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Agriculture and water resource assessments in the extensive rangelands of northern Australia

Watson, I[1]; Petheram, C[2], Bruce, C[3]; Philip, S[4], Chilcott, C[5]

[1]CSIRO Agriculture and Food, Ian.Watson@csiro.au, [2]CSIRO Environment, Cuan.Petheram@csiro.au, [3]CSIRO Environment, Caroline.Bruce@csiro.au, [4]CSIRO Environment, Seonaid.Philip@csiro.au, [5]CSIRO Environment, Chris.Chilcott@csiro.au

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Abstract

Sustainable regional development is a priority for all governments which have jurisdiction in northern Australia. The land and water resources of most of northern Australia's rangelands have not been mapped in sufficient detail to provide for reliable resource allocation, mitigate investment or environmental risks, or build policy settings that can support decisions about development.

Since 2012 CSIRO has led large multi-disciplinary assessments across about 620,000 km^2 of northern Australia. These assessments have considered; Indigenous rights, values, interests and development aspirations; climate drivers; surface water hyrdology; groundwater hydrology; ecological assets and impacts; soils and land suitability; surface water storage; and agricultural and socio-economic considerations. The assessments have included a combination of field data collection, desktop studies and modelling to provide a comprehensive analysis of the kinds of intensified water resource development which might be possible and the risks which would accompany those developments.

The catchments studied are largely 'greenfield', i.e. potential development would occur on land which is not already within a matrix of existing water resource development or intensified agricultural production. The majority of the land is Indigenous held and/or is used for extensive beef cattle grazing on native pastures.

The work has shown that there are considerable soil and water resources which could be developed, however these resources are not always found together and intensified production would only be economically viable under certain, often difficult to meet, conditions. Beyond financial considerations, there are many other issues which influence the extent to which development might occur. These relate to the social licence to develop water resources, to grow certain crops such as cotton, and to clear native vegetation - as well as regulatory and legislative conditions which reflect this social licence.

Introduction

Northern Australia is remote and sparsely populated and decisions made about development need to be based on the best available data and information, provided in a manner which the public can access and digest. We used a multidisciplinary approach to examine the resources in eight study areas (14 catchments) in the rangelands of northern Australia and then investigated how these might be used to support increased economic activity. We also considered the risks (social, cultural, environmental and financial) which might accompany this activity.

Methods

A wide range (and large number) of quantitative and qualitative methods were used. Topics covered are shown in Figure 1. The approach was to provide a number of detailed technical reports, typically more than 10 reports for each catchment, a synthesis of which was provided in Catchment Reports, then pared back into much shorter Summary Reports. Data layers were made available through CSIRO's Data Access Portal. Several web-based tools were developed along with short videos. The full set of more than 110 reports is provided at https://www.csiro.au/en/research/natural-environment/water/water-resource-assessment

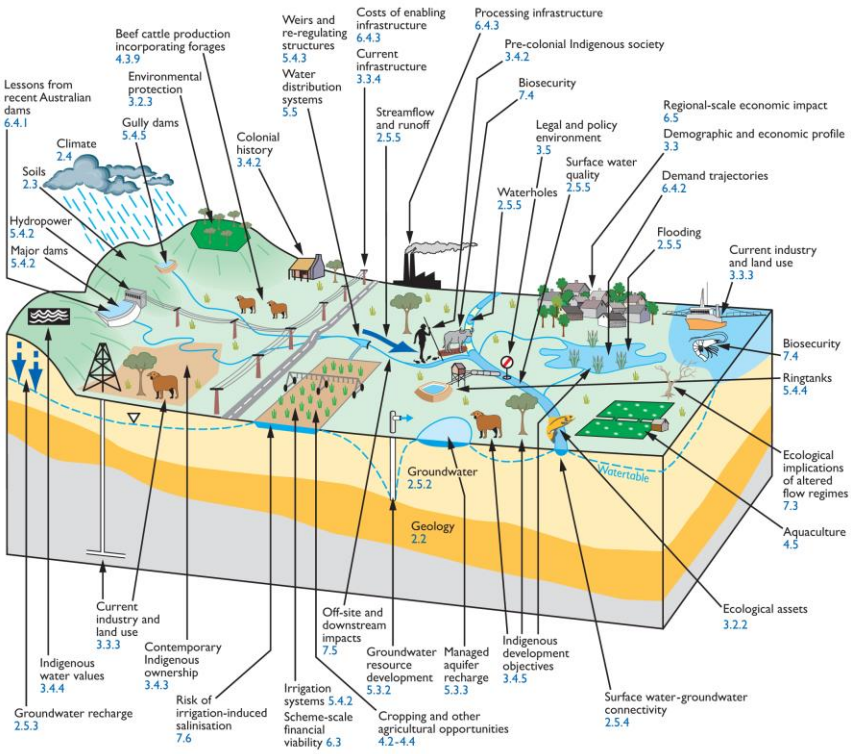

Figure 1. Schematic diagram of key components and concepts considered in the Assessments. Section numbers are from Petheram et al., (2024).

