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Water conservation : the storage life of farm dams

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THE STORAGE LIFE OF FARM DAMS

A guide to the stock watering capacity of the main type of farm dam in Western Australia's agricultural areas.

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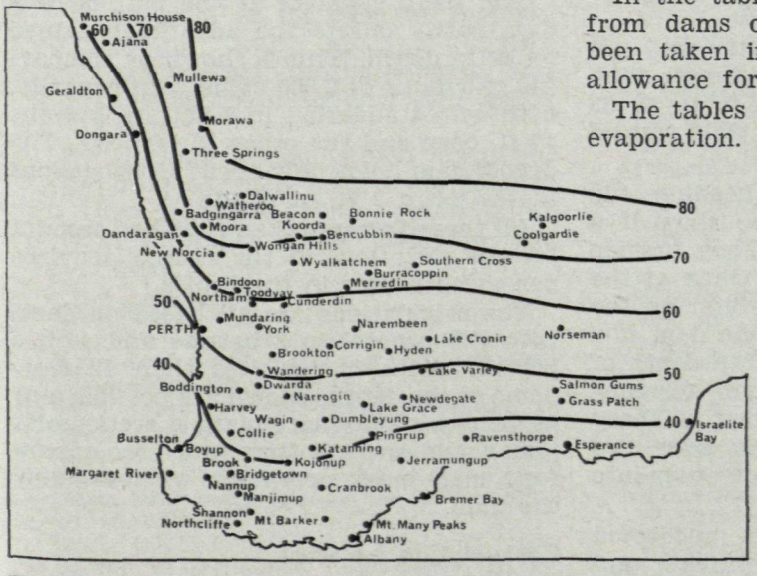
HOW MANY stock can a dam of a certain size and depth be expected to carry and how long will the supply last? What size of dam is needed in case the winter rains fail? How many stock can a dam support and still provide a drought supply?

This article presents a map and tables of figures as a guide to answering these and related questions for all sizes of dams in all parts of the agricultural areas of Western Australia.

Only the square or rectangular excavated earth tank type of dam, which relies entirely on run-off of surface water, is considered here.

Location

The map below shows the agricultural areas divided into zones of estimated average evaporation of water from dams.



AVERAGE EVAPORATION FROM FARM DAMS
Inches per year

It should be used to find in which zone the dam or farm is located and to help in selecting the appropriate table.

The map is based on the Bureau of Meteorology's map of measured average annual evaporation, but the figures given on the Bureau's map are shown here adjusted by a factor of four-fifths. This has been done because meteorologists and water engineers usually take the evaporation from water surfaces of the size of farm dams to be four-fifths of the rates given by the measuring pans at official weather stations.

In the tables the expected evaporation from dams over the periods stated has been taken into account and no further allowance for evaporation is needed.

The tables assume uncontrolled average evaporation.

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The tables

The tables at the end of this article give a guide to the number of stock which can be watered from any size dam in each evaporation zone.

For some sizes, the number of sheep the dams should carry can be read directly from the table. For dams of intermediate size, figures for storage required per sheep (in cubic yards of water) allow the number of sheep a dam should carry to be worked out by simple arithmetic.

The method is described with examples at the end of the article.

Length of storage period

Each table shows two periods of supply —10 months and 22 months. In the southernmost zones a 34 month period is also shown. These storage periods are based on the following considerations:—

In a normal season in the agricultural areas, run-off into dams may cease by the end of August and not start again until the following July. A dam must therefore be big enough to supply stock and allow for evaporation for at least 10 months.

The tables provide a guide for a decision to be made at the end of August on the number of stock that can safely be put on a dam if a supply is required for one season only, without relying on summer or early rains to produce run-off.

If the winter rains fail, dams may not be replenished for 12 months longer than a normal season, giving a total of 22 months between rains which yield run-off into dams.

The figures under the heading "22 months supply" in the tables show if a drought supply is possible. They provide a basis for a decision to be made at the end of August in a normal winter on the number of sheep to put on the dam if a drought supply is required. The depth of water shown in the table allows for continuous stocking by the number of sheep specified and for evaporation over two seasons with no further flow of water into the dam.

A 34 months supply from uncovered dams (that is, over two winters and three summers with no run-off), is only possible in the southern part of the State where evaporation rates are lowest.

Depth of storage required

Because of evaporation, the depth of water stored is important. It is not sufficient to base decisions about dams solely on cubic yards of water stored.

Both depth and storage required per sheep, allowing for expected evaporation, are shown in the tables.

Evaporation rates are highest in January. Dams in the northern agricultural areas lose an average of nearly 13 in. of water in this month while those near the south coast lose about 5 in.

Evaporation causes the loss of a certain *depth* of water; the *amount* of water this represents depends on the size of the dam.

