AMURI IRRIGATION COMPANY

Calculating Irrigation Efficiency for Amuri Basin Farms

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Irrigation efficiency is calculated using a soil water balance model (SWBM). The model used is from the UNFAO (United Nations Food and Agricultural Organisation) and has been the standard method for calculating water requirements for several decades.

A SWBM is a water budgeting tool. It accounts for water gains from rainfall and irrigation, and water losses from evapotranspiration and drainage below the root zone. The SWBM includes an irrigation module, which considers how an irrigator moves around a series of paddocks before starting back in the first paddock (i.e., return interval), and how not all applied irrigation water is effective, because some water is lost to evaporation, wind drift, and (depending on the system) non-uniform application.

The version of the model used for calculating farm efficiency in the Amuri Basin assumes the entire irrigated area is intensive pasture and **does not** consider soil pans or where the groundwater is close to the surface. Both simplifications are conservative, in that they predict **more** irrigation water is needed. In practice, farms that have a portion of cropping, soil pan, or groundwater close to the surface will require **less** water than predicted. This means the calculated irrigation efficiency is a best-case scenario, and actual efficiency will be lower if one of these factors is present.

Water requirements vary across the Basin, depending on the soil type (water holding capacity) and the location (since rainfall varies across the Basin). The calculations consider the mix of soils on every farm. The soil's Plant Available Water (PAW) is taken from ECan/Landcare soils database. Currently we only have two reliable rainfall records, at the aerodrome and at Mouse Point substation.

Evaporation (ET) doesn't vary much across the Basin [on the flats]. Wind exposure is the main factor that can result in slightly higher or lower ET in different places. In the model a single ET record (from a NIWA climate station) is used for the entire Basin.

The Calculation

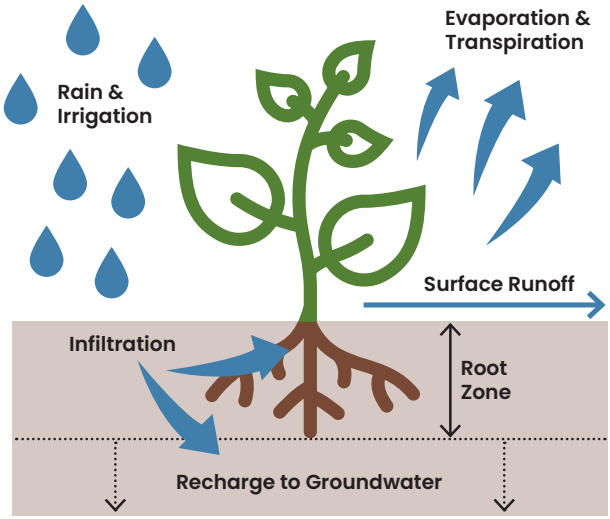
For every farm, irrigation efficiency is calculated using the following equation:

Farm irrigation efficiency = (Calculated water use for 80% efficient irrigator) / (Recorded water use) x 80%

An 80% efficient irrigator means that 80% of the applied water is retained in the root zone after application (and allowing for up to 24 hours for rootzone percolation to occur). Well managed irrigation should also not fill the soil water 'bucket' up to the brim, but rather leave a gap of 10-20mm (depending on the soil type). That is, it is not good practice to bring the soil moisture all the way up to field capacity after irrigation.

Like any model, the accuracy of the results will depend on the accuracy of the data inputs. The main issues potentially affecting the results are:

- Farms that spread water further than the number of shares they own.
- Farms that have a secondary private water source.
- Farms with missing water meter data. Where this missing data is obvious, it has been excluded.



Example 1

Farm A (soil PAW = 80mm & near Mouse Point rain gauge) uses 510 mm in 2022-23, but the calculated water requirements was only 354 mm. The irrigation efficiency for that season would be: 354 / 510 x 0.8 = 56%.

Example 2

Farm B (soil PAW = 65mm & near aerodrome rain gauge) uses 280 mm in 2022-23, but the calculated water requirements was 395 mm. The irrigation efficiency for that season would be: 395 / 280 x 0.8 = >100%.

We would say that this farm's irrigation was 90%+ efficient. The fact that the farm uses less water than predicted doesn't mean they are under-irrigating. Rather it reflects that the water requirement calculations are conservative, with a tendency to over-estimate water needs.

The method is primarily intended to identify farms that are overwatering, rather than focusing on the farms that are more efficient. For example, in 2022/23 over half of all farms had a calculated water use efficiency of 90%+.

- The full variability in rainfall within a season across the Basin is not captured. AIC is in the process of installing additional high quality research grade rainfall stations, so we can more accurately account for **actual** rainfall at a farm scale in the future.

At present, the numbers account for our best estimate of actual irrigated area, hopefully capturing where spreading of water is occurring. It hasn't allowed for any private water usage. For those, the numbers could either under-estimate or over-estimate efficiency depending on how they operate the two supplies. In the future we hope to represent these factors more accurately at a farm scale.

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