



## Irrigated and rainfed cropping on northern Australian rangelands

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### Abstract

Over the last quarter of a century a small part of the northern Australian rangelands has been converted to cropping for fodder, fibre and food production. The expansion of cropping onto rangelands has been slow and still is small in percentage terms (0.04 %) when compared to the area of northern Australia (300 million hectares). Much of the cropping area is being used to grow fodder crops, however, cotton, grain sorghum, table grapes, citrus, watermelons, sweet corn, potatoes and vegetables are also being grown. State and Territory governments are encouraging development in cropping and horticulture on rangelands by undertaking research into water and soil resources and funding feasibility studies for development of new regional infrastructure such as cotton gins and water supplies. This paper analyses the changes that are happening, specifically in rangelands, and is based on a broader study that has assessed all cropping, horticulture and plantation forestry across northern Australia in 1999 and 2023 using Sentinel and Landsat imagery as well as other publicly available information. Irrigated cropping, horticulture and sandalwood plantations on northern Australian rangelands occupied 5,393 Ha in 1999 expanding to 17,481 Ha in 2023, a three-fold increase over 24 years, a net annual increase of 504 Ha or an annual compounded growth of 5 %. Rainfed cropping and forestry occupied 11,878 Ha in 1999 expanding to 94,963 Ha in 2023, an eight-fold increase over 24 years, a net annual increase of 3462 Ha or an annual compounded growth of 9 %.

### Introduction

How much of northern Australian rangelands have been converted to cropping? At what rate are the rangelands being converted? Where is the conversion taking place and why? To be able to answer these questions we require land use data. Since 1990, State and Territory agencies have been mapping land use (DAFF 2024) however, this data is a mosaic of mapping products with varying time stamps and resolutions (ABARES 2023). It has, therefore, been impossible to answer the above questions without methodically examining satellite imagery. The objective of the original study was to adjust the publicly available land use data to a consistent time and resolution using satellite imagery and other publicly available information and map the changes that have occurred in cropping, horticulture and forestry on northern Australian rangelands. This rangelands analysis is based on the data collected in the broader study.

## Methods

### Scope

This analysis of fodder, fibre and food cropping was to analyse the expansion of cropping and horticulture onto rangelands in northern Australia (north of the Tropic of Capricorn). This analysis excluded the cropping and horticultural occurring in the Ord River Irrigation Area, Carnarvon Irrigation Area, Skuthorpe, Mataranka, Katherine, Douglas – Daly, Darwin, Gilbert River Agricultural Precinct and Julatten area. We also did not include catchments that drain into Great Barrier Reef lagoon (northeastern Queensland). Results are expressed to at least the secondary level of the Australian Land Use Classification (ABARES 2016) and are expressed in hectares (Ha) of land rather than crop yields or commodity values. For growth or decline in area, annual compounded percentage is used. For absolute change between 1999 and 2023 area is used.

### Method

Land use data was collated from existing mapping undertaken by State and Territory agencies (ABARES and DPIRD 2018; DEPWS 2022; QLUMP 2024) and adjusted with publicly available Sentinel and Landsat satellite imagery from 1999 (Geoscience Australia 2022) and 2023 (Fuqin *et al.* 2019). Cropping or horticulture on rangelands was deemed to be present if it was visible on the satellite imagery at any time during the calendar years 1999 and/or 2023. Cropping or horticulture was not accounted for if it was established after the year 1999 and ceased before the year 2023. Cropping or horticulture that appears abandoned was not included in the data. However, land that appears fallow between crops and the crop can be identified using nearby fields was included. Commodity was confirmed where possible using publicly available data on the world wide web or local knowledge.

## Results

Irrigated and rainfed fodder, fibre and food crops occupied 17,271 Ha in 1999 expanding to 112,368 Ha in 2023. This was a 6.5-fold increase in area or nearly 4000 Ha per year resulting in a compound growth of 8 % per annum. Fodder, broadacre cropping and forestry accounted for the largest percentage of this area. Most of the forestry was restricted to Melville Island as a plantation of *Acacia mangium* for pulp wood.

Irrigated cropping and horticulture occupied 5,393 Ha in 1999 expanding to 17,481 Ha in 2023, a three-fold increase over 24 years, an increase of 504 Ha per year resulting in a compound growth of 5 % per annum. Rainfed cropping occupied 11,878 Ha in 1999 expanding to 94,963 Ha in 2023, an eight-fold increase over 24 years, an increase of 3462 Ha per year resulting in a compound growth of 9 % per annum.

Most of the expansion in irrigated cropping has been to produce fodder such as hay and silage, pasture and forage sorghum. Irrigated horticulture is mostly restricted to single enterprises and has changed little over the 24 years of the study. Most of the expansion in rainfed agriculture has occurred as cropping to produce fodder mostly as forage sorghum (1894 Ha per annum). Expansion in rainfed broadacre cropping has occurred as grain sorghum and cotton (274 Ha per year). Plantation forestry (Mangium) on Melville Island and African mahogany (Daly catchment) are excluded from this summary but results are shown in the Table 1.

