NSWIC
NEW SOUTH WALES IRRIGATORS' COUNCIL

PO Box RI437
Royal Exchange NSW I225
Tel: 02 9251 8466
Fax: 02 9251 8477
info@nswic.org.au
www.nswic.org.au
ABN: 49 087 281 746

Briefing Note

CSIRO SUSTAINABLE YIELDS REPORT

Water Availability in the Murray-Darling Basin

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Mark Moore
Policy Analyst

SCENARIOS CONSIDERED

Results framed around four scenarios of climate and development defined by 111 years of daily climate data.

Baseline scenario - historical climate from mid-1895 to mid-2006 and the current level of water resource development.
Second scenario - climate of 1997 to 2006. Evaluate consequences of a long-term continuation of the recent severe drought, provide a reference point for the climate change scenarios.
Third scenario - climate change by 2030. Considered using three global warming levels and 15 of the global climate models. Focuses on median of the range and uncertainty is reported as a 'wet extreme' and a 'dry extreme' in the range.
Fourth scenario - likely future development and the 2030 climate. Development includes growth in farm dam capacity, expansion of commercial forestry plantations and increases in groundwater extraction.

The projections are 'best guesses', maximum allowable under existing water sharing arrangements. All four scenarios assume the continuation of the existing surface and groundwater sharing plans implemented by states.[1]

IMPACTS OF CLIMATE CHANGE BY 2030

- Are uncertain
- Surface water across entire MDB more likely to decline than to increase
- Decline in the south is more likely than in the north
- A very substantial decline In the south of the MDB is possible
- Significant increases in the north of the MDB is possible
- Median decline for entire MDB is 11% (9% in the north / 13% in the south
- Median water decline would reduce total surface water use by 4% (with current water sharing arrangements) but would further reduce flow at Murray mouth by 24% to be 30% of the total without development outflow.
- Majority of impact borne by environment rather than consumptive users.
- Impact of climate change on surface water use, much greater in dry years.

- Under median 2030 climate, diversions in driest years would fall:
    - By more than 10% in most New South Wales regions,
    - Around 20 % in the Murrumbidgee & Murray regions, and
    - Around 35 to over 50% in the Victorian regions

- Under dry extreme 2030 climate, diversions in driest years would fall:
    - By over 20% in the Condamine-Balonne,
    - Around 40 to 50% in New South Wales regions (except the Lachlan),
    - Over 70% in the Murray
    - And 80 to 90% in the major Victorian regions.

GROUNDWATER

- Groundwater currently represents 16% of total water use in the MDB

[1] Future water sharing plans must comply with Basin Plan under Commonwealth Water Act 2007

- Under current water sharing arrangements groundwater use could increase to over one-quarter of total water use
- One-quarter of current groundwater use will eventually be sourced directly from induced streamflow leakage, equivalent to about 4% of current surface water diversions.
- Around 40% of eventual streamflow leakage will occur in the Namoi, Lachlan, Murrumbidgee and Murray regions.
- Current groundwater use is unsustainable in seven of the twenty high-use groundwater areas and will lead to major drawdowns in groundwater levels in the absence of management intervention. (Condamine, Border Rivers, Lower Namoi, parts of the Lower Macquarie, parts of the Lower Lachlan, the Upper Lachlan and the Mid-Murrumbidgee).
- Indications extraction in Upper Murray may not be able to be sustained.
- Future increases in groundwater use are expected to significantly affect baseflow in small tributaries and turn many into ephemeral streams.
- Highlights need to bring all groundwater use into the water entitlement system.

CURRENT CLIMATE AND DEVELOPMENT

- MDB is naturally an inefficient hydrologic system. Surface water losses (via evapotranspiration and to groundwater) are naturally high, only 52% of assessed total surface water would reach Murray mouth in absence of flow regulation and consumptive water use.

- Surface water losses support floodplain and wetland ecosystems throughout MDB

- Losses linked to the large but infrequent floods that characterise the highly variable natural flow regimes of the MDB – especially in the north-west rivers.

- Relative level of current surface water use averaged over the historical climate sequence is high at 48% summed across MDB, varies widely between 18 regions.

- Nearly two-thirds of average annual consumptive surface water use occurs in the Murray, Murrumbidgee and Goulburn-Broken regions. These regions collectively represent slightly over half the total MDB surface water resource.

- Consumptive use has reduced average streamflow at Murray mouth by 61%.

- Water resource development has caused major changes in flooding regimes. Flows at the Murray mouth reduced by 61% with river ceasing to flow through mouth 40% of the time (compared to 1% in the absence of water resource development).

- Severe drought inflows to Lower Lakes (annual inflow less than 1500 GL) – which would never occur in the absence of consumptive water use under the historical climate – prevail in 9% of years at the current level of water resource development.

