Dam-sell in Distressing Times – a cost-effective solution to farm water shortages

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Summary: The following is a brief cost-benefit analysis of how to increase the effective catchment of farm dams ten-fold.

Introduction: Flying from Perth to Melbourne during daytime last week, we passed over the Eyre Peninsula, South East South Australia and South West Victoria. While much of it was green (albeit patchy), it was clear that most dams were less than half-full – at the end of the rainy season. Not quite drought, but nearly so, and barring a miracle, these areas will be short of water like the rest of the Eastern States before the end of summer. The dams took up a tiny fraction of each paddock – plenty of room for more dams – but more dams isn't the issue – it's *full* dams. Then it struck me – I've solved this problem before…

The context: The mitigation of the effect of drought on farmers needs short, medium and long-term solutions. Short-term (that is, immediate) solutions are like any other disaster mitigation – food, money etc for people, food and water for stock – and/or stock re-location or elimination if absolutely necessary. Mid-term solutions (one- to five-years) include making farms more resilient – particularly greater storage of food and water and perhaps better land management. Long term involves "industry restructure", which involves, like other industries that have been restructured, some farmers being assisted to exit the land. If mid-term solutions don't work after five years, the farm is obviously a dud. Sorry – you can't claim your profits in good years and claim benefits in bad years.

A Solution: Here's one idea that qualifies as a "mid-term solution" – it won't fill up empty dams tomorrow, but it will fill them up over a season or two, even with poor rainfall. I've actually done this myself on the small farm that I owned a few years ago. It's not rocket science – it's even in the Government of South Australia's Farm Dams Guide[1], but not in any of the other States' similar publications. It's simple – *it's plastic sheeting*.

[1] *Farm Dams – A Guide to Siting, Design, Construction and Management on Eyre Peninsula;* Eyre Peninsula Natural Resources Management Board, 2011.

The maths: Across Australia, 3- to 5-Megalitre (ML) dams are common on farms with stock. That's about 30-50 metres diameter and 3 metres deep in the middle. The nominal catchment area is about 5-10 hectares (Ha) – that's 50,000-100,000 square metres (sqm), depending on the average rainfall and the porosity of the catchment surface.

There's a Catchment: Not much can be done about the rainfall, but something can be done about the porosity of the catchment surface. Simply, only about *2-10% of the rain falling on the catchment runs off into the dam* – the rest is absorbed into the soil and then evaporates into the air. The run-off depends on the state of the soil at the time of the rain, the intensity of the rain, the frequency of the rain and the amount of rain in a wet period. For example, 10 mm falling in half and hour would have a large fraction of run-off, even from previously dry soil; the same 10 mm over 12 hours would have minimal run-off, starting with dry soil, but much more if the topsoil was already damp and so on. Various techniques are used to improve the run-off towards the 10% level – generally trenching the area and/or compacting it, if clay is available.

Increasing the catchment area (which often has trenches on its sides, which delineate the catchment area) is generally not allowed, as that would reduce run-off into streams and rivers. So, decreasing the porosity (that is, increasing the impermeability) of the catchment area and decreasing the evaporation over the dam are the only parameters that can varied.

Let's first look at the catchment area: Most of the Australian agricultural area has an annual average rainfall of 500 mm or more – that's half a metre in total. That means that each hectare – 10,000 sqm – receives 5,000 cubic metres of rainwater- that's 5 megalitres (5 ML)- added to which is about another 1ML which falls directly on the dam. That's about 6 ML total with one hectare of catchment. But with the usual soil catchment, only 2-5% (and at best 10% in most dam construction manuals) of that 5 ML will run into the dam – that's 0.1-0.25ML. That's not much, so the suggested catchment area, as described above, is 5-10 Ha, to get around 3ML.

If the porosity of the catchment was zero, one (1) Ha would be more than adequate for our hypothetical average dam. In principle, this can be done quite readily by covering the catchment with plastic sheeting. Even allowing for losses (light rain, leaks etc), plastic sheeting is rated at 70% "impermeable", giving 3.5ML plus 1ML over the dam in a 500mm rainfall zone. Problem solved!

Costings: How much would this cost? Rolls of 200 sqm of 100-micron black plastic sheeting from Bunnings can be purchased for about 50 cents/sqm. Large supplies (by the tonne) from Alibaba can be purchased for 20-30 cents/sqm (best price found 20 cents/sqm for 200 micron). One tonne of 100-micron plastic sheeting will cover about one Ha. If we assume that a large number of farmers decided to club together to purchase a much larger quantity, we could assume a price of about 15 cents/sqm, or about $1,500/Ha.

Even allowing for evaporative losses, the average dam of 3 ML with the average rainfall of 500 mm would easily be filled with 1 Ha of catchment covered with 100-micron black

plastic. That's $500/ML or 50 cents/kL and assuming a 5-year lifetime for the plastic sheeting, that's 10 cents/kL.

How does this price compare? Australian capital city dwellers pay $2-4/kL ($2000-4000/ML) and irrigators in the Southern Murray-Darling Basin now pay about $5/kL or $5,000/ML. So, $500/ML seems a pretty good deal. This cost does not, of course, include the cost of the dam, which we assumed, at the beginning, already existed. There may also be some groundwork to ensure that the ground under the plastic is smoothed and free of sharp objects. The plastic would also have to be held down- I suggest cement stabilised mud-bricks- they don't have to be fancy- they just have to sit there. The plastic sheet catchment in the attached photo uses old tyres. Most farms have a lot of scrap lying around which could be used, if necessary, to keep costs down. Fencing off the catchment may be a good idea, although livestock would generally have no interest in grazing a hot, barren area. The sheeting doesn't have to be welded together, although this is an enhancement. Added costs? This will depend on the skills and resources of the particular farmer, but these costs are unlikely to double the cost to 20 cents/kL.

How many farm animals can be watered with 1ML? The standard measure is a "DSE"- a "Dry Sheep Equivalent"– 5-10 litres/day.

Animal	**Water**	**No/3 ML Dam**
Sheep	1 DSE	1,000
Ewe (with lamb)	1.5 DSE	600
Cow	10-15 DSE	60-100
Horse	10 DSE	100
Pig	2-4 DSE	250-500

The 3 ML in the dam could also irrigate about 1 Ha of land, producing up to 5 tonnes of grain – enough to feed 100 sheep for the whole year.

Conclusion: As I found 15 years ago on my own farm, using plastic sheeting as an efficient water catchment is surprisingly easy and efficient. My brother-in-law, a very successful farmer commented at the time that he had only seen it used a few times. Given that it would only take several thousand dollars per dam to ensure sufficient water for stack, I remain amazed that it isn't standard practice, given the acknowledged variability of rainfall in all areas of Australia.

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