facts Natural Resources and Water
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catchment series

Brigalow Catchment Study

Clearing brigalow increases runoff

Overland flow has been measured for 40 years as part of the Brigalow Catchment Study to determine if clearing brigalow country for cropping or grazing increases runoff.

The study took place at a site near Theodore in Central Queensland and represents the extensive brigalow lands of Queensland and New South Wales (about 40 million hectares). Refer to fact sheet C3 Brigalow Catchment Study for site information.

Method

The study is a paired catchment design consisting of three catchments of 12 to 17 ha.

Flumes were constructed (Figure 1) and runoff was measured in the three similar adjoining catchments during three stages:

Stage I: Runoff from the three un-cleared catchments was measured for 17 years (1965–81) so runoff from one catchment could be calculated using runoff from any other catchment.

Stage II: A land development period of two years (1982–84) during which C2 was cleared for cropping and C3 for improved pasture (buffel grass). C1 was left uncleared.

Stage III: A land-use comparison phase of 20 years (1984–2004). During this stage, runoff from C2 and C3 can be compared to their predicted uncleared runoff using the stage one calibration.

Figure 1 Flume for runoff measure-ment in the brigalow scrub catchment

Overall Result

In their original state, the catchments behaved similarly, with about five per cent of annual rainfall running off from each. Once cleared, total runoff from both the cropping and grazing catchments doubled to about 10 per cent of annual rainfall.

Runoff volume for individual events varied with land use. The increase in annual runoff is attributed to decreased evapotranspiration associated with annual cropping and winter-dormant pasture. It also reduced infiltration as a result of soil structural decline and reduced ground cover.

Individual stage results

Stage I: Calibration phase (January 1965-March 1982)

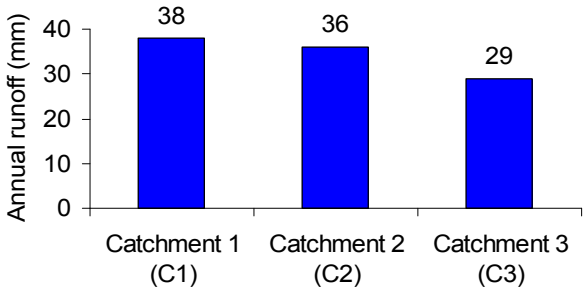

Figure 2 Average annual runoff for the three brigalow forest catchments (1965–82)

From 1965 to 1982, the catchments were monitored in their original state. Average annual runoff for the three catchments is shown in Figure 2. The calibration of the catchments was found to be:

C2 runoff (mm) = C1 runoff (mm) × 0.9539

C3 runoff (mm) = C1 runoff (mm) × 0.7176

Stage II: Land development phase (March 1982–September 1984)

In March 1982, the vegetation in C2 and C3 was cleared with bulldozer and chain. The fallen timber was then burnt in-situ in October 1982. In C2,

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narrow-based contour banks and a grass waterway was established to carry water to the flume. Catchment three was sown to buffel grass (Cenchrus ciliaris cv. Biloela) in November 1982. Catchment one remained undisturbed throughout.

Stage III: Land use comparison phase (September 1984–December 2004)

The first crop (sorghum) was planted in September 1984, followed by annual wheat for nine years. Fallow management in this period was mechanical tillage with disc and chisel ploughs, resulting in significant soil disturbance and low soil cover. Minimum tillage was introduced in 1992 and opportunity cropping in 1995.

Grazing started in December 1983 with a stocking rate of 0.29–0.71 head/ha and adjusted to maintain pasture dry matter levels at no less than 1000 kg/ha with no feed supplementation. This grazing pressure is conservative by regional standards.

Examining runoff increase

Average annual runoff for the three catchments is shown in Figure 3. Run-off from C2 and C3 is nearly double that of C1.

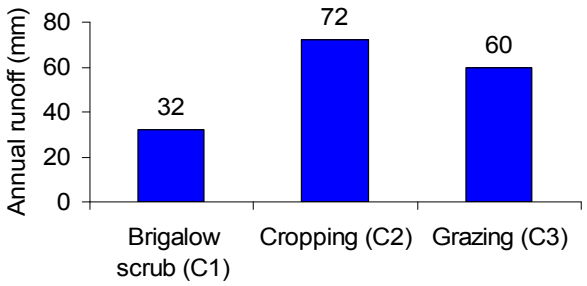


Figure 3 Average annual runoff for the brigalow scrub, cropping and pasture catchments (1984–2004).

On a monthly basis, C2 and C3 had more runoff in all months than C1 (Figure 4).

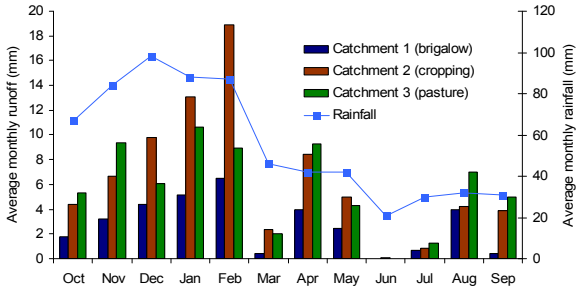
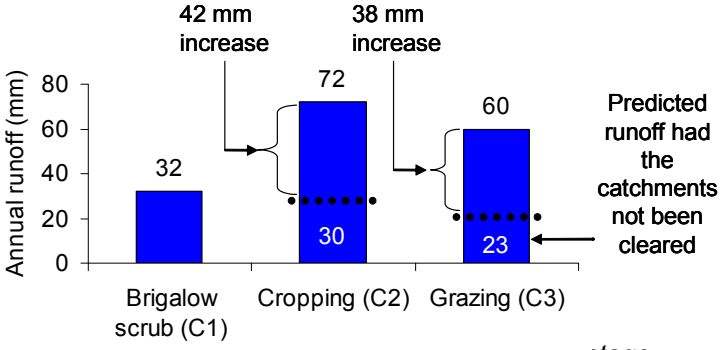


Figure 4 Average monthly runoff from the three catchments in stage three. In all months, the cropping and grazing catchments had more runoff than the brigalow scrub catchment

From mid winter until the end of spring, C3 yielded the highest runoff. Throughout summer C2 yielded the highest runoff. March and April yielded similar runoff from C2 and C3 while May and June runoff was higher from C2. The lowest average monthly runoff was close to nil in June for all catchments. The highest was 7 mm from C1 in February, 19 mm from C2 in February and 11 mm from C3 in January

Using the catchment calibration found in stage one, the runoff from C2 and C3 can be estimated had they remained brigalow scrub. Figure 5 shows that measured runoff from C2 and C3 has more than doubled with cropping and grazing land uses.



stage one show the observed runoff from the cropping and grazing catchments is now more than double the runoff expected as brigalow scrub

Conclusions

Developing brigalow land for agriculture (cropping or grazing) doubles the volume and frequency of runoff in small catchments (10–15 ha), compared to the native system. The seasonal distribution of the runoff also changes, and differs depending on the land use.

Further reading

Other fact sheets on the Brigalow Catchment Study:

- Overview (C3)
- Fertility decline of brigalow land cleared for grain or beef production (C4)

The Brigalow Catchment Study: II. Clearing brigalow (Acacia harpophylla) for cropping or pasture increases runoff. Australian Journal of Soil Research (paper submitted).