The top foot of the excavation of a 2,000 cubic yard dam holds about 60,000 gallons, while the top foot of a 4,000 yard dam holds about 100,000 gallons.

As the dam excavation has sloping sides, the amounts also vary at different levels throughout its depth. The evaporation of a foot of water from the bottom of a 2,000 cubic yard dam 10 ft. deep is about 12,000 gallons. This compares with 30,000 gallons that would be lost from the mid-depth, or 60,000 from the top of the dam.

Correspondingly, consumption of a certain amount of water by stock lowers the water by varying depths, depending on the level at which it stands at the time.

The small capacity at the bottom of a dam partly offsets the advantage gained by extra depth. This is shown by comparing two dams of 2,000 cubic yard capacity, both with standard 1 in 3 batters, but one 10 ft. deep and the other 12 ft. deep. The deeper dam holds only about 15,000 gallons in the extra 2 ft. of depth.

All these factors taken together account for the variations in the storage required per sheep shown in the tables.

The calculations are all based on dams with the usual 1 in 3 batters and with a bottom width of not less than 12 feet. Some of the depths shown are possible only in dams with a square plan; a rectangular plan would give a bottom width too narrow for a machine to operate in when building the dam.

Consumption by stock

Sheep

Actual consumption by an adult sheep averages just over one cubic yard of water

a year. A sheep drinks about ¾ gallon a day during the summer months, rising to a gallon or more on the hottest days. In a normal winter on green pasture sheep may obtain most or all of their water from the green feed but they may drink up to ¼ gallon per head a day.

The tables assume continuous stocking by sheep throughout the periods of supply shown.

Cattle

The storage requirements for cattle can be estimated by substituting one beast, of any age from weaning onwards, for 10 sheep in the numbers shown in the tables. If a dam can carry 500 sheep, it should be able to water 50 cattle.

Using the tables

Some uses of the tables are:

- When the depth of water in an existing dam is known at the end of winter, to decide the number of stock which the dam can safely carry over the following summer or over a longer period.
- To decide if a particular dam is capable of providing a worthwhile drought supply.
- To calculate the number of stock which can be safely carried by the existing dams on a property.
- To help plan new dams for seasonal or for drought supplies, taking into account district evaporation, the catchments and the depth of holding clay available.
- To help decide which forms of drought water reserve are possible or desirable when planning or reviewing a water policy for the farm.

EXAMPLE

A 2,000 cubic yard dam at Cranbrook 8 feet deep is full at the end of August. How many sheep can it carry?

1,000 sheep for 10 months, derived as follows: The map shows that Cranbrook is in the zone with up to 40 in. average evaporation per year. Refer to the appropriate table and look along the line for 2,000 cu. yd. dams.

Under the heading for 8 ft. minimum depth it will be seen that 1,000 sheep can be carried for one season (10 months) if the dam receives no further run-off.

The number of sheep which can be carried on dams intermediate in size to those shown in the tables can be worked out as follows:—

See the figure for storage required per sheep, shown in brackets in the appropriate table, for a dam of the nearest size smaller than the dam you have in mind. Thus for dams between 1,500 and 2,000 cubic yds. consult the line for 1,500 yd. dams; for dams in the 5,000 cubic yard range consult the line for 4,000 yd. dams, and so on. Divide the figure in brackets, selected in this way, into the capacity of the dam you have in mind. The result is the number of sheep which can be carried on a dam of this size

EXAMPLE

How many sheep can be carried in the 70 to 80 inch evaporation zone on a 3,500 yard dam 14 feet deep?

In the appropriate table, consult the line for dams of the nearest size shown, smaller than 3,500 yds., that is 3,000 yds. The storage required is shown as (3) cubic yds. per head.

3,500 divided by 3 = 1,166

1,166 sheep can be carried for one season only. No drought supply can be expected on a dam of this size in this zone.

EXAMPLE

How many sheep can be carried in the under 40 in. evaporation zone on a dam of 1,800 cu. yds. 10 ft. deep?

The appropriate table shows the figures of storage required to be:—

- For 10 months' supply, (2) cu. yds. 1,800 divided by 2 = 900.
- For 22 months' supply, (8) cu. yds. 1,800 divided by 8 = 225.

900 sheep can be carried for one season only, or 225 sheep if a drought supply is required.

EXAMPLE

Consider a block in the under 40 in. evaporation zone which is expected to carry 1,000 sheep. No dam sites can be found deeper than 10 ft. Is a drought supply possible?

The appropriate table shows that a 22 month drought supply could be achieved, but not a longer period. A total storage of 8,000 cu. yds. would be required, say two 4,000 yd. dams.

If there is an alternative drought reserve available, and reasonable prospects of filling a dam in most years so that a supply for one season only could be considered, a 2,000 yd. dam would be big enough.

