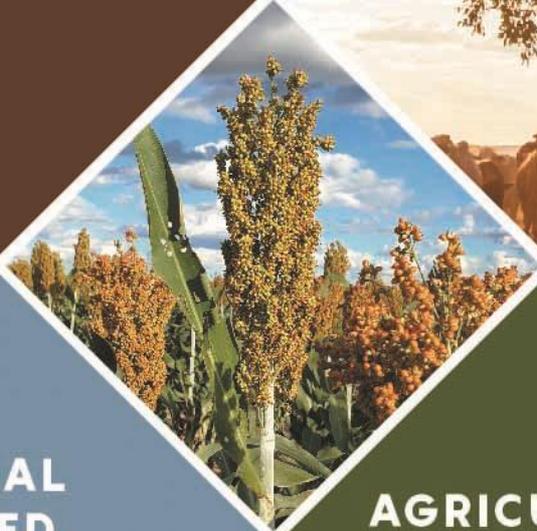


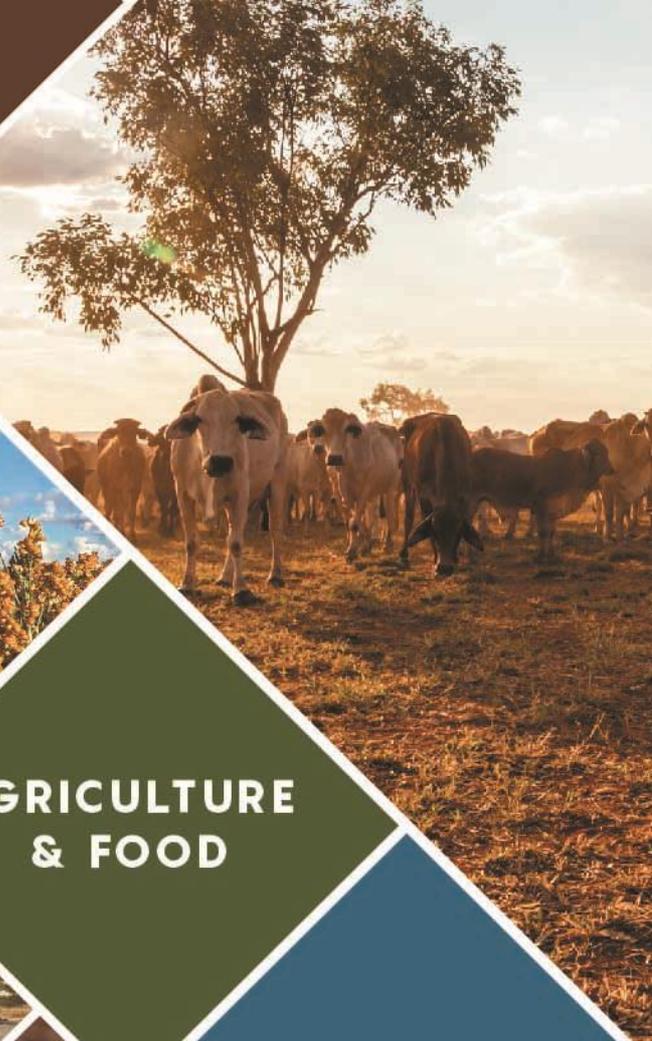
**NORTHERN HEALTH
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**TRADITIONAL
OWNER-LED
DEVELOPMENT**



**AGRICULTURE
& FOOD**



BASELINE STUDY - AGRICULTURAL CAPACITY OF THE INDIGENOUS ESTATE

LEAD AUTHORS:

**RUSSELL BARNETT, ANNA NORMYLE,
BRUCE DORAN AND MICHAEL VARDON**

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The CRCNA recognises the value of knowledge exchange and the importance of objective peer review and is committed to encouraging and supporting its research teams in this regard.

The authors confirm that this document has been reviewed and approved by the Project Steering Committee, independent reviewers and the program's leaders acknowledged on the contributors' page.

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- methodology
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Independent Peer Reviewers

- Dr Cass Hunter: Indigenous Social Ecological Researcher, Coastal Development and Management Program, CSIRO
- Professor Quentin Grafton: UNESCO Chair in Water Economics and Transboundary Water Governance, Crawford School of Public Policy, Australian National University (*pro bono*)

PROJECT PARTNERS

Cooperative Research Centre for Developing Northern Australia (CRCNA)

Indigenous Land and Sea Corporation (ILSC)

Commonwealth Department for Agriculture, Water and the Environment (DAWE)

The Australian National University (ANU)

CONTRIBUTORS

Editor and Authors

- Editor: Russell Barnett, Honorary Associate Professor, First Nations Portfolio, Australian National University
- Authors Synthesis, Chapters 1 and 2: Russell Barnett, Honorary Associate Professor, First Nations Portfolio, Australian National University
- Authors Chapter 3: Dr Bruce Doran, Associate Professor, Fenner School of Environment and Society, College of Science, Australian National University
- Anna Normyle, PhD Student, Fenner School of Environment and Society, College of Science, Australian National University
- Authors Chapter 4: Dr Michael Vardon, Associate Professor, Fenner School of Environment and Society, College of Science, Australian National University
- Anna Normyle, PhD Student, Fenner School of Environment and Society, College of Science, Australian National University

The Project Steering Committee

- Professor Peter Yu: Vice President and Chief Investigator, First Nations Portfolio, Australian National University (Chairperson)
- Dr Chris Bourke: Program Director, Indigenous Science and Engagement, CSIRO
- Ms Amanda Clarke: Program Manager, Physical Environment Accounts and Statistics Branch, Australian Bureau of Statistics
- Professor Saul Cunningham: Director, Fenner School of Environment and Society, Australian National University
- Mr Joe Morrison: Chief Executive Officer, Indigenous Land and Sea Corporation

