Floodplain harvesting

Fact sheet

Estimating rainfall run-off and harvesting in the NSW Murray–Darling Basin

Rainfall run-off within irrigation properties forms part of floodplain harvesting. This fact sheet describes information used to help estimate this component within the river system models that will be used to determine floodplain harvesting entitlements in line with the NSW Floodplain Harvesting Policy.

Floodplain harvesting is the capture and use of water flowing across a floodplain. Floodplain harvesting includes rainfall run-off, whether it is contaminated or not, as well as overbank flows. The licensing of floodplain harvesting will not apply to used irrigation water that flows across the floodplain or rainfall over a water storage.

The NSW Government through the Department of Planning, Industry and Environment is implementing the NSW Floodplain Harvesting Policy in the northern tributaries of the Murray–Darling Basin: the NSW Border Rivers, Gwydir, Namoi, Macquarie, and Barwon–Darling.

The department will determine the floodplain harvesting entitlements associated with regulated rivers and the Barwon-Darling unregulated river using upgraded river system models. These upgraded models will also be used for general water policy and planning purposes, including for assessing compliance with sustainable diversion limits set out in the Basin Plan.

We are upgrading these models to represent individual properties with their associated infrastructure and access to overland flow. We are in the process of preparing technical reports that describe the modelling for each river system in order to provide transparency.

Rainfall run-off rates

Run-off originating from rainfall is a fundamental component in determining total water availability in all of our river systems. All of our models include run-off from catchment areas that contribute to river flows. These models use rainfall and potential evapotranspiration as input, and we calibrate these to gauged flow records.

Not all rainfall becomes run-off. The rate of run-off will vary over time depending on how wet and dry the conditions have been. This effect is explicit in the input to our models.

The percentage of rainfall that becomes run-off depends on several factors, dominated by rainfall depth. The higher the average rainfall, the higher the average percentage of rainfall that becomes run-off. While run-off from individual rainfall events may be very high, the long-term average will be much lower.

Other factors affect run-off rates from within farms. The most important is additional water from irrigation, which has the effect of increasing depths of run-off by maintaining higher soil moisture prior to a rain event.

Run-off rates from natural catchments are fairly well understood, and are based on a large pool of climate and quality-controlled, gauged-flow data collected over a long period under variable climate conditions. There is much less quality-controlled data available for run-off from irrigated areas.

Rainfall run-off rates assumed in northern Basin modelling

In the upgraded models for floodplain harvesting, we have used the best available information on rainfall run-off to account for differences in run-off rates between undeveloped, developed and irrigated areas. A separate rainfall run-off model is included for each property, continuously tracking the soil moisture of undeveloped, developed and irrigated areas. This enables us to calculate different rates of run-off from these areas based on soil moisture and rainfall. We calibrated these farm area models to produce a long-term average rate consistent with available data derived from our reviews of a range of papers and data sets.

An analysis of data from all calibrated gauged rainfall run-off models in northern river systems shows run-off rates increasing with rainfall, with 2–4% of rainfall becoming run-off for catchments with less than 600 millimetres per year average annual rainfall. This rainfall is most representative of irrigated areas. The comparative rates for higher rainfalls are 4–8% (600-–800 millimetres per year) and 8–16% (800–1100 millimetres per year).

There is limited relevant information available for the irrigated on-farm environment. Most papers either refer to rainfall run-off from upland areas with steeper slopes, or use theoretical calculations rather than field data. The studies most relevant to on-farm run-off generation are listed in the References section of this fact sheet.

We will calibrate the on-farm rainfall run-off models within our river system models to produce long-term averages consistent with the data we have the greatest confidence in. This includes the gauged data for undeveloped areas, and the peer-reviewed, published research work of Connolly et al. (see References). Table 1 summarises this data for a representative farm in the Border Rivers model.

Table 1. Rainfall run-off rates for Boomi climate

Area	1950–2000
Summer Irrigated + Winter Fallow	8.8%
Fallow	4.1%
Undeveloped	2.1%

The monitoring reported in FSA and Aquatech consulting (2012) (see References) provides verifiable data that suggests that these estimates may be on the high side. On the other hand, the farm survey data, with its large range and uncertain quality control, indicates that the results are within the range reported by landholders.

Rainfall run-off rates in the southern Basin

On-farm rainfall run-off harvesting does not take place to the same extent in the southern Murray–Darling Basin when compared to the northern Basin. Most southern farms have not invested in large on farm storages to harvest run-off because of they have access to higher reliability, regulated entitlement products provided by relatively large public headwater storages. Because of the comparatively low historical significance of run-off harvesting compared to total diversions, we did not represent this in our models of the southern river systems.

There is evidence that rainfall run-off harvesting may be increasing, based on changing cropping patterns and water availability. However, based on comparative ratios of on-farm storage capacities to average annual total diversions, it is an order of magnitude (~10–20 times) less significant than in the northern basin.

The run-off rates from the upland catchments tend to be higher than in the northern basin. This is partly because of higher ratios of rainfall to potential evapotranspiration. Also, in the south winter rainfall patterns dominate, whereas summer rainfall dominates in the north. This is most apparent in the 800–1100 millimetres per year rainfall zone, with run-off rates of 15–20%. The run-off rates in the less-than-600 millimetres per year rainfall zone, based on two data sets, are similar to the north.

There are no comparable observed data sets for on-farm processes. The relative change of run-off rates for irrigated compared to non-irrigated land is likely to be less because irrigation takes place during the comparatively drier summer months in the south, whereas in the north there is more rain in summer.

Beecham and Arranz (2009) (see References) reported on a study based purely on modelled results in the Murray irrigation districts as part of salinity assessment. This modelling estimated the relative changes in run-off for different soil types resulting from developing areas for irrigation, as well as irrigating. The results indicate that laser-grading an area for irrigation increased run-off compared to undeveloped land by 50–100%, whereas irrigating that land increased run-off compared to undeveloped land by 100–200%. While there was no actual data to calibrate the model against, the undeveloped rates are consistent with regional gauged data, and the increases are in line with observed data and modelled results in the north.

Conclusion

Harvesting of on-farm rainfall run-off forms part of floodplain harvesting and entitlements in the northern Basin. We have estimated this harvesting using the best available information. Nevertheless, there are uncertainties associated with both rainfall run-off harvesting and overland flow harvesting. The consequences of this uncertainty have been partly managed by ensuring overall water balances are reasonable given historic cropping and diversions.

For this reason, the models are best used to assess total floodplain harvesting. They are less reliable for separately reporting rainfall and overland flow harvesting.

We do not use estimates of rainfall run-off harvesting in the models of our southern river systems because of the comparatively low historical significance of this harvesting.

References

Beecham*, R. and Arranz, P. (2009) NSW Murray Irrigation Limited Land and Water Management Plans Salinity Assessment, NSW Office of Water.*

Connolly RD, Kennedy IR, Silburn DM, Simpson BW, Freebairn DM (2001) Simulating endosulfan transport in runoff from cotton fields in Australia using the GLEAMS model. Journal of Environmental Quality 30, 702–713.

FSA Consulting and Aquatech Consulting (2011) Estimating Land Surface Diversions: Stage 2, Final Report (August 2011), Murray Darling Basin Authority, Canberra.

Silburn, M; Montgomery, J; McGarry, D; Gunawardena, T; Foley, J; Ringrose-Voase, A; Nadelko, T (2012), Deep drainage under irrigated cotton in Australia: a review. In: Wiggington, David, editor/s. WaterPak. A guide for irrigation management in cotton and grain farming systems. Australia: Cotton Research and Development Corporation; 2012. 40–58.