Evaporation mitigating solutions for Australian cotton water storages: Economic analysis of application in cotton production.

KEY MESSAGES

- **The greatest water losses on-farm are evaporation losses from on-farm storages, with an industry average loss of 25 per cent, and as high as 45 per cent.**
- A combination of wind barriers and monolayers being developed and trailed by the University of Melbourne has shown the potential to reduce evaporation by up to 35%.
- For an example irrigation system with a 1000 ML (30 ha) storage and 1885 ML of irrigation water available, the combined barrier and monolayer could generate benefits equal to $712,978 ($23,405 per ha of the 30ha water storage).
- The benefits will be impacted by a range of factors including the dimensions of the farm storage, seasonal water availability, and seasonal water use patterns.

ABOUT THE RESEARCH

As part of the ***Smarter Irrigation for Profit Phase 2*** (SIP2) project, the University of Melbourne (UMelb) developed and demonstrated cost-effective and practical solutions to reduce evaporation from water storages. The research builds on previous large-scale field trials and subsequent lab trials to develop a unique solution to mitigate wind impacts on monolayer films, reducing water evaporation. Trials were undertaken at Yanco (NSW) and St George (QLD).

The trials highlighted the potential benefits related to wind barriers and monolayers:

- The developed barrier technology efficiently reduced the impact of the wind, and decreased evaporation by 19%.
- By combining a monolayer film with the wind barrier technology, a total evaporation saving of 35% could be achieved.

ANALYSIS OF FARM LEVEL COSTS AND BENEFITS

Incorporating the UMelb SIP2 outputs into an example cotton irrigation system highlights the potential economic benefits of the evaporation mitigation solutions. The whole farm water budget[1] included a 1000 ML water storage, evaporation[2] and rainfall[3] data for Yanco (NSW), and used all available water for solid configuration cotton production. The analysis applied discounted cashflows over 15 years, being the estimated life of the barrier technology, and applied a 5% discount rate[4].

For the example irrigation system, by reducing evaporation the combined barrier and monolayer technology increased farm irrigation water use efficiency from 64% to 69% and increased the cotton gross margin by $36/ML (9%).

Table 1 shows the water budget and water use efficiency for the three scenarios: the baseline (no evaporation mitigation), the barrier technology only, and the barrier technology combined with the monolayer film. Table 1 also shows the impact on improved farm level water use efficiency and water use productivity.

[1] Based on WATERpak chapter 1.2 Water use efficiency, benchmarking and water budgeting.
[2] NCEA, Ready Reckoner.
[3] BOM, Climate data online.
[4] Discounted cashflows reflects the time value of money, where $1 today is worth more than $1 in the future. To make all figures comparable, future cashflows are discounted to "present values" using a "discount rate" (here 5%) reflecting the business cost of capital.

Table 1. Summary of results. Whole farm water budget for the baseline (no evaporation mitigation), the barrier technology only, and the barrier plus monolayer.

	Baseline	Barrier only	Barrier + Monolayer
Farm irrigation water supply (ML)	1885	1885	1885
Evaporation losses (ML)	355	291	237
Other storage/conveyance losses (ML)	45	46	47
Field inlet supply (ML)	1,485	1,548	1,601
Field Canal/Conduit Efficiency (%)	79%	82%	85%
Field losses (ML)	271	282	292
Plant available (ML)	1,214	1,266	1,309
Application efficiency (%)	82%	82%	82%
Whole farm irrigation efficiency (WFIE)	64%	67%	69%
Farm irrigated area (ha)	237	247	256
Farm yield (@ 12bales/ha)	2,844	2,965	3,067
IWUI (farm) (bales/ML)	1.51	1.57	1.63
GPWUI (farm) (bales/ML)	1.21	1.25	1.28
Cotton GM ($/ha)	3203	3224	3240
Cotton GM ($/ML)	403	423	439

Over the 15 year expected useful life, the combined barrier and monolayer technology generated a present value of benefits equal to $712,978 ($23,405 per ha for the example 30 ha water storage) (Table 2).