- These hydrologic changes are linked to the significant levels of environmental degradation observed at numerous floodplains and wetlands across the MDB.

FUTURE DEVELOPMENT

- Commercial forestry plantations could expand in area by 52,000 ha (18%) by 2030

- Increases would be in the Eastern Mount Lofty Ranges (2000 ha), Murrumbidgee (17,000 ha) and Murray (33,000 ha) regions.

- Developments would use a small volume of water in a MDB-wide context and the reduction in average annual runoff at the regional scale would be less than 1%.

- Expansion likely to be concentrated in small areas and the local impact on runoff could be significant.

- Current capacity of small farm dams estimated to be 2000 GL. Projections based on historical data for farm dam growth and current policy controls suggest possible 10% increase in this total farm dam capacity by 2030.

- New farm dams would reduce average annual runoff by about 0.7%

- Developments may have more impact at local or subcatchment scale including environmental consequences for tributary streams. Streamflow impacts by 2030 of commercial plantation forestry (28 GL/year), additional farm dams (170 GL/year) and the streamflow leakage induced by additional groundwater extraction (177 GL/year) would collectively represent a volume of surface water use of 375 GL/year.

- These increases in surface water use due to development and the reductions in surface water diversions due to climate change, would occur in different relative proportions in each region.

RECENT DROUGHT

- Annual rainfall in southern MDB (1997 to 2006) was significantly lower than the long-term average. Similar to low-rainfall periods in the 1890s and around 1940.

- Modelled annual runoff in southern MDB (1997 to 2006) was lower than for any other ten-year period in the last 112 years and is less than half the long-term average in some areas.

- The low runoff in the southernmost parts of the MDB has an average recurrence interval of over 300 years.

- Work by CSIRO and Bureau of Meteorology indicates these extreme climate conditions may be partly attributed to global climate change and such conditions are likely to become more common.

- Rainfall and runoff averaged across the entire MDB (1997 to 2006) are not significantly different to the long-term historical averages.

IMPACTS OF CLIMATE CHANGE

- Surface water availability is expected to decline due to climate change.

- The future will be significantly drier on average but these conditions would be less severe than a continuation of the recent climate in the south of the MDB.

- Surface water reduction would be greatest in the south-east where majority of runoff is generated and where the impacts of climate change are expected to be greatest.

- The impact on surface water use ranges from a maximum reduction of 10% in the Wimmera region to 2% increase in the Barwon-Darling (due to increased irrigation demand under a warmer climate).

- Impacts of climate change on the reliability of ‘water products’ vary greatly between the products, regions and states.

- High reliability water products (including town water supplies) would generally not be affected.

- General security and low reliability type water products would be affected in terms of the average seasonal allocation and the fraction of years of 100% allocations.

- Greatest reductions in reliability in regions where the relative level of surface water use is already high and where the climate change is expected to have the largest impact on water availability, and for water products that are already less reliable.

- Largest reductions in reliability would thus occur in the Murray, Goulburn-Broken, Campaspe, Loddon-Avoca and Wimmera regions, and under the dry extreme 2030 climate.

- Reduction in surface water availability and the lesser reduction in surface water use would cause overall relative level of use across the 18 regions (under the median 2030 climate) to rise to 54 percent.

- Outflows through the Murray mouth would fall from 39 to 30% of the without-development volume.

- Reductions in surface water availability due to climate change would be focussed in the high water use Murray, Goulburn-Broken and Murrumbidgee regions.

- Under a continuation of current water sharing arrangements, much of the impact of reduced surface water availability would be transferred to the riverine environments along the Murray River including the Lower Lakes and the Coorong.

- Flow at the Murray mouth would cease 47% of the time and severe drought inflows to the Lower Lakes would occur in 13% of years.

- Current surface water sharing arrangements would generally protect consumptive water users from much of the anticipated impact of climate change but offer little protection to riverine environments.

- This result should be considered in the development of future water sharing plans, as the NWI indicates that water plans should consider the risk of climate change on the size of the water resource and the implications for sharing.

- The Gwydir region is a notable exception as current arrangements would see the consumptive and non-consumptive water shares affected to a similar degree.

- Hydrological impacts of climate change remain very uncertain.

- Uncertainty in the impacts of climate change is expected to reduce in the coming few years with improvements in climate change science. Projections further into the future become increasingly uncertain due to divergence in the range of possible greenhouse gas emissions trajectories.

- The median climate becomes increasingly drier further into the future and by 2070 the median climate under high global warming is expected to be broadly similar to the dry extreme 2030 climate. This highlights the need for far greater flexibility and adaptive capacity in water resources