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DROUGHT PROOFING THE FARM: CASE STUDIES

By J. L. Frith, Adviser, Irrigation and Water Resources Branch

For many years, Western Australia's north-eastern wheatbelt has suffered chronic shortages of water for stock and domestic use. The area's average annual rainfall is generally low—less than 350 millimetres—and droughts in the 1970s caused further problems. Many dams in the area leak or have inadequate catchments and groundwater is scarce or of poor quality.

In March 1982, the Western Australian Government provided $100,000 for the Department of Agriculture to demonstrate the potential of establishing permanent, drought-proof water supplies on farms in the north-eastern wheatbelt. The methods were to use existing techniques to build dams and catchments. In a year of low rainfall, for example, a well-maintained roaded catchment can yield one quarter of the rain falling on it. This article describes the project, the works undertaken, the costs and benefits.

Background

The Dalwallinu, Koorda, Mt Marshall and Mukinbudin Shire Councils were asked to nominate farms they knew to have severe difficulty in obtaining water. From a list of 20, four farms, one in each shire, were chosen. The participating farmers and the Department equally shared the costs of the work involved, up to a total of $50,000 for each farm. Any additional costs were met by the farmers. The aim was to provide permanent water supplies to withstand drought or years of low rainfall. The farmers should not have to reduce stock numbers or cart water again.

Work started in November 1982 and was almost completed by mid 1985. The watering systems have been working effectively for two years on three of the farms and many of the dams had filled after only one winter. Most of the work on the fourth farm was finished this year.

The projects

Mukinbudin

This 2,000 hectare farm on the outer fringe of the wheatbelt at Bonnie Rock in the Shire of Mukinbudin runs 2,000 sheep. The average annual rainfall is 305 mm. The demand for water is:

- Sheep 2,000 DSE
- Homestead and garden 1,500 DSE
- Other uses 500 DSE
- Total 4,000 DSE

Before 1983, three existing farm dams supplied 1,200 dry sheep equivalents. Runoff from house and shed roofs supplied domestic demands equivalent to 200 DSE, while another 500 DSE of demand for house and a modest garden were met each year by carting water from the Bonnie Rock standpipe 10 kilometres away. If that water had not been carted, the total deficiency would have been 2,600 DSE. This deficiency was met in dry years by carting more water and by selling sheep to restrict demand.

Improvements made in 1983 were:

- Three roaded catchments totalling 15 ha were added to three of the dams. One of these dams in leaky pallid zone was deepened and clay-lined. The combined supply capacity of all dams increased from 1,200 to 5,000 DSE.
- Two new dams of 7,500 and 9,500 cubic metres capacity were constructed, both with large natural catchments. One of the dams also
collects runoff from an airstrip and the other will have four hectares of roaded catchment added. Together, these dams provide for 2,500 DSE.

- A distribution network comprising six 55 kilolitre tanks, several kilometres of polythene pipe and three pumping units conveys water to the homestead and to all parts of the farm not directly served by a dam.
- Buried reticulated irrigation was installed in the homestead garden. Water is pumped from two concrete tanks used to settle suspended clay in water supplied from two of the dams.
- The existing, well organised roof runoff collection system continued to supply the in-house demand of 200 DSE.

The total water supply capacity for the farm is now 7,700 DSE, 3,700 DSE more than estimated demand.

The total cost of the improvements was $56,000. About $26,000 was spent on dams and roaded catchments which form the basic supply, and $30,000 on the distribution system.

An alternative approach to achieving a drought-proof supply at less cost would have been to construct larger roaded catchments on the three existing dams. For reasons of personal preference and perceived management convenience, the farmer chose the approach that was adopted.

**Koorda**

This 1,200 ha farm is 40 km north of Koorda and runs 2,000 sheep. The average annual rainfall is 313 mm. The demand for water is:

- Sheep 2,000 DSE
- Homestead and garden 1,200 DSE
- Horses and other uses 300 DSE
- Total 3,500 DSE

Before 1983, two dams of 7,500 and 2,500 cubic metres capacity together supplied 700 DSE. There were three small dams, all less than two metres deep, and a large dam in leaky pallid zone, none of which provided permanent water supplies.

The deficiency of 2,800 DSE was met in dry years by restricting demand and by carting water 12 km.

Improvements made in 1983 were:

- The construction of six hectares of roaded catchment on the existing 7,500 cubic metre dam, increasing its capacity from 500 to 2,400 DSE.
- Two of the small dams were deepened and one which overlies pallid zone was clay-lined. Their combined capacity increased to 1,000 DSE.
- A new 8,500 cubic metre dam with nine hectares of roaded catchment was constructed to provide water to the house and that half of the farm which had no permanent water supply. Its capacity is 3,800 DSE.

**Dalwallinu**

This 2,200 ha farm at Kalannie, 40 km east of Dalwallinu, could run up to 3,000 sheep. There is also a piggery with up to 600 pigs. The average annual rainfall is 309 mm. The demand for water is:

- Sheep 3,000 DSE
- Pigs 3,000 DSE
- Homestead and garden 1,500 DSE
- Total 7,500 DSE

Before 1983, the supply consisted of two 4,000 cubic metre dams, two bores and a well. The dams seeped slightly and although one had a small roaded catchment, neither was considered to be a permanent supply.

The two bores were limited in volume and very saline. The well could yield 20 kilolitres a day, but its location and its salinity—more than 5,000 milligrams per litre total dissolved solids (T.D.S.)—restricted its capacity to 2,000 DSE as adult sheep.

