inflation geared against the Esperance Port Zone's back-to-back record-breaking harvests presents a neutralized position for many respondents, mirrored in the response to perceived profitability.

Conclusion

The pre and post survey, conducted in 2021 and 2023 respectively, aimed to determine if the project had increased grower knowledge and ability to implement on-farm subsurface drainage and whether this has led to on-farm practice change that addresses areas of the farm impacted by waterlogging. The low proportion of respondents having completed both the pre and post survey posed a significant challenge in quantifying knowledge change over time and attributing this to the extension and engagement activities of this project.

Responses to the perceived profitability, difficulty to install and return on investment of subsurface drainage reflect that growers have gained a realistic picture of subsurface drainage which was a poorly understood tool in the South Coast region. Whilst there is still much to understand about subsurface drainage, the trial has successfully contributed substantial knowledge to growers and advisors across the region through on ground demonstration of the tool.

Waterlogging is still a significant issue for the South Coast region, and continued research extension and engagement surrounding subsurface drainage and best practice surface water management is critical in helping growers and advisers to build profitable and climate resilient farm systems. Operating a demonstration trial throughout a period of significant global volatility stresses the importance of building resilient farm systems, and responses to perceived impact of waterlogging and likelihood to install subsurface drainage are reflective of this.

Figure 9. Waterlogged barley crop at the Neridup trial site in July 2023. Photo Credit: Rosie Henderson.