Results

Streamflow is highly variable both within years (due to the wet-dry climate) and between years. For example, the mean annual streamflow is 34% higher than the median annual streamflow in the Fitzroy River and more than double in the Flinders River. Streamflow is more variable than for catchments found in similar environments elsewhere in the world. The catchments are largely unregulated, being free of dams or weirs except in a few cases. Modelled median annual streamflow is shown in Figure 2.

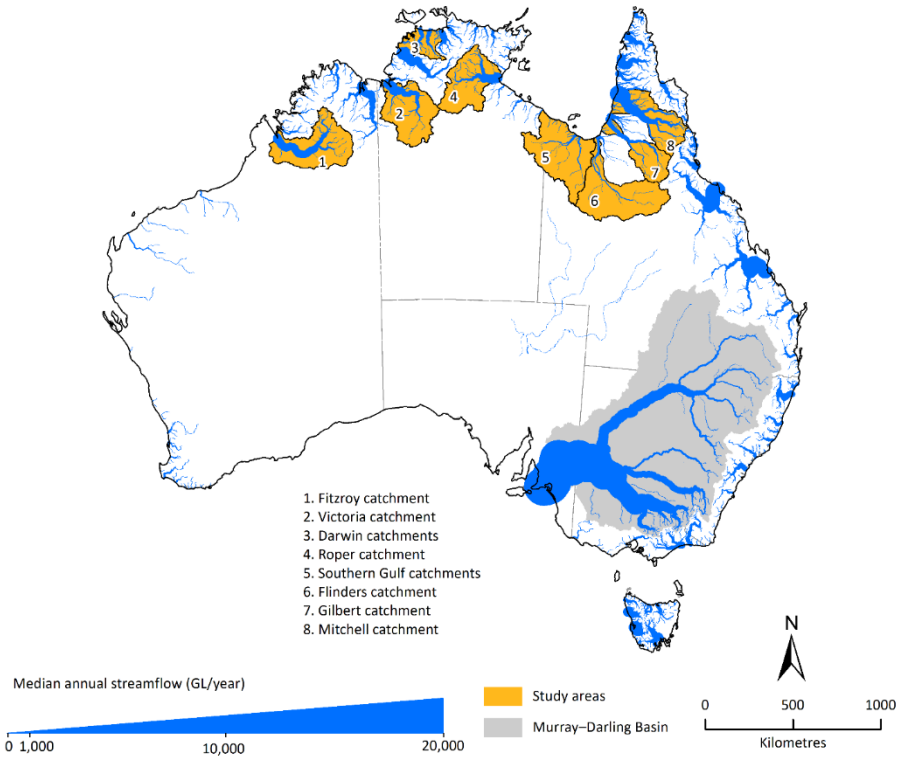

Figure 2. Schematic showing modelled median annual streamflow of Australian catchments (prior to European settlement and development). Study areas shown in orange.

Only one assessment (Darwin catchments) contained a population centre in excess of 20,000. The population density is very low (Table 1) and in all catchments the proportion of the population which is Indigenous exceeds the Australian average of 3.2%. The level of socio-economic disadvantage is high.

Soils mapping and consequent land suitability assessment suggested that between 35% and 76% of each catchment was suitable for growing irrigated Rhodes grass using spray irrigation (Table 1) such as might be fed to cattle on-farm. Note that land suitability does not consider risk of flooding, secondary salinisation, water availability or other factors, it is an upper bound.

The dominant agricultural land use was extensive beef cattle grazing, which occupied between 37% and 95% of the catchments. Almost all cattle grazing occurred on pastoral leasehold land, owned by the Crown. Indigenous-owned freehold land makes up nearly one half of the Northern Territory. In the Victoria and Roper catchments Indigenous freehold was 31% and 45% respectively. While freehold, these lands are held in communal ownership and unlikely to be intensively developed beyond very small scale activities. From a regulatory and legal basis, the extent to which pastoral leasehold land can be intensively developed for cropping is disputed. While diversification is sometimes permitted, the extent to which pastoral land can be used for cropping depends on the jurisdiction and is the subject of recent court cases.