Roof runoff collection supplied 200 DSE at the homestead.

The deficiency of about 5,300 DSE was met in dry years by restricting stock numbers and garden demand, and carting water 10 km to supply the piggery.
Improvements completed in 1983 were:
- A roaded catchment was added to both existing dams, bringing their combined capacity to 1200 DSE. One of them supplies the house and piggery.
- Two new dams, one of 12 500 cubic metres with a 5.4 ha roaded catchment, the other of 4 500 cubic metres and collecting runoff from a granite outcrop, were constructed to supply the house and piggery. Their combined capacity is 3 800 DSE.
- Five small dams ranging from 1 000 to 3 300 cubic metres were constructed at points spaced around the farm. Three have roaded catchments, one collects water from a granite outcrop, and the other from a farm track. Between them, they provide for 2 300 DSE.
- The well supply was re-directed to the southern extremity of the farm. The total planned water supply is 9 500 DSE, with an increased supply of 7 300 DSE. The total cost was $50 000: $32 000 for the basic dams and roaded catchments, and $18 000 for distribution, storage, and reticulated irrigation in the garden.

Mt Marshall
The Mt Marshall farm comprised three blocks separated by public roads and totalling 4 000 ha. The demand for water is:

<table>
<thead>
<tr>
<th></th>
<th>Sheep</th>
<th>Piggery</th>
<th>2 homesteads</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 000 DSE</td>
<td>4 000 DSE</td>
<td>2 000 DSE</td>
<td>9 000 DSE</td>
</tr>
</tbody>
</table>

The only reliable supplies before 1984 were two bores with a combined supply of 2 000 DSE. The water from one had 3 000 mg/L T.D.S., barely suitable for pigs; the other was more saline. Water carting for pigs was a continual chore, made possible only by the nearness of a public water tank and rock catchment. Two shallow dams provided small quantities of water for short periods.

The deficiency amounted to 7 000 DSE.

Improvements completed in 1984 were:
- The construction of a 6 800 cubic metre dam which has a small roaded catchment and some good natural catchment of rock outcrop and farm tracks. This dam supplies two homesteads and the piggery by siphoning and gravity.
- Another dam of 6 300 cubic metres capacity with four hectares of roaded catchment and collecting runoff from public roads and a farm track was built. Water is pumped by windmill to one homestead and the piggery. These two dams between them will meet 4 000 DSE of demand.
- The construction of a 4 400 cubic metre dam with four hectares of roaded catchment and equipped with a windmill will supply up to 1 600 DSE in several surrounding paddocks.
- Four smaller dams varying from 500 to 1 500 cubic metres capacity are distributed at strategic points around the main farm block. Two of these dams are not in themselves permanent supplies, but can be supplemented...
from the larger dams. The others between them give 1,000 DSE of supply.

- A small dam between 2,000 and 3,000 cubic metres capacity will be constructed. It will provide for 500 DSE.
- A dam of about 2,500 cubic metres capacity and with two hectares of roaded catchment is located on each of the two outlying farm blocks. Between them they supply 1,200 DSE.

Total additions to supply therefore been 8,300 DSE, which with the existing bore supplies give an overall total of 10,300 DSE.

The total cost of the additions has been $54,000. Dams and roaded catchments cost $42,000; pipes, mills and tanks cost $12,000.

**Discussion**

Farmer interest in the demonstrations of establishing permanent, drought-proof on-farm water supplies has centred on their adequacy and cost. These aspects are shown in the table. The inclusion of a planned surplus water supply is a matter for personal judgement and preference, taking into account the possibility of droughts more severe than those previously recorded, loss of roaded catchment efficiency with time and reduced maintenance, and a possible future increase in demand for water.

All the participating farmers wanted to provide for full stocking capacity. Two operate intensive piggeries with a high demand for low salinity water. All chose fully reticulated home gardens.

These farms were selected because they all faced severe difficulties in obtaining enough water each year. This is reflected in the amount of earthworks and other watering equipment installed.

Based on these demonstration projects, the Department of Agriculture believes it generally would be easier and perhaps less costly for many north-eastern wheatbelt farmers to improve and secure reliable, drought-proof water supplies than it was on the four demonstration farms.

### Supply capacities and outlay costs of on-farm water supply demonstrations

<table>
<thead>
<tr>
<th>Farm</th>
<th>Mukinbudin</th>
<th>Koorda</th>
<th>Dalwallinu</th>
<th>Mt Marshall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous supply capacity</td>
<td>1,400</td>
<td>700</td>
<td>2,200</td>
<td>2,000</td>
</tr>
<tr>
<td>Demand</td>
<td>4,000</td>
<td>3,500</td>
<td>7,500</td>
<td>9,000</td>
</tr>
<tr>
<td>Increased capacity</td>
<td>6,300</td>
<td>7,400</td>
<td>7,300</td>
<td>8,300</td>
</tr>
<tr>
<td>Outlay cost</td>
<td>$55,800</td>
<td>28,310</td>
<td>50,326</td>
<td>54,000</td>
</tr>
<tr>
<td>Per hectare of farm</td>
<td>$27.94</td>
<td>$22.54</td>
<td>$22.88</td>
<td>$13.50</td>
</tr>
<tr>
<td>Per DSE of supply increase</td>
<td>$8.90</td>
<td>$3.70</td>
<td>$6.89</td>
<td>$6.50</td>
</tr>
</tbody>
</table>