- Ms Anne-Marie Roberts: First Assistant Secretary (Indigenous Leader) – Strategic Policy and Partnerships, Australian Government Department of Agriculture, Water and the Environment
- Mr Brian Stacey: Professor in Practice, First Nations Portfolio, Australian National University

Other Contributors

- Dr Christopher McDonald: Director, Office of the Strategic Policy Adviser (Indigenous Leader), Commonwealth Department of Agriculture, Water and the Environment; Honorary Associate Professor, First Nations Portfolio, Australian National University
- Mr Michael Davies: Agribusiness Development Manager, Indigenous Land and Sea Corporation

The Australian National University First Nations Portfolio Project Team

- Mr Bruce Gorring: Director, National Indigenous Business Development Hub (Program Lead)
- Ms Camila Leon: Administrative Assistant
- Mr Jacob Ong: Project Officer
- Dr Lorrae McArthur: Senior Project Officer
- Ms Meghan Bergamin: Executive Officer
- Mrs Sheree-Anne James Rozario: Executive Assistant

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Morr Morr Pastoral Company	Ms Letitia Rainbow: Director Ms Fiona Daniel: Senior Client Manager – Accounting and Business Advisory
Noongar Land Enterprise Group	Mr Alan Beattie: Chief Executive Officer
Nyamba Buru Yawuru Limited	Ms Niniella Mills: Chief Executive Officer Mr Scott Downsborough: Interim Chief Financial Officer



TABLE OF CONTENTS

Acknowledgements 1

Disclaimer 1

Peer review statement.....2

Project partners2

Contributors 1

List of Tables7

List of Figures7

List of Graphs8

List of Maps9

Acronyms..... 11

EXECUTIVE SUMMARY 13

SYNTHESIS 14

INTRODUCTION 18

 Australian agriculture, fishing and aquaculture: Australia’s 65,000-year-old industry? 19

 The modern Australian agricultural industry.....21

 The Australian Indigenous Estate29

 First Nations water rights.....33

 The contemporary First Nations agriculture, fishing and aquaculture industries35

 Toward \$100 billion in GVP: what is the role for First Nations agriculture?37

 Purpose of this study.....41

FIRST NATIONS PARTICIPATION IN THE MODERN AUSTRALIAN AGRICULTURE, FISHING AND AQUACULTURE INDUSTRIES43

 The value of agricultural production from the Australian Indigenous Estate.....43

A data deficient environment..... 46

Toward an estimate of the value of agricultural production from the Australian Indigenous Estate 48

 First Nations employment, training and education and small business in the Australian agricultural industry50

First Nations employment in the Australian agricultural industry 50

First Nations training and education in the Australian agricultural industry 51

First Nations small business in the Australian agricultural industry 51

 The size and dimensions of modern First Nations agriculture, fisheries and aquaculture sector: a sample analysis52



<i>Size of the Australian First Nations agriculture, fisheries and aquaculture sector</i>	52
<i>Dimensions of the Australian First Nations agriculture, fisheries and aquaculture sector</i>	53
The dimensions of modern First Nations agriculture, fisheries and aquaculture enterprise: case study analysis	56
GIS ANALYSIS: A BASELINE ASSESSMENT OF AGRICULTURAL SUITABILITY AND PRODUCTION FACTORS ACROSS THE INDIGENOUS ESTATE	68
Methods	68
<i>Definitions and context</i>	68
<i>Modelling approach</i>	69
GIS Study Objectives	74
Data Processing	75
<i>Creation of baseline datasets</i>	75
<i>Mapping of biocultural assets</i>	76
<i>Agricultural scenario modelling</i>	76
<i>Dashboard visualisation</i>	77
<i>Caveats on analysis</i>	78
Results	79
<i>Baseline National Datasets</i>	79
<i>Biocultural influence models</i>	82
<i>Regional agricultural suitability</i>	85
<i>Multi-Objective Land Use Allocation Scenarios</i>	86
<i>Power BI Dashboard Visualisation</i>	87
<i>A proposal for strategic regional GIS assessments involving Traditional Owners</i>	90
Summary and key recommendations	92
<i>Purpose and nature of GIS analysis</i>	92
<i>Key findings and interpretations</i>	93
<i>Baseline datasets and Power BI dashboard</i>	93
<i>Recommendation for strategic assessments directly involving Traditional Owners</i>	93
ACTIVATING THE INDIGENOUS ESTATE: NATURAL CAPITAL ACCOUNTING	95
Background	95
<i>System of Environmental-Economic Accounting (SEEA)</i>	96
<i>Objectives</i>	100
SEEA and Indigenous values	100
Data sources and methods for account production	101
<i>Defining and selecting the accounting areas</i>	102
<i>Account selection</i>	104



<i>Data processing</i>	107
<i>Systematic review</i>	107
Results.....	108
<i>Land cover extent account</i>	108
<i>Land cover condition account</i>	115
<i>Land use account</i>	118
<i>Supply of agricultural commodities</i>	122
<i>Systematic review</i>	124
Discussion	125
<i>Limits of data</i>	126
Conclusion.....	127
STRATEGIC RECOMMENDATIONS AND PATHWAYS	128
References	130
Appendices.....	139
<i>Appendix 1 – Sample of First Nations Primary Production Enterprises</i>	139
<i>Appendix 2 – GIS Supplementary Data</i>	156
<i>Appendix 3 – Natural Capital Accounting Supplementary Data</i>	159



