01 WATER RESOURCES IN NORTHERN AUSTRALIA

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A lot of rain falls on northern Australia, but where and when it falls makes it hard to capture and manage. Above-ground water storages will have large evaporation losses and dry-season water supplies may need to come from groundwater storages. The few rivers that flow during the dry season are fed by groundwater, so co-management of surface water and groundwater is critical. Understanding how groundwater storages are replenished and how water moves under the ground should be a precursor to any extraction development. The future climate is likely to be drier due to increased rates of evaporation.

A lot of rain but highly variable from year to year and highly seasonal

On average, more than a million gigalitres—equivalent to 100 times the capacity of Lake Argyle (mainland Australia's largest lake) or 2000 Sydney Harbours—of rain falls across the north each year. From year to year, however, the amount varies greatly. A single extremely wet year (e.g. 1974) can dramatically increase the long-term rainfall average. This variability increases away from the coast and towards the south: year-to-year variability of rainfall for Mt Isa in the south is twice that of Darwin in the north.

Rainfall is highly seasonal, with more than 94% falling between November and April and three to six months receiving little or no rain at all. The potential for evaporation and plant transpiration is so high throughout the year that, on average, for 10 months of the year, there is not enough rain to meet this demand i.e. on an annual basis the north has a water deficit.

No water is going to waste

All water in northern Australia is being fully used. Even water flowing out to sea is needed by plants and animals that live in the estuaries and near the coast. The few rivers that flow during the dry season are fed by groundwater and plants growing on the banks of these rivers would not otherwise survive the dry season.

While current levels of water use are low relative to the total water available, any changes to river flows will have consequences throughout the water cycle.

Unlike the Murray-Darling Basin which has a single large basin, the north has 55 independent basins. So changes to surface water resources in one basin should have little effect on the others. Groundwater storages, however, may cross catchment boundaries (under the ground), so extracting water from one storage could affect a number of catchments.

Storing surface water for the dry season is hard to do

Water needs to be stored during the wet season to satisfy consumptive demand during the dry season and in the lead up to the wet season. But the variability of rainfall from year to year, its highly seasonal nature and the high potential for evaporation and plant transpiration make it hard to store surface water year-round without very large and deep storages.

River flows mirror the rainfall patterns and therefore:

- Flows can vary hugely from year to year.
- Most rivers stop flowing shortly after the wet season.
- Water runs off very quickly.
- Few rivers flow all year round.

Most rain falls near the coast, on the estuaries, not in the rivers' headwaters (unlike the Murray-Darling Basin). In the southern Gulf catchments, the flat coastal landscape makes it hard to capture runoff except in the upper reaches of catchments. In these areas, however, rainfall is lower and more sporadic, and the potential for evaporation and transpiration is higher. To compensate for evaporation, storages need to be large and able to handle droughts spanning many years. Lake Argyle, for example, loses a quarter of its volume, or about half the annual demand, through evaporation. Across the north, there are 24 sites with a storage capacity greater than 1 GL (a gigalitre is a billion litres).

The wetter regions of the far north and west offer the most potential for storing water. Potential sites around Darwin are currently being considered to increase Darwin's water supply.

Dry-season water supplies need to come from underground storages

Harvesting water from floodplains after heavy rain might help to prolong water supplies into the dry season, but water levels often drop too quickly for this to be practicable. Storages (above or below ground) that fill each wet season could give certainty of supply volumes during the subsequent dry season.

Beneath the north's 55 river basins lies a complex architecture of water-holding storages (aquifers) that are replenished via a complex interaction with water on the surface. Water levels in shallow aquifers rise and fall rapidly with the seasons (wet and dry). While they often fill to capacity during the wet season and drain during the dry season, a run of dry years or increased extraction could reduce reliability of supply.

Several aquifers have potential for large-scale (greater than 100 GL/year) extraction, mainly in the Daly region in the Northern Territory. Current extraction levels are low, but supplies are fully allocated and caps on extraction are, or are soon to be, in place. Smaller extractions (10 to 100 GL/year) are feasible within the aquifers of the Canning Basin in north-west Western Australia. Extractions in the Darwin Rural Area have reached their limit and there is a moratorium on any further groundwater development.

Understanding how groundwater moves is critical

The ways in which water flows under the ground are complex and they often vary locally. When groundwater for agriculture (including irrigation) is mismanaged, problems such as dryland salinity, irrigation salinity and over-allocation can arise. For example, failing to implement a drainage strategy in the Murray-Darling Basin caused widespread salinity. Groundwater usually moves slowly over a long time, so problems can be hard to identify and expensive to fix. To avoid such problems, investigations to understand how the water moves through the landscape should be carried out before implementing agricultural developments.

The few rivers that flow year round are fed through the dry season by seeping groundwater, mostly where rivers intersect with limestone aquifers, or where Great Artesian Basin springs occur. Pumping groundwater from shallow aquifers can reduce flows in nearby rivers, so future extractions will need to be sited far enough away from rivers to make sure the rivers are not affected before the wet season breaks.

Understanding how groundwater storages are replenished (recharged) and how groundwater flows laterally should be a precursor to any extraction development.

The future is likely to be drier

In the future (around 2030), rainfall and river flows are likely to be similar or slightly less than the historical past (the last 100 years), and much less than the recent past (the last 10 years), especially in the Northern Territory and the north of Western Australia. The potential for evaporation and transpiration by plants will be higher, so overall it is likely to be drier.

More intense rains may increase the volume of water recharging underground storages, even if rainfall and runoff volumes do not increase.

Tropical cyclones are likely to become more intense but, at the regional scale, large low-pressure systems often produce larger amounts of rainfall over much bigger areas and, so, may be more important from a water resources perspective.