PROBLEM

If dams are not full at the end of August, how can the tables be used?

First estimate the quantity and depth of water as accurately as possible.

The depth can be found by sounding with a long pole if necessary. Another method is to use a piece of twine about 12 ft. long. Tie rags onto the twine at one foot centres (as on a kite's tail) and tie a weight on one end. Then tie the other end on to the middle of a cord about 140 ft. long. Have two people standing on the opposite sides of the dam holding the long cord so that the weighed twine hangs in the centre of the dam. Note where the water level comes on the twine when the weight just rests on the bottom of the dam.

The quantity (volume) of water can be most accurately worked out by using the same method as for calculating the excavation of a dam. However, in this case instead of measuring the top of the excavation, use the length and width of the water surface. A good estimate can be derived by using the Volume Calculator which follows this article.

EXAMPLE

If the dam is square, pace or measure one side of the dam at water level and look for that measurement (or the nearest one to it) in the *left*-hand column of the Calculator.

A square dam contains 6 ft. of water and the length along one side at water level is 105 ft. What is the volume of the water?

In the left-hand column of the calculator, the nearest length of side is 103 ft. Moving along the 103 row, the volume of water under the 6 ft. depth is 1,620 cu. yds.

EXAMPLE

If the dam is rectangular, measure right round the dam (the perimeter) at water level and look for that measurement in the *right*-hand column of the Calculator. *A rectangular dam has sides of 96, 105, 96 and 105 ft. at water level. If it contains 14 ft. of water, what is the quantity of water?*

The perimeter of the dam at water level is the total of its four sides, i.e.,

96 + 105 + 96 + 105 ft. = 402 ft.

In the right-hand column of the calculator, the nearest figure below that measurement is 388. Reading left along the 388 row, the volume of water under the 14 ft. depth is 1,872 cu. yds.

Take the amount arrived at in this way as the "volume of the dam" when referring to the storage life tables.

CALCULATING DAM STORAGE LIFE

Figures in the tables show the NUMBER OF SHEEP which can be watered continuously on dams in the stated zone for the periods shown, assuming that the dams receive no run-off after August 31 of any year. Within the tables, the figures in brackets ( ) show the number of cubic yards of water required per sheep for each period of storage.

UP TO 40 INCHES AVERAGE EVAPORATION PER YEAR

(South of a line through Harvey, Kojonup, Pingrup and Scaddan)

Dam	10 months supply		22 months supply			34 months supply	
	Minimum depth of water in dam at the end of August						
	Under 8 ft	8 ft	10 ft	12 ft	15 ft	16 ft	18 ft
cu. yds 1,000	333 (3)	500 (2)	100 (10)				
1,500	500 (3)	750 (2)	187 (8)				
2,000	666 (3)	1,000 (2)	250 (8)	333 (6)			
3,000	1,000 (3)	1,500 (2)	375 (8)	500 (6)	500 (6)		
4,000	1,333 (3)	2,000 (2)	500 (8)	800 (5)	800 (5)		
6,000	2,000 (3)	3,000 (2)	750 (8)	1,200 (5)	1,200 (5)	600 (10)	600 (10)
8,000	2,666 (3)	4,000 (2)	1,000 (8)	1,600 (5)	2,000 (4)	800 (10)	800 (10)
10,000	3,333 (3)	5,000 (2)	1,666 (6)	2,000 (5)	2,500 (4)	1,000 (10)	1,250 (8)
12,000	4,000 (3)	6,000 (2)	2,000 (6)	2,400 (5)	3,000 (4)	1,200 (10)	1,500 (8)

The minimum depth of water which can be expected to give a drought supply for 22 months is 10 feet. For a 34 months supply the minimum depth is 16 feet.

40 to 50 INCHES AVERAGE EVAPORATION PER YEAR

(North of the previous zone, and south of a line through Pingelly to Lake Varley and Salmon Gums)

Dam	10 months supply			22 months supply			
	Minimum depth of water in dam at the end of August						
	Under 8 ft	8 ft	10 ft	12 ft	14 ft	16 ft	20 ft
cu. yds							
1,000	333 (3)	333 (3)	500 (2)	The smallest dam which can be expected to give a drought supply of 22 months is 2,000 cu. yards with 12 ft depth of water at the end of August.			
1,500	500 (3)	500 (3)	750 (2)				
2,000	666 (3)	666 (3)	1,000 (2)	200 (10)			
3,000	1,000 (3)	1,000 (3)	1,500 (2)	375 (8)	375 (8)		
4,000	1,333 (3)	2,000 (2)	2,000 (2)	500 (8)	666 (6)	666 (6)	
6,000	2,000 (3)	3,000 (2)	3,000 (2)	750 (8)	1,000 (6)	1,200 (5)	1,200 (5)
8,000	2,666 (3)	4,000 (2)	4,000 (2)	1,000 (8)	1,333 (6)	1,600 (5)	1,600 (5)
10,000	3,333 (3)	5,000 (2)	5,000 (2)	1,250 (8)	1,666 (6)	2,000 (5)	2,000 (5)
12,000	4,000 (3)	6,000 (2)	6,000 (2)	1,500 (8)	2,000 (6)	2,400 (5)	3,000 (4)

A 34 month supply can only be expected in this zone from dams of 12,000 cubic yards or larger with at least 20 ft. depth of water at the end of August, allowing 10 cubic yards of water per sheep.