Table 2. Summary of results. Discounted cashflows of benefits compared to the baseline scenario.

	Area	GM/ha	Total yearly farm GM	Benefit over 15 years (PV)
Baseline	237	$ 3,203	$ 759,198	
Barrier only	247	$ 3,224	$ 796,426	$ 386,417
Barrier + monolayer	256	$ 3,240	$ 827,888	$ 712,978

Value of water saved. The example assumes that all saved water is used for additional cotton production. The gross margin per megalitre (GM/ML) reflects the value of water used in cotton production. In the baseline, the farm average GM/ML is $403. By enabling additional cotton production from the same amount of farm water supply, the evaporation reduction technology increases the farm average GM/ML to $439/ML. Depending on the farm system, the saved water could also be valued at the temporary transfer price, or the GM/ML of alternative crops or enterprises.

Storage dimensions. The example 1000 ML storage has a 5:1 batter, and 3.5 m high walls, generating a surface area of just over 30 ha. As evaporation for a given storage is calculated on surface area, the benefits of mitigation are influenced by the ratio of surface area to storage volume. More efficient storages (such as those with higher walls generating increased volume for the same surface area) have reduced evaporation, and therefore a reduced potential saving.

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Water availability. The ability to derive a return from the investment is tied to water availability. The example has an initial supply of 1885 ML of water in the season. This includes water from the source (e.g. river or bore water) as well as captured rainwater. Higher volumes of water (such as from a higher allocation) for a given storage will increase the average water height and surface area of the storage throughout the year, and therefore increase evaporation and potential water savings. Conversely, a lower average water supply decreases the potential water savings.

Storage use. In the example, all farm irrigation water was pumped into the system in five even lots and held in the storage for a minimum of 10 days. All water in the example was used for cotton production, with minimal water held in the winter cropping season. The less time water spends in the storage, the less evaporation will occur. Minimising the time water spends in the storage will reduce the total evaporation; however, this needs to be managed in line with supply constraints and irrigation risk mitigation to ensure crops are not water stressed. For scenarios where storages hold water for most of the year, there will be much higher levels of evaporation and therefore potential savings.

The total benefits of $23,405 per ha of water storage reflect the maximum cost for the investment to be viable (break-even cost), including up-front and ongoing costs.

Investment costs. These technologies are still in the research and development stage, so a commercial cost is not currently available. By understanding the **t**otal benefit of using the evaporation mitigation technology, a maximum price can be identified for a given irrigation system (break even cost). For the barrier technology, which is a fixed investment, the present value (PV) of benefits of $386,417 equates to a break-even cost of $12,685/ha for the example 30 ha storage. For the monolayer film, which is applied regularly (e.g. weekly) when water is present in the storage, the maximum (break-even) cost is equivalent to the marginal benefit of each application, which will vary depending on the seasonal conditions. In the example, the monolayer generates an additional $31,462/year (undiscounted), which equates to $1,033/ha/year of storage surface area per annum. In the example, there is water in the storage for approximately 19 weeks, generating a weekly benefit (and break-even cost) of $54/ha/week. This analysis assumes the monolayer is applied each year over the 15-year life of the barrier technology, generating a PV of benefits of $10,720/ha.

CONCLUSIONS

Drawing on the UMelb SIP2 research and other industry data, this analysis quantified the potential value of water savings from the use of a combination of wind barriers and monolayers. The present value of benefits equal to $712,978, or $23,405 per ha for the example 30 ha water storage, represents the maximum cost (break-even cost) for the investment to be viable in this particular irrigation system. This will differ based on individual farm systems. The UMelb SIP2 research is focussed on early development and trials. As the technology progresses into further large-scale trials and development, producers will be able to draw on refined data to understand the economic implications, as well as the practical implications of installation and use.

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For more information on this economic analysis, please contact George Revell, Principal Economist at Ag Econ, through george@agecon.com.au.

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