List of Tables

Table 1 – National Farmers’ Federation \$100 billion by 2030 Roadmap and Australian Government Ag2030 policy platform (source: NFF 2018; DAWE 2020, 2021, 2022).....	38
Table 2 – National Farmers’ Federation \$100 billion by 2030 Roadmap and First Nations Agriculture (source: NFF 2018).....	40
Table 3 – Ag2030 and First Nations Agriculture (source: DAWE 2020, 2021, 2022)	41
Table 4 – Indigenous Land and Sea Corporation Involvement in the First Nations Agricultural industry	56
Table 5 – Summary of the case studies investigated by McArthur et al. 2022.	58
Table 6 – Research papers based on GIS multi-criteria methods for land suitability evaluation (source: adapted from Kahsay et al. 2018).....	72
Table 7 – Indicative importance rankings for land-use scenario models.	77
Table 8 – Saaty’s (1980) Pairwise ranking matrix.....	91
Table 9 – Datasets used for accounts.....	105
Table 10 – Land cover accounts, Australia’s Indigenous Estate, 2016–2020	113
Table 11– Condition account for vegetation land cover in Indigenous Estate, 2020	115

List of Figures

Figure 1 - Generic representation of an index model (adapted from Chang 2019).	69
Figure 2 – Flow chart of modelling stages and outputs.	75
Figure 3 – Dashboard interface in Power BI. Filters show key outputs for different native title areas, in Gkuthaarn and Kukatj People, and Rubibi Community in Queensland. The dashboard can be explored live at: https://cutt.ly/ASA0522	89
Figure 4– A proposed model for stakeholder-based strategic regional assessments of agricultural suitability (source: adapted from Musakwa 2018).	92
Figure 5 – Conceptual model of SEEA Ecosystem Accounting. Source: SEEA Ecosystem Accounting (United Nations 2021)	98
Figure 6 – Conceptual model of ecosystem accounting for Indigenous people	101



List of Graphs

Graph 1 – Value of Australian agricultural production by commodities (2019–2020) (source: ABS 2021)	22
Graph 2 – Value of Australian agricultural production by state and territory (2019–2020) (source: ABS, 2021)	25
Graph 3 – Australian fisheries and aquaculture production by state and territory (2019–2020) (source: ABARES 2021a)	27
Graph 4 – Total value of Australian wild catch fisheries, by sector (2019–2020) (source: ABARES, 2021a)	28
Graph 5 – Australian aquaculture production by sector (2019–2020) (ABARES 2021a)	29
Graph 6 – Portion of Australian First Nations workforce working in sectors of the Australian agricultural industry (source: ABS 2017b)	50
Graph 7 – Geographical distribution of the sample agricultural lands, by area	54
Graph 8 – Number of First Nations enterprises operating - by sector	54
Graph 9 – First Nations agriculture businesses – by sector and state	55
Graph 10 – 2022 land cover extent for the identified Indigenous Estate	110
Graph 11 – 2020 land cover extent data for the Indigenous Estate areas in the Rangelands, Northern Territory and Cape York NRMRS	111
Graph 12 – Mean condition scores for vegetation within the Indigenous Estate in the year 2020	116
Graph 13 – 2020 land use data for the identified Indigenous Estate	120
Graph 14 – Comparative land use for the Indigenous Estate for the Rangelands, Northern Territory and Cape York NRMRS	121
Graph 15 – Agricultural production value per square kilometre for financial year 2016–2017 to 2019–2020	123
Graph 16 – Agricultural production values per commodity, Rangelands, Northern Territory and Cape York NRMRS, 2019–2020	123
Graph 17 – Percentage area of the Indigenous Estate by the value of agricultural production (\$/ha) for all NRMRS	124



List of Maps

Map 1 – Australian agricultural land use (source: ABARES 2021a)	24
Map 2 (A), (B), (C) and (D) – The geographical extent of different forms of First Nations Tenure that define the Indigenous Estate (source: Jacobsen, Howell & Read 2020; NNTT 2022; Deloitte Access Economics 2021)	32
Map 3 (A) and (B) – The First Nations Estate derived by this study: (A) by recognised rights and (B) cumulative First Nations Estate	33
Map 4 – Indigenous Estate and Pastoral Leases (source: ABARES 2021b)	44
Map 5 – Indigenous Owned Pastoral Leases – Western Australia (source: DPIRD 2019)	45
Map 6 – Murray Darling Basin (source: MDBA 2022)	49
Map 7 – Geographical distribution of the Aboriginal and Torres Strait Islander (A) and Australian agricultural workforce (B), 2016 (source: ABARES 2019b)	51
Map 8 – General location of the five case studies	57
Map 9 - A national model of suitable site for cropland development in Mongolia (source: Otgonbayar et al. 2017: 256)	70
Map 10 - Sample maps of the baseline datasets incorporated in the analysis	82
Map 11 - Biocultural models for vegetation, water, climate, soil and access influences to agricultural suitability across the Indigenous Estate. The red to green colour gradient provides an indication of the relative 'low to high' suitability for agricultural development.	83
Map 12 - Areas of the Indigenous Estate identified as 'most suitable' for agriculture based on the combined influence models.	84
Map 13 – Agricultural suitability scenarios for pastoralism, carbon farming and cropping development across Indigenous Estate areas within three northern-Australian Aboriginal Land Councils	85
Map 14 - Example weighted MOLA scenarios for pastoralism, carbon farming and cropping (rainfed and irrigated) for (A) exclusive native title and owned; and (B) non-exclusive native title and managed areas of the Kimberley Land Council.	86
Map 15 – Map of accounting areas	104
Map 16 - Map of 2020 land cover extent across the identified Indigenous Estate	109
Map 17 – Relative condition for agriculture score by NRMR. Red indicates low condition, yellow is moderate and green indicates high condition. The condition scores are based on water, climate, vegetation, soil and access indicators and are not seasonally adjusted	117
Map 18 – Map of land use for the Indigenous Estate in 2020	118
Map 19 – Portion of each NRMR that is part of the Indigenous Estate	119