Table 1: Key characteristics of each study area. 'Suitable land' is percentage area for Rhodes grass under spray irrigation (first number) and for cotton under furrow irrigation in the dry season (second number), noting that suitability includes various limitations. References for all study areas are provided below.

Study area, jurisdiction & year released	Area (km^2)	Median annual streamflow (GL/yr)	Population (Indigenous)	Grazing land	Suitable land
Flinders, Qld, 2013	109,000	*1,241	8,952 (19%)	96%	76%, 71%
Gilbert, Qld, 2013	46,000	*2,647	2,948 (37%)	84%	43%, 19%
Fitzroy, WA, 2018	94,000	4,925	7,533 (65%)	95%	58%, 6%
Darwin, NT, 2018	30,000	10,188	139,052 (9%)	37%	43%, 2%
Mitchell, Qld. 2018	72,000	14,237	6,365 (26%)	95%	46%, 18%
Roper, NT, 2024	77,400	4,341	2,500 (73%)	46%	51%, 4%
Victoria, NT, 2024	82,400	5,370	1,600 (75%)	62%	35%, 8%
Southern Gulf, NT & Qld, 2024	108,200	4,961	22,500; (27%)	77%	47%, 17%

* Modelled for the most downstream gauging station. All others modelled for end of system.

The amount of water made available for uses such as irrigated agriculture is a matter for legislation and regulation under the Western Australian, Northern Territory and Queensland governments. Ideally, this is laid out in water resource, or water management plans, but not all catchments are the subject of such plans. Typically, water extraction rules are conservative. Released in February 2024, the NT's 'Surface water take – wet season flow policy' states '*The volume of water available from wet season water flows to consumptive uses will be five per cent of the 25th percentile of total flows for the three highest flow months of the year based on the previous 50 years flow or modelled rainfall data of the river basin …*'. Note that a greater volume of water than this could be made available if it was established in a water allocation plan. In the absence of a water allocation plan, the policy would restrict surface water take in the Victoria catchment to about 2.5% of median annual flow.

Indigenous Traditional Owners were not necessarily averse to water resource development, however they have strong views, consistent across northern Australia, about the nature of that development. Traditional Owners were not in favour of large in-stream dams but could see benefit in small scale surface water capture or use of groundwater to irrigate such things as forages for cattle, or fruit and vegetables for local markets. Typically, they want to be owners, partners, investors and stakeholders in any future development. This reflects their status as the longest-term residents (tens of thousands of years) with deep inter-generational ties to the catchment. In at least one catchment, the Martuwarra (Fitzroy) Elders from independent First Nations groups have formed an alliance to limit the influence of 'extractive industries' (including water resource development) to 'forever economies' (https://martuwarra.org/protect_martuwarra).

While these catchments are not pristine, their low human density and minimal (in global terms) level of development has meant they retain high-value (often iconic) ecological processes, habitats and species. Examples include monsoon vine forest, large numbers of groundwater dependent ecosystems, nationally important wetlands, seagrass habitats, the freshwater sawfish (*Pristis pristis*) the northern river shark (*Glyphis garricki*) and the Rosewood keeled snail (*Ordtrachia septentrionalis*) as well as a number of migratory shorebirds.

Irrigated agriculture was found to be financially viable only if there was an alignment of good prices for high-value produce and market advantages. Other factors include availability of suitable markets for the products, investment in fundamental infrastructure such as all-weather roads, bridges and processing facilities, and land tenure arrangements that support development. Rainfed cropping was determined to be largely opportunistic and depend upon farmers' appetite for risk and the extent to which it could be an adjunct to an irrigation enterprise. Growing forages or hay to feed cattle to be turned off at a younger age was determined unlikely to be financially viable. Feeding irrigated forages or hay increases beef production and total income, but increased costs mean that

gross margins would be less than baseline cattle operations, and the high capital outlay would in most cases be prohibitive.

Discussion

The catchments assessed were not homogenous. Each had different characteristics which provided a range of opportunities and risks. The coincidence of soil and water (within the context of bio-physical and regulatory constraints) could result in irrigated development of less than 2% of the land area across all catchments. That is, the essential rangeland characteristics of these areas would remain into the future, that being; Indigenous held land, land set aside for nature conservation, and land used for extensive beef cattle grazing.

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References

The references below are for the eight catchment reports, which contain references for the technical reports.

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