Cropping varies between regions and is affected by local drivers. In the Pilbara, water from mine dewatering activities has caused an expansion in irrigated fodder cropping. On the grazing country between the Great Sandy Desert and the Indian Ocean, fodder cropping and horticulture (sweet corn and melons) using groundwater resources was being grown. A single sandalwood plantation exists in the Ord River catchment using water from their own large gully dam. Cotton is establishing in the Daly catchment as well as vegetables and melons. Melons and table grapes are being grown in remote areas of central Australia. Cotton is expanding in the southern Gulf of Carpentaria catchments. Hay is being produced in the northern parts of the Channel Country of Queensland.

Table 1 Area and change in fodder, fibre and food crops on northern Australian rangelands

	<b>Land use / Year</b>	<b>1999</b>	<b>2023</b>	<b>Change</b>	<b>Growth*</b>	
		(Ha)	(Ha)	(Ha)	(%)	
<b>Rainfed</b>	Forage sorghum	n/a	44,724			
	Hay & Silage	2,329	3,038	709	1.1	
	<b>Fodder</b>	<b>2,329</b>	<b>47,762</b>	<b>45,433</b>	<b>13.4</b>	
	Cereals	n/a	5,345			
	Cotton	n/a	4,188			
	<b>Broadacre cropping</b>	<b>3,003</b>	<b>9,577</b>	<b>6,574</b>	<b>5.0</b>	
	<b>Horticulture</b>	<b>5</b>	<b>42</b>	<b>37</b>	<b>9.3</b>	
	African mahogany	n/a	5,768			
	Mangium	5,200	31,766	26,566	7.8	
	<b>Plantation forestry</b>	<b>6,517</b>	<b>37,558</b>	<b>31,041</b>	<b>7.6</b>	
	<b>All fodder, fibre and food</b>	<b>11,878</b>	<b>94,963</b>	<b>83,085</b>	<b>9.0</b>	
	<b>Irrigated</b>	Irrigated pasture	111	1,846	1,735	12.4
		Forage sorghum	n/a	1,219		
Hay & Silage		1,131	4,884	3,753	6.3	
<b>Fodder</b>		<b>1,242</b>	<b>7,949</b>	<b>6,707</b>	<b>8.0</b>	
Cotton		n/a	3,978			
<b>Broadacre cropping</b>		<b>2,129</b>	<b>4,655</b>	<b>2,526</b>	<b>3.3</b>	
Table grapes		2	453	451	25.4	
Orchards**		261	305	44	0.7	
<b>Perennial horticulture</b>		<b>414</b>	<b>797</b>	<b>383</b>	<b>2.8</b>	
Melons		729	732	3	0.0	
Vegetables		327	1,027	700	4.9	
<b>Seasonal horticulture</b>		<b>1,090</b>	<b>1,800</b>	<b>710</b>	<b>2.1</b>	
Sandalwood		n/a	2,121			
<b>Plantation forestry</b>	<b>518</b>	<b>2,130</b>	<b>1,612</b>	<b>6.1</b>		
<b>All fodder, fibre and food</b>	<b>5,393</b>	<b>17,481</b>	<b>12,088</b>	<b>5.0</b>		

\*Compound growth \*\*Including mango, citrus and date plantations

### Discussion

This research provides a more quantitative analysis of fodder, fibre and food cropping on northern Australian rangelands than has been done previously. This study has attempted to adjust / correct / update the available data as far as practical without doing a field survey and thus we believe provides more authoritative information on state and trend currently about fodder, fibre and food cropping on northern Australia rangelands. An ultimate inventory of land use would require a field survey, however, even a field survey can not provide the historical data for 1999. We used Sentinel satellite imagery to confirm land use in 2023, but we were limited by the lower resolution Landsat imagery available for 1999. Because ACLUMP is a multi-agency program with varying levels of implementation of the Australian land use and management classification (ABARES 2016), it is difficult to make a detailed assessment of current state and trends from their data.

Despite much recent interest and activity in northern Australian development, the increase in rainfed and irrigated cropping away from existing schemes and other clusters of development is relatively low in comparison to the area of rangelands as a whole. This is due to several factors including regulatory and legal constraints to land clearing and land use as well as access to water for irrigation. The economic viability of cropping also constrains expansion. Long distances to milling, markets or ports results in high transport costs which need to be offset by higher value crops. Commodity crops, or other crops of low value struggle to be viable. More promise is held for higher value crops or higher value horticulture aimed at supply gaps in southern Australian (or other markets).

What might the next decade or two look like? Two factors may limit increased area. Tighter restrictions on diversification of pastoral leasehold land may limit expansion. Some of the 'low hanging fruit' may have been developed in the past 24 years. By contrast, the construction of two new cotton processing facilities in northern Australia will make cotton production more viable, which may cause rapid increases in the area of (particularly rainfed) cotton.

### Acknowledgements

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