Map 20 – Relative value of agricultural production in 2019–2020 by NRMR. Note that values are adjusted by the NRMR area used for agricultural production..... 122



Acronyms

ABARES	Australian Bureau of Agricultural and Resources Economics and Sciences
ABS	Australian Bureau of Statistics
AHP	Analytical Hierarchical Process
ALUM	Australian Land Use and Management
ANU	Australian National University
ATSIC	Aboriginal and Torres Strait Islander Commission
BoM	Bureau of Meteorology
CABEE	Counts of Australian Businesses including Entries and Exits
CLC	Central Land Council
CLUM	Catchment scale land use of Australia (data package)
CRCNA	Cooperative Research Centre for Developing Northern Australia
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CYLC	Cape York Land Council
DAWE	Commonwealth Department for Agriculture, Water and the Environment
DEA	Digital Earth Australia
DPIRD	Western Australia's Department of Primary Industries and Regional Development
ESG	Environmental, Social and Governance (investment factors)
GIS	Geographic Information System
GST	Goods and Services Tax
GVP	Gross Value of Product
ILSC	Indigenous Land and Sea Corporation
ILUA	Indigenous Land Use Agreement
IPA	Indigenous Protected Area
KLC	Kimberley Land Council
MODIS	Moderate Resolution Imaging Spectroradiometer



MOLA	Multi-Objective Land Use Allocation
NBY	Nyamba Buru Yawuru Limited
NCA	Natural Capital Accounting
NDVI	Normalised Difference Vegetation Index
NDWI	Normalised Difference Water Index
NFF	National Farmers' Federation
NNTT	National Native Title Tribunal
NPP	Net Primary Productivity
NRMR	Natural Resource Management Region
NWI	National Water Initiative
PBC	Prescribed Body Corporate
PGIS	Participatory GIS
RATSIB	Representative Aboriginal/Torres Strait Islander Body
SEEA	System of Environmental-Economic Accounting
TEK	Traditional Ecological Knowledge
WLC	Weighted Linear Combination



EXECUTIVE SUMMARY

The Australian National University's (ANU) First Nations Portfolio partnered with the Cooperative Research Centre for Developing Northern Australia (CRCNA), Indigenous Land and Sea Corporation (ILSC), and the Commonwealth Department for Agriculture, Water and the Environment (DAWE) to prepare a situational analysis of the Indigenous primary industries, with the main focus being on the agricultural sector.

The purpose of the situational analysis is to attain a better understanding of the relationship between First Nations primary production enterprises and the larger Australian primary industries, focusing primarily on agriculture.

The study identifies that:

- While a significant amount of primary production occurs on the First Nations Estate, a significant majority of this is not undertaken by First Nations primary production enterprises;
- There is still a relatively small, but emerging and unique First Nations primary production industry that is diverse, increasingly financially sustainable, and delivering significant cultural, environmental and social benefits to local First Nations communities; and
- There is opportunity to grow the First Nations primary production industry so that it makes a significant and unique contribution to the growth targets of Australian primary industries – beyond what the agricultural industry or the Australian Government have contemplated.

To achieve this mutually beneficial outcome for Australia's First Nations people and their agricultural industry, a concerted effort needs to be made to better understand: the nature and extent of agricultural production that takes place on the Indigenous Estate; the nature and extent of the First Nations primary production industry; opportunities to accelerate First Nations agricultural capability development; and, attraction of social impact and other Environmental, Social and Governance (ESG) oriented investment to the emerging sector. This effort needs to be overseen and driven by a multi-stakeholder, mission-oriented industry development governance framework.

SYNTHESIS

Russell Barnett, Honorary Associate Professor, First Nations Portfolio, Australian National University

Fisheries, aquaculture and particularly agriculture are industries of vital importance to Australia from an economic, strategic and social perspective. They produce goods with a gross value of A\$64 billion, employ 245,000 people, (ABS 2021; ABARES 2021a) provide food security for the Nation and underpin much of the social fabric of regional Australia. With a growing global population, and particularly a growing middle class, there is also much opportunity for growth in these important Australian primary industries.

Academic contention continues with respect to the extent to which, prior to colonisation, First Nations Australians were engaged not only in hunting and gathering, but also in food production systems more akin to agriculture. Regardless, it is increasingly apparent that there is an important role for the emerging modern First Nations agricultural and fishing sectors to play in the mainstream Australian primary industries, whereby Traditional Ecological Knowledge (TEK) is used to underpin unique and valuable production systems. TEK can be applied both on its own and in conjunction with conventional primary production methods to achieve a range of outcomes, including the production of new products for new markets and enhancement of the Australian primary industry's ESG credentials; an issue that will become increasingly important for accessing both product and financial markets.

The extent of the Australian Indigenous Estate and the strong synergies between primary industries and the economic aspirations of Australia's First peoples, combined with the trajectory of Australian jurisprudence pertaining to the economic rights of First Nations, underpins a pathway for further development of the sector. However, the industry development plans of both the National Farmers' Federation (NFF) and the Australian Government give very little credence to the contribution the First Nations sector can make in helping Australian primary industries reach their growth targets. This is likely, at least partly, the result of historical tensions between First Nations Australians and the agricultural industry that has a legacy of 230 years and has been the subject of a significant amount of the aforementioned jurisprudence.

This study demonstrates that the nature and structure of relevant data that is maintained by the Australian Bureau of Statistics (ABS) and Australian Bureau of

Agricultural and Resources Economics and Science (ABARES) does not facilitate accurate quantification of the value of agricultural production that is derived from the Indigenous Estate or the value of production that is produced from Indigenous primary production enterprises. A very rudimentary analysis undertaken by this study suggests that: the total value of primary production derived from the Indigenous Estate is unlikely to exceed 50% of the total of Australian agricultural Gross Value of Product (GVP); and, that the vast majority of production that takes place on the Indigenous Estate does not benefit First Nations people.

