

# Seasonal forecasting of water allocations in irrigated catchments

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## The context

The summer irrigation season in the Murrumbidgee Valley is from July to the following June. The amount of water that irrigators have access to for any one year is based on the seasonal water allocation announcements delivered by the Department of Land and Water Conservation (DLWC)<sup>1</sup> over the irrigation season. A water allocation is the percentage of the licence holders entitlement and is derived by the amount of storage in the two main reservoirs, Burrunjuck and Blowering dams and minimum expected inflows. The two dams have holding capacities of 1,026 GL and 1,631 GL respectively. Irrigation entitlements for the two main irrigation areas in the Murrumbidgee Valley, the Murrumbidgee Irrigation Area (MIA) and the Coleambally Irrigation Area (CIA) are 1213 GL and 503 GL respectively.

The first irrigation allocation announcements for general security<sup>2</sup> water users in the Murrumbidgee Valley is at the beginning of the water year, around July to August. This allocation announcement is usually very conservative as the DLWC announces allocations based on an often quoted reliability of inflows to dams of at least 99%. That is, there is a greater than a 99% chance that the more water allocations will be available as the season proceeds. The announcements are based upon minimum recorded stream flow sequence over the period covered by the allocation announcement.

The choice of such a conservative announcement has been made on the basis that the individual licensees should undertake the level of risk of water supply shortfall. Increases in allocation generally occur throughout the irrigation season whenever there are significant inflows into the major storages. However, individual irrigators are at risk of losing their cropping investments if they overestimate water availability later in the season if irrigation water allocations do not rise to their anticipated levels. If irrigation allocation increases beyond the anticipated levels there is a risk of over irrigation and therefore lower efficiency of consumptive water use.

In addition, irrigators are allowed to overdraw and carryover water. Licensees may borrow against the next season's allocation during the current year (up to a specified level), or carry over unused allocation to the following season. Upper limits to overdraw and carryover are usually announced as a percentage of the licensee's entitlement, depending on the expected availability of resources. If taken up, overdraw will reduce the allocation for the licensee below the announced allocation in the following season.

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<sup>1</sup> now called the Department of Infrastructure, Planning and Natural Resources (DIPNR).

<sup>2</sup> License entitlements are divided into general and high security, reflecting the type of water use. High security entitlement guarantees the licence holder of receiving its full entitlement in 99% of seasons and is usually issued for town water supplies, stock and domestic requirements, industrial use and permanent plantings (i.e. orchards, vineyards, etc.). General security entitlement, is the allocated percentage of remaining water available for consumptive use after high security and environmental demands have been allocated for.

## Results

A detailed study on SOI correlation with rainfall and SST correlations with inflows to the Burrinjuck and Blowering Dams and rainfall in the catchment were carried out. The detailed results are given in Khan et al (2004). To show the skill of SST forecasts comparisons between the actual and the modelled inflow value with 50% confidence limits for the Burrinjuck and Blowering Dams are shown in Figures 1 and 2 respectively.

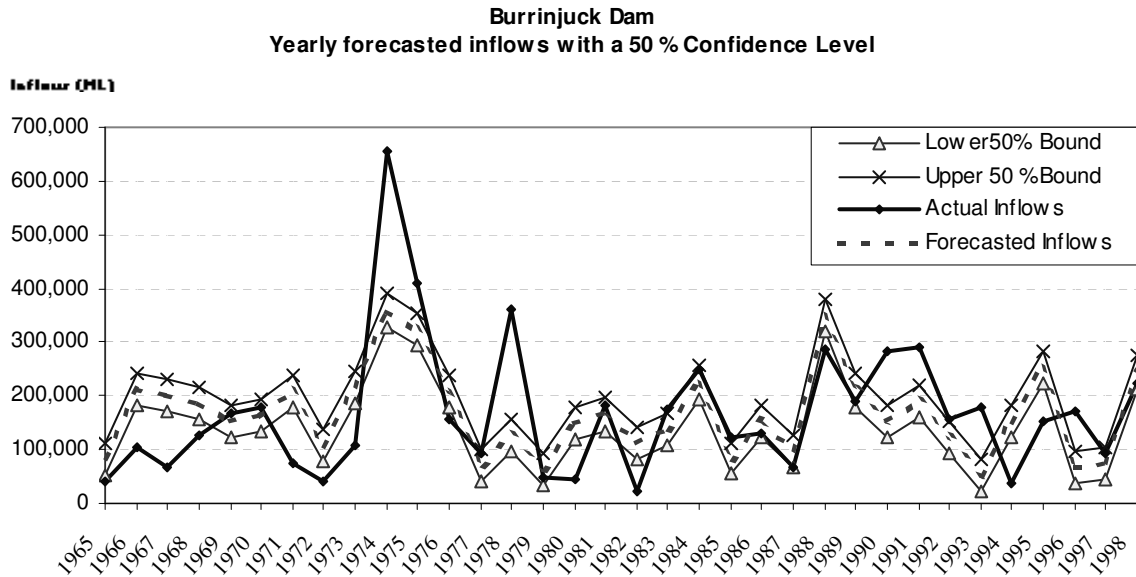


Figure 1: Burrinjuck Dam Yearly Forecasted May-Oct Averaged Inflows with a 50 % confidence level.