50 to 60 INCHES AVERAGE EVAPORATION PER YEAR

(North of the previous zone, and south of a line through Toodyay and Merredin. Up to 20 miles inland from the coast north of Perth)

Dam	10 months supply			22 months supply			
	Minimum depth of water in dam at the end of August						
	Under 10 ft	10 ft	12 ft	13 ft	15 ft	18 ft	20 ft
cu. yds							
1,000	333 (3)	333 (3)	The smallest dam which can be expected to give a drought supply of 22 months is 4,000 cu. yards with 13 ft depth of water at the end of August.				
1,500	500 (3)	500 (3)					
2,000	666 (3)	666 (3)	1,000 (2)				
3,000	1,000 (3)	1,000 (3)	1,500 (2)				
4,000	1,333 (3)	2,000 (2)	2,000 (2)	400 (10)	500 (8)	500 (8)	
6,000	2,000 (3)	3,000 (2)	3,000 (2)	600 (10)	750 (8)	1,000 (6)	1,000 (6)
8,000	2,666 (3)	4,000 (2)	4,000 (2)	800 (10)	1,000 (8)	1,333 (6)	1,333 (6)
10,000	3,333 (3)	5,000 (2)	5,000 (2)	1,000 (10)	1,250 (8)	1,666 (6)	2,000 (5)
12,000	4,000 (3)	6,000 (2)	6,000 (2)	1,200 (10)	1,500 (8)	2,000 (6)	2,400 (5)

60 to 70 INCHES AVERAGE EVAPORATION PER YEAR

(North of the previous zone, and south of a line through Moora, Bencubbin and Bullfinch. Up to 40 miles inland from the coast north of Lancelin)

Dam	10 months supply			22 months supply			
	Minimum depth of water in dam at the end of August						
	Under 10 ft	10 ft	12 ft	15 ft	16 ft	18 ft	20 ft
cu. yds 1,000	250 (4)	333 (3)		The smallest dam which can be expected to give a drought supply of 22 months is 4,000 cubic yards with 18 ft depth of water at the end of August.			
1,500	375 (4)	500 (3)					
2,000	500 (4)	666 (3)	666 (3)				
3,000	750 (4)	1,000 (3)	1,000 (3)				
4,000	1,000 (4)	1,333 (3)	2,000 (2)			400 (10)	
6,000	1,500 (4)	2,000 (3)	3,000 (2)		600 (10)	750 (8)	750 (8)
8,000	2,000 (4)	2,666 (3)	4,000 (2)	800 (10)	800 (10)	1,000 (8)	1,000 (8)
10,000	2,500 (4)	3,333 (3)	5,000 (2)	1,000 (10)	1,000 (10)	1,250 (8)	1,250 (8)
12,000	3,000 (4)	4,000 (3)	6,000 (2)	1,200 (10)	1,500 (8)	1,500 (8)	2,000 (6)

70 to 80 INCHES AVERAGE EVAPORATION PER YEAR

(North of a line through Moora, Bencubbin and Bullfinch. Up to 60 miles inland from the coast north of Eneabba)

Dam	10 months supply				22 months supply	
	Minimum depth of water in dam at the end of August					
	Under 10 ft	10 ft	12 ft	14 ft	18 ft	20 ft
cu. yds 1,000	166 (6)	250 (4)			The smallest dam which can be expected to give a drought supply of 22 months is 6,000 cubic yds with 20 ft depth of water at the end of August.	
1,500	250 (6)	375 (4)				
2,000	333 (6)	500 (4)	666 (3)			
3,000	500 (6)	750 (4)	1,000 (3)	1,000 (3)		
4,000	800 (5)	1,333 (3)	1,333 (3)	2,000 (2)		
6,000	1,200 (5)	2,000 (3)	2,000 (3)	3,000 (2)		600 (10)
8,000	1,600 (5)	2,666 (3)	2,666 (3)	4,000 (2)		800 (10)
10,000	2,000 (5)	3,333 (3)	3,333 (3)	5,000 (2)	1,000 (10)	1,250 (8)
12,000	2,400 (5)	4,000 (3)	4,000 (3)	6,000 (2)	1,200 (10)	1,500 (8)