Despite this, the study clearly identifies an emerging modern First Nations agricultural sector, whereby there are at least 95 First Nations primary production businesses, operating on 8.1 million hectares of land in every state and the Northern Territory of Australia (equivalent to 2% of the Australian agricultural estate). Predominately, these businesses operate in the northern beef industry (38 operations) and southern beef industry (14 operations), with aquaculture and fishing accounting for around seven operations and traditional produce, five operations. Variably, these enterprises deploy conventional primary production practice, are based exclusively on the application of TEK or deploy hybrid models that endeavour to produce economic surplus as well as other environmental, social and cultural benefits.

Additionally, ABS Census data indicates that, in 2016, there were approximately 600 First Nations owner-manager businesses operating in the agricultural sector (primary producers and service providers) and 4,600 First Nations people employed in Australian primary industries.

A deeper case study-based analysis of a smaller sample of First Nations primary production enterprises illustrates these common characteristics:

- A technical, commercial and governance capability-building exercise that can be decadal in nature is typical among First Nations primary industries businesses.
- First Nations primary production businesses are commercial in nature, seeking to optimise sustainable natural resource usage, achieve financial viability and profitability and are executing diversification and expansion plans.
- Social dividends for local First Nations communities are a critical component of First Nations primary industries business models.
- Preserving culture and caring for Country are critical components of First Nations primary industries business models.



- Governance frameworks based on holding-subsidary company models that provide appropriate cultural and community oversight, whilst separating operational management of the primary production enterprise are commonplace among First Nations primary industries businesses and appear to be a tried-and-tested model.
- First Nations organisations collaborate extensively with each other in primary industries.
- The ILSC has been an important resource for establishing and supporting many First Nations primary production enterprises.
- A range of other Commonwealth, state and territory agencies and instrumentalities provide financial, research and advisory services to First Nations primary production businesses.
- To date, there appears to have been very little private capital invested in First Nations primary production businesses, potentially creating an opportunity to attract greater social impact and other ESG-oriented investment to the sector.

A spatial analysis, mainly using Geographic Information System methods, known as Weighted Linear Combination and Multi-Criteria Decision Analysis, has been used in the study to model the spatial distribution of agricultural suitability across the Indigenous Estate. These methods have been used extensively across the globe for identifying agricultural and other land use potential. This GIS analysis uses data inputs from vegetation, climate, water, soil and infrastructure elements and indicates high agricultural potential across many areas of the Australian Indigenous Estate, particularly along the Northern Australian coastline and western Queensland. However, it also indicates that much of the Estate that is First Nations owned, or the subject of exclusive native title, has fewer areas of suitability when compared with areas of shared tenure.

The study has also explored the potential application of natural capital accounting to the Indigenous Estate in order to quantify ecosystems services associated with that estate and the impact of activities, including First Nations agriculture, on ecosystems services. This analysis used the recognised United Nations developed framework known as the System of Environmental-Economic Accounting (SEEA) that is utilised by around 100 nations world-wide, including Australia. This work has identified that this can be used to better reflect First Nations values in land, identify areas suitable for

agricultural development and to support evidence of ESG for the purposes of market access and private capital attraction.

While the study has not been able to accurately estimate either the value of primary production that takes place on the Indigenous Estate or the value of primary production that is produced from First Nations agricultural enterprises, it has identified:

- a geographically dispersed emerging, modern, First Nations primary production sector that operates across most sectors of the Australian agricultural industry, whereby established enterprises are financially sustainable and delivering significant cultural, environmental and social dividends; and,
- there is potential to improve agricultural productivity within the exclusive Indigenous Estate, and in areas of the Indigenous Estate that are characterised by co-existing tenure, there is opportunity to enhance the ESG credentials of Australia's primary industries more broadly through mutually beneficial production models.

Supporting the growth of the emerging First Nations agricultural sector in this regard will result in new products and new markets, improve the ESG credentials of the industry, and underpin export and financial market access for other Australian primary industries.

In addition to addressing the obvious dearth of data for measuring and monitoring primary production from the Indigenous Estate and the performance of the First Nations primary production sectors, this study recommends a governance framework and a set of initiatives designed to ensure that the First Nations primary production sector makes a significant contribution to national industry growth targets.



INTRODUCTION

Russell Barnett, Honorary Associate Professor, First Nations Portfolio, Australian National University

This study has been undertaken to provide an improved understanding of the intersection between Australia's First Nations ('Indigenous') peoples and the key Australian primary industries of agriculture and, to a lesser extent, fisheries and aquaculture¹. The study achieves this by: articulating the extent to which the primary production assets of these industries intersect with First Nations people's legal interests and rights in land and water estates; the nature and extent of involvement of Australian First Nations people's in agricultural, fisheries and aquaculture primary production; and, the potential for greater involvement of First Nations interests in the agriculture, fisheries and aquaculture industries through both activating unproductive areas of the exclusive Indigenous Estate and mutually beneficial, symbiotic collaboration in instances of shared tenure.

This study acknowledges that there are also First Nations interests in the other main sector of Australian primary industries, forestry and timber products. However, given the relatively small contribution of the primary forestry production operations to total primary industries GVP, together with challenges associated with accessing adequately detailed data, forestry has not been included in this analysis. However, it is identified as an area for future investigation.

A key intent of this study is to provide a basis for shifting a dialogue that, in far too many instances, revolves around First Nations legal interests in land and water being a barrier to primary production, to being one that revolves around opportunities for modern First Nations primary industries to work with mainstream industry and government to help achieve national primary industry growth objectives as espoused by the agricultural industry's peak body, the NFF (NFF 2018) and the Australian Government (DAWE 2020, 2021, 2022).