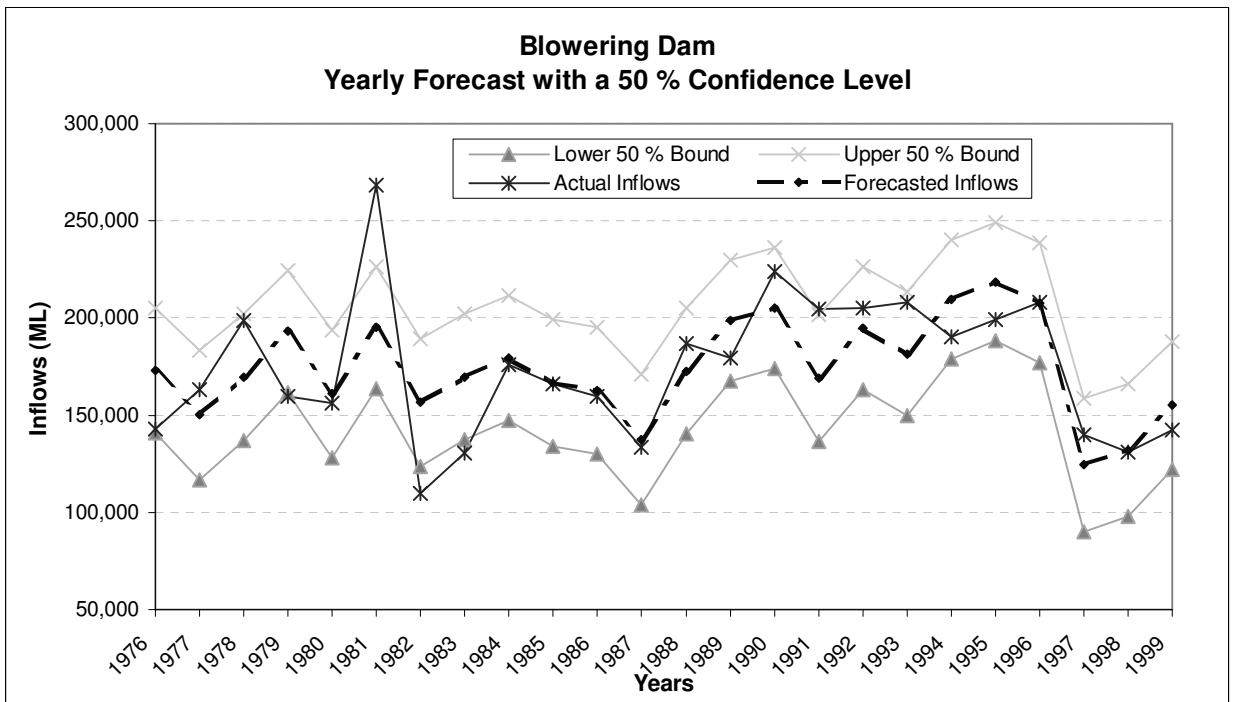


Figure 2: Blowering Dam Forecasted May-October Averaged Inflows with a 50 % confidence level.

A neural network model was trained using the August and January water allocation levels for the Murrumbidgee Valley with today's environmental flow rules for the years 1890 – 1995, based on DLWC's IQQM model. This model was improved using the SST temperature forecasts for inflows dams. Figure-3 shows that the forecasting ability of the neural network model significantly improves by the inclusion of SST forecasts.

A dedicated user-interface (Figure-4) to facilitate adoption of climate forecasts using a risk-based approach was also developed using the .NET programming platform. The user needs to input start of the season water allocation, a risk factor and choice whether to SST temperature prediction or not. The model uses the trained neural networks and predicts the end of the season water allocation. There is a lot of interest among growers for testing and using the framework.

