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FARM DAMS IN HIGH RAINFALL AREAS

By G. C. BROWN, Irrigation Officer, Bunbury.

WATER storage is essential on most south-west farms to ensure adequate irrigation supplies in the dry summers. Government irrigation water supply schemes are limited and most farmers must supply their own water storage.

Earth wall dams and excavated tanks, when properly constructed, are the cheapest and simplest form of farm water storage. However, because of lack of planning or knowledge of construction techniques, such dams may fail.

Structural safety and water-holding capacity are the essential considerations. Before beginning work on earth tanks or dams, it is advisable to obtain advice from an expert in the field.

Planning

The estimated water requirements for present and future farming operations should be determined, and related to the rainfall and estimated run-off in the area.

It is normally better to build one large dam than two small ones. Although it is essential to have a reasonable storage-to-excavation ratio, the provision of very large areas of shallow water achieves little. The high evaporation in summer will seriously reduce the effectiveness of a dam. A very low ratio of conserved volume to excavated material may make a dam very expensive in terms of cost per acre foot of water conserved.

Gully dams

Before building a gully dam across a creek or water course, the farmer should find out his rights in this regard and, if necessary, obtain a permit from the controlling authority, the Public Works Department.

Where possible the proposed dam site should be chosen bearing in mind the areas where the water will be used.

The site must then be examined for the presence of outcrops or intrusions of rock within the dam area. Rocks mixed into an earth (clay) structure can prejudice the ability of the dam to hold water—and the safety of the structure—because rock and clay cannot knit closely enough together to be sure the structure is impermeable and of sufficient strength.

The whole area of the gully, especially the dam wall site, should be tested with an auger, drill or backhoe to determine the quantities and qualities of materials available for the proposed walls.

Earth tanks

For an earth tank, the site must be tested to a much greater depth to check underground water for salt, and because more excavation is usually necessary to supply material for the walls.

When constructing earth tanks, it is common to uncover isolated pockets of small rock or gravel or intrusions of sand or silt or other poor water-holding material. Such pockets should be dug out of the finished floor of the tank, and backfilled with good clay and thoroughly compacted.

Gully dam construction

Before beginning a gully dam, the core and upstream base area should be stripped of all vegetation and porous earth material. This should be deposited downstream of the core area for later use in building up the downstream wall batter.

Wall

A gusset 12 to 14 ft. wide is opened up, following the centre line of the wall, and excavated well into the foundation clay body and into the clay base of the side slopes. Clay for the core is then laid down in the excavated gully in layers about 6 to 9 in. thick and compacted firmly.

The clay should be fine-grained with no large lumps of unbroken clay. If it is dry, it should be moistened before compaction. Compaction should be done with a rubber-tyred roller, sheep-foot roller or vibrator roller. Bulldozer tracks do not pack the clay evenly and consistently, and leave air spaces or voids through which water can soak, causing “blowholes” or “p’pes” in the dam wall.

As the clay core is built up, the upstream and downstream batters should be built up. They usually have slopes of at least 3:1 and 2:1. All batter and slope work should be thoroughly compacted.

Spillway

A spillway or by-pass is essential to take away excess water when the dam has reached its safe capacity. It must be designed to carry
the maximum run-off likely from the catchment area, taking into account the amount of vegetative cover, the type and depth of the topsoil, and the steepness of the slope.

To allow a suitable safety margin in high rainfall areas, the spillway should be 6 ft. below the top of the dam wall. Its width should be related to the extreme maximum rate of inflow and surface area of the water and, if possible, the sides should have a slope of 2:1.

After the likelihood of heavy winter rains has passed and the stream flow is only gentle, the by-pass may be partially closed off and water stored to within 2 ft., but no closer, to the top of the dam wall.

**By-pass channel**

The by-pass channel should have a fairly flat grade—say 1 or 2 ft. in 100 ft. It is imperative that the velocity and turbulence of the water be minimised to prevent eroding and scouring of the sides and bottom.

The channel should be constructed in material which will resist erosion by the force of the water. A mosaic of broken rock lining the floor of the channel and continuing a little below water level in the form of an "apron" is satisfactory. The section below water level can be grouted to prevent undercutting. The side walls of the by-pass can also be built up 2 to 3 ft. with rock to prevent cavitation. The rock side walls should also continue to the floor apron and be turned into the hill slope on one side and rounded past the point of the dam wall and by-pass. The rock corners should also be cement grouted.

When the by-pass is some distance from the dam, it may revert to a grassed waterway which brings the overflow gently back to the stream bed.

If there is a limited distance for a by-pass, there may need to be a series of steps or waterfalls to bring the water back to the level of the creek. These must be constructed strongly of timber or stone to resist erosion damage.

**Protection of walls**

After completion of the dam wall, it is a good idea to lay a cover of sand about 6 in. thick on top of the clay where topsoil is limited. This can be seeded with grass, sub clover or kikuyu runners and will then help to resist rilling and washing, and will also help to prevent the hot summer sun from reaching the clay and creating large cracks in it and providing a source of future troubles.

Prevailing winds driving across the water surface towards the wall can whip up surface waves which lap against the wall and damage it. This effect can be reduced by setting brush hurdles into the bank at a slight angle to the bank. These will then take the force of the water. The planting of a windbreak around the dam is useful and scenic at the same time.

Kikuyu grass may be grown on the inside of the bank and will help to reduce the effect of waves, although it will not grow under water.

**Release pipe**

An additional and usually compulsory means of coping with water overflow is with a pipe through the bottom of the wall, fitted with a regulatory valve. For many streams it is necessary to preserve riparian rights for those downstream.

A pipe also provides a means of flushing out saline and highly mineralised water remnants at the end of each summer. However, the pipe must be very securely packed into the clay bed of the wall foundation and have baffle plates to prevent seepage around the outside of the pipe which can develop into a serious leak and cause dam failure.