¹ While the study discusses aquaculture and fishing interests, it focuses on sectors of Australia's agricultural industry. The study excludes the forestry industry.

Australian agriculture, fishing and aquaculture: Australia's 65,000-year-old industry?

The trend toward urbanisation in Australia (Hiller, Melotte & Hiller 2013) has resulted in fewer Australians having frequent visibility of the Nation's, mainly regionally located, primary production industries. Regardless, the common conceptualisation of agriculture is one of operational models that involve the modification of landscapes and use of various technology and inputs such as fertilisers and supplementary feeding to improve productivity in the production of primarily introduced species as food or, as inputs to the manufacturing of food products. This conceptualisation includes all forms of modern-day horticulture, broadacre cropping, intensive and extensive livestock and mixed farming operations across Australia.

Aquaculture in Australia adopts numerous forms including land-based pond and recirculation systems and marine-based cage, *purse seine* and ranching operations that produce a variety of native and introduced finfish, crustacean, mollusc and other species. These production models also variably rely on substantially modified production environments, technology and inputs including manufactured feeds and animal health treatments. By its nature, wild-catch fishing does not seek to modify or control production environments, but uses technology to locate and prosecute a catch with optimal productivity.

Continual improvement in the productivity and environmental sustainability of these systems of primary production has and will continue to be of vital importance to feeding the world's growing population. Supported by a long-standing industry-government research, development and marketing co-investment framework (Agtrans Research 2019), the Australian primary industries have and will continue to play a significant role in this function, with just under three-quarters of domestic production export bound (ABARES 2022) where it is competitive in a range of particularly higher value food and fibre markets.

For much of the past 250 years, there has been a widespread understanding that pre-British settlement Indigenous society in Australia revolved around a purely nomadic culture, whereby peoples wandered the Australian wilderness, foraging for edible vegetation and hunting wild animals. Anthropologists have promoted a different understanding based on evidence that Indigenous society was based on a more complex hunting and gathering economy that included the active management of natural resources.

Through systems of inter-generational knowledge transfer that underpin the World's longest continually practised culture, First Nations Australians are acutely aware of the methods through which their ancestors deployed TEK to improve the productivity of harvesting natural resources for the purposes of food production. Such practices are understood to have included: modifying landscapes to create natural pastures that attracted animals to areas where they could be more productively harvested burning landscapes to encourage regeneration of vegetation and, forming fish trapping systems (Gammage 2012; Pascoe 2018). In the absence of manufactured inputs such as fertilisers, animals suited to domestication, and mechanised equipment, these practices were arguably the most effective means of optimising food production from much of Australia's natural agronomic conditions. This is particularly so in the context of Australia's uniquely high proportion of nutrient-deficient soils (Thompson & Leishman 2004).

The precise nature and extent of these traditional systems of food production is a matter of some conjecture (Keen 2021; Sutton & Walshe 2021). It is beyond the scope of this paper to address this disparity in detail, other than to say that, regardless of the specific nature of traditional food production practices the modern First Nations agriculture, fisheries and aquaculture sector is clearly demonstrating that TEK can be applied on its own and in conjunction with conventional primary production methods to achieve positive outcomes including the production of new products for new markets and enhancement of the ESG credentials, an issue that will become increasingly important for accessing both product and financial markets.

The establishment of the seven Australian British colonies—New South Wales (1788), Van Diemen's Land (1803), South Australia (1834), Swan River Colony (1829), Victoria (1851), Queensland (1859) and, for a very short time, North Australia (1846)—marked the end of the traditional food production systems that had been developed for 65,000 years by First Nations Australians. Colonial governments exercised what they understood to be British sovereignty by claiming Australian First Nations land in the name of the Crown, and then used these forcibly acquired lands to provide released convicts and new settlers with land grants. Thus, the traditional lands that had supported the First Nations food production systems for at least 65,000 years were progressively, and in many areas rapidly, replaced by European-centric agricultural production systems. In the southern half of the continent this was characterised primarily by large-scale land clearing for the purpose of producing introduced crops

and ruminant species, and in the northern half, primarily by the introduction of ruminant species to the environment to graze on natural pastures. In many instances, agricultural production across the Nation has been supported by substantive surface and subsurface water diversions.

While aquaculture was not a widely used production system at the time, commercial fisheries increasingly prevented First Nations people from accessing fish resources which were of vital importance to their subsistence, trade and culture.

The transition of much of the south eastern and south western areas of Australia to broadacre and intensive livestock and crop production, introduction of pastoral grazing to northern Australia and altered waterways in areas like the Murray Darling Basin and Ord River regions to support irrigation that occurred primarily over the course of the 19th and early 20th century resulted in not only an end to traditional systems of food production in many parts of Australia, but established the context for a significant element of early First Nations – Settler relations.

The forced acquisition by colonial governments and subsequent occupation of those lands by settlers and released convicts was in many instances characterised by forced removal and relocation, slavery, incarceration and state-tolerated and sanctioned massacres of First Nations Australians. However, in the context of the relationship between the Australian colonies (and subsequently the Nation) and Australia's First Peoples at the time, the relationship between settler agriculturalists and local First Nations people across many regions of Australia entered a relatively harmonious phase, whereby in exchange for employment, albeit on very discriminatory terms, agricultural employers frequently allowed First Nations people to live and practice culture on their traditional lands, now the legal possession of the settler. This situation continued until the late 1960s when, as the result of organised industrial action by First Nations workers over the course of 30 years, including Skull Spring (1942–1946) and Wave Hill (1967), the Australian Conciliation and Arbitration Commission finally put into force equal pay regulation. While obviously just, this act resulted in redundancy of First Nations agricultural workers and contributed to what has become known as the Aboriginal Welfare Crisis.