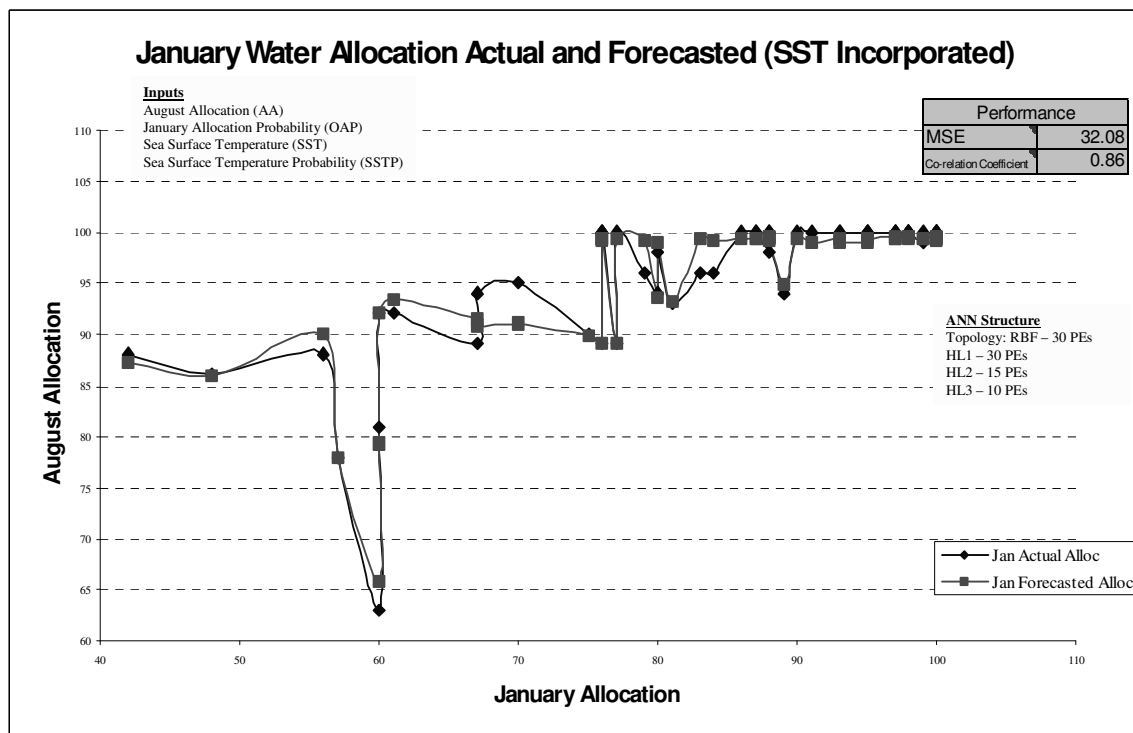


Figure-3 Actual and forecasted water allocation for January (Sea Surface Temperature incorporated).

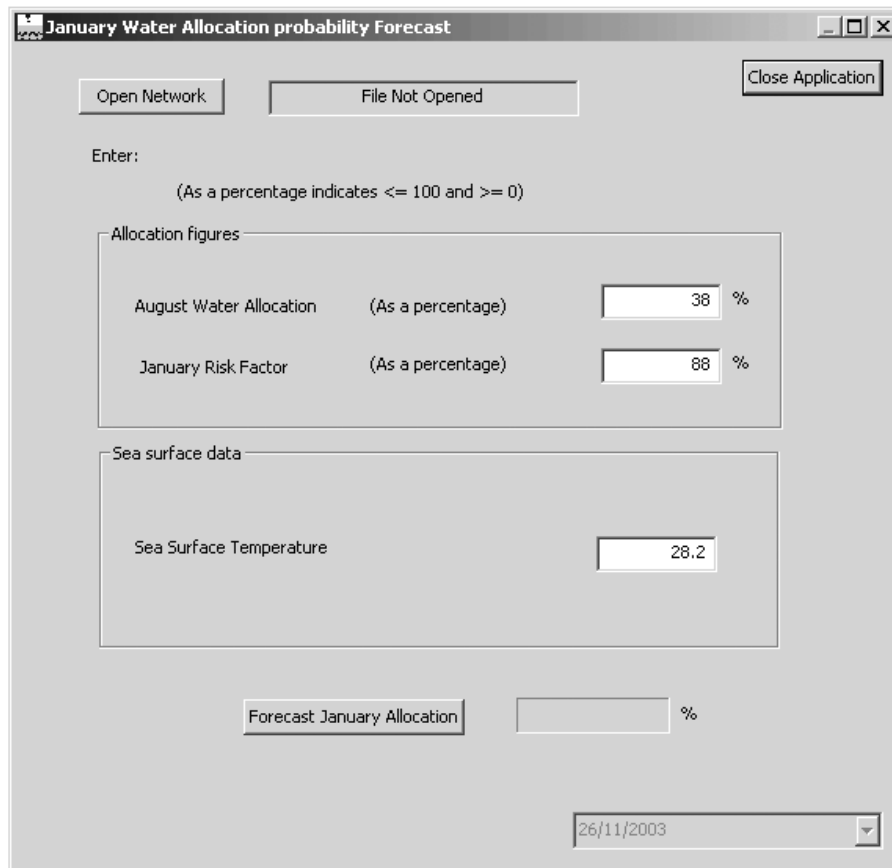


Figure-4 User-interface for risk based irrigation management.

## Conclusions

The following conclusions are drawn from this study:

- Seasonal prediction of water availability is a major determinant in irrigators cropping decisions. More reliable information on the likelihood of end-of-season allocation levels can assist irrigators to make cropping decisions that will minimise production risk and improve the profitability of the farm.
- The SST correlations with inflows to dams provided promising results, which can be used to forecast flows to dams with lead times of around 1 year.
- Neural network (NN) approaches which can learn from historic model simulations and SST predictions have been developed. Results of the NN model show good correlations with the historic water allocation trends over a given season. This tool can be used to make informed decisions on cropping risk decisions.

## Reference

Khan, S., Robinson, D., Beddek, R., Wang, B., Dharma, D. and Rana, T. (2004). Hydro-climatic and Economic Evaluation of Seasonal Climate Forecasts for Risk Based Irrigation Management. *CSIRO Land and Water Technical Report 5/04*.