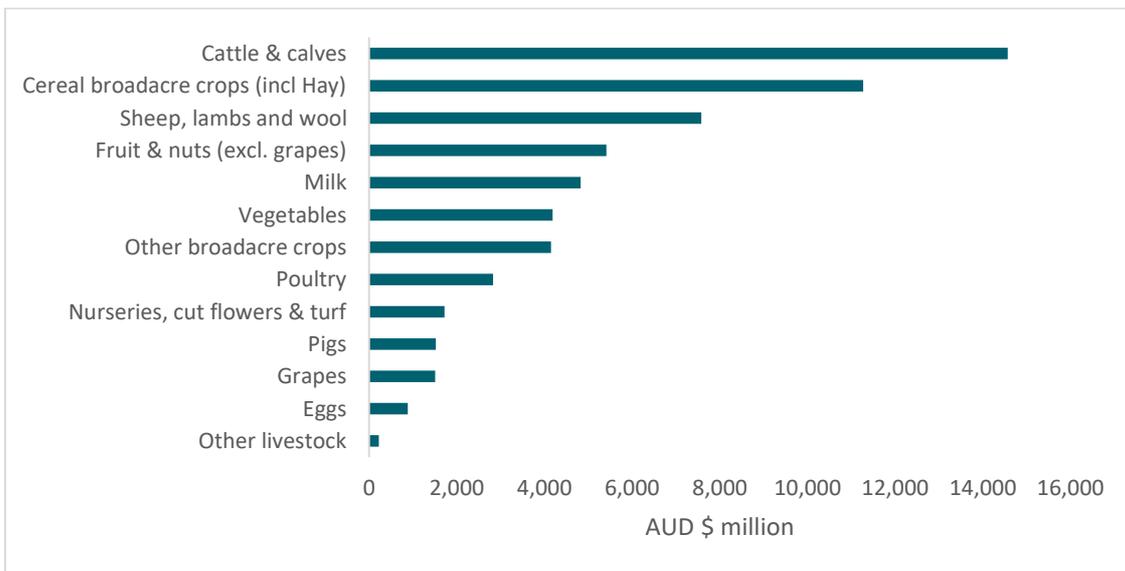
The modern Australian agricultural industry

Today, Australia's westernised agriculture, fisheries and aquaculture industries are a key component of the national economy. With Australian's importing only 11% of their

food requirements (ABARES 2020), agriculture in particular is by far the principal supplier of domestic consumption and with a vast majority of imports derived from demand for tastes and variety, provides the nation with food security.

Collectively, the agriculture, fisheries and aquaculture industries produce product with a gross value of approximately A\$63.6 billion and employ approximately 245,000 people, representing approximately 2% of Australia’s workforce (ABS 2021; ABARES 2021a).

The sectors of the agricultural industry produce 95% of this total gross value and employ 93% of the workforce. Overall, the relatively homogenous and common broadacre and intensive and extensive pastoral farming systems that variably produce beef cattle, cereal and non-cereal broadacre crops, sheep and sheep-derived products and dairy products account for 70% of agricultural GVP (ABS 2021). The sector contributions to Australian agricultural GVP are illustrated in Graph 1 (ABS 2021) below.



Graph 1 – Value of Australian agricultural production by commodities (2019–2020) (source: ABS 2021)

Combined, cereal and non-cereal cropping are the largest sector of the Australian agricultural industry, accounting for 26% of Australian agricultural GVP.

Cereal broadacre crops (including hay which is produced from non-cereal but, primarily cereal crops) is by far the largest sector of cropping and is the second largest sector of the Australian agricultural industry, accounting for 18.6% of the value of Australian

agricultural production in 2019–2020. The eastern grain belt and irrigated lands of the Murray Darling Basin across New South Wales and Victoria accounted for 44.3% of cereal crop production, with Western Australia, and almost exclusively the grain belt region in south-west Western Australia, accounting for a further 36.1% of cereal crop production in 2019–2020. With the inclusion of South Australia’s and Tasmania’s cereal crop production, approximately 95% of cereal crop production occurs in the southern half of the Australian continent.

Other broadacre crops including canola, oilseed, chickpea and other pulse and legume production accounted for 6.9% of Australian agriculture GVP. While there is greater geographic distribution of non-cereal cropping, with Queensland, accounting for 32.4% of the value of non-cereal crop production in 2019–2020, a majority (approximately 65%) of non-cereal crop production still occurs in the southern half of the continent: Western Australia, and primarily the Western Australian Grainbelt (20%), South Australia (19.3%), Victoria (16.3%) and New South Wales (10.8%).

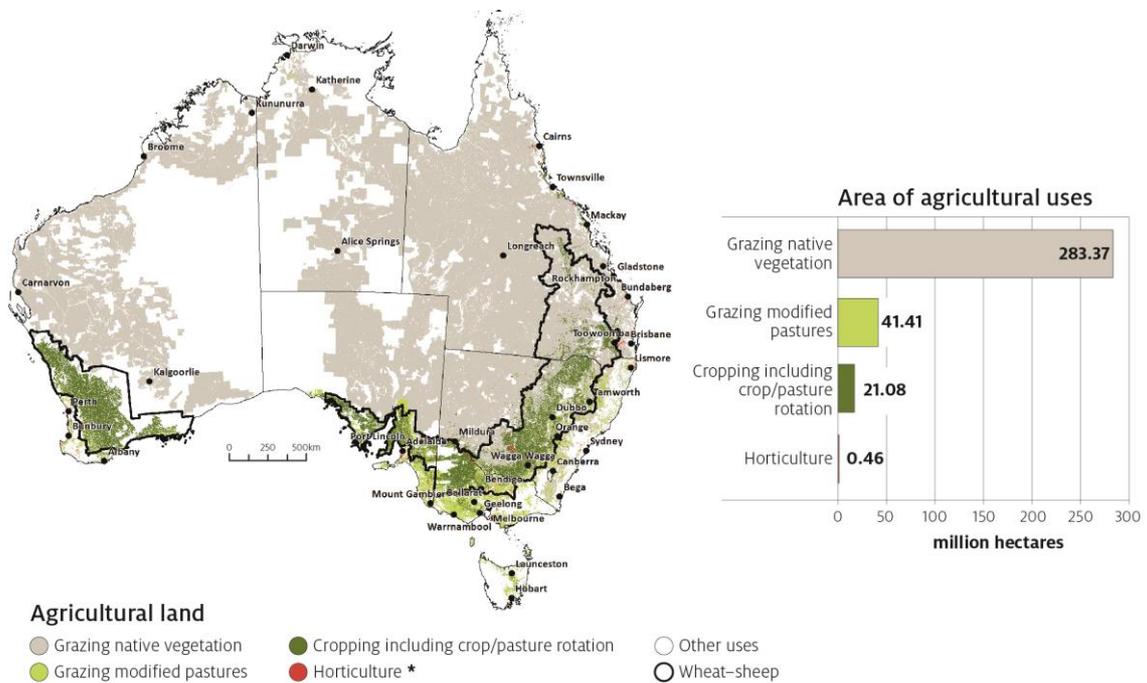
The beef industry is the largest single agricultural sector. Cattle and calf slaughter accounted for 24.1% of the value of Australian agricultural production in 2019–2020. Beef cattle derived from both *Bos taurus* and *Bos indicus* genetics are produced across Australia from a range of production systems including broadacre and intensive pastoral systems in the south, as well as extensive grazing operations in the north servicing a downstream supply chain of backgrounding, live export, feedlotting, meat works and cold chain domestic market and export infrastructure. Approximately 45% of beef production occurs in Queensland, which is also home to a majority of feedlot and abattoir operations, with an additional 40% of beef production taking place across New South Wales and Victoria.

The sheep meat and wool sector is the second largest livestock sector. It accounted for 12.5% of the value of Australian agricultural production in 2019–2020. While rangelands production of sheep occurs in Australia, most lamb and wool is produced from rotational broadacre farming systems in the nation’s grain-producing regions, and on more intensive specialist livestock production systems located primarily in high rainfall regions in the southern areas of the continent. Victoria accounted for 39.4% of the value of sheep and wool production, with New South Wales and Western Australia collectively accounting for 45.6% of sheep and wool production.

Fruit and nut production is concentrated in New South Wales, Victoria and Queensland, with 77.6% of production undertaken in those three states. In the case of

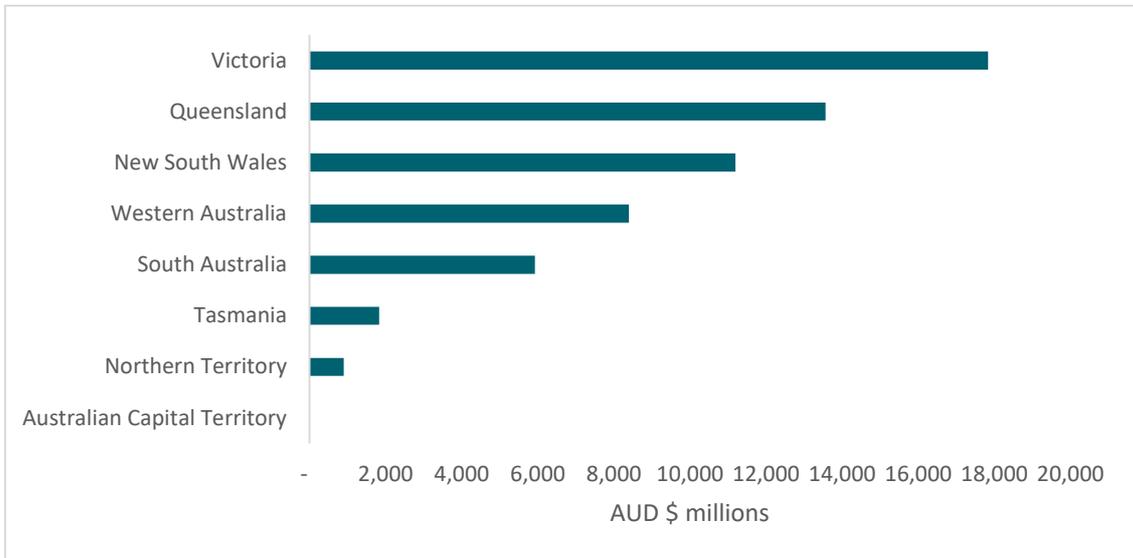
dairy production, 62.4% of milk was produced in Victoria and 23.9% in New South Wales and Tasmania combined. Most (51.7%) vegetables are produced in Victoria and Queensland, with New South Wales, South Australia, Western Australia and Tasmania accounting for 39.2%. Poultry and egg production, as well as nursery operations, are heavily concentrated in Victoria, New South Wales and Queensland. Just under 70% of pork production occurs in Victoria, Queensland and South Australia. Grape production is concentrated in South Australia, Victoria and New South Wales with just over 90% produced from those three states.

The majority of production from these key sectors occurs in the ‘sheep-wheat zone’ in the south-west and south-east of the Australian continent under typically crop-pasture rotational farming systems, grazing operations using modified pastures and/or irrigated lands. With the exception of relatively small irrigation areas, the vast majority of the remaining agricultural estate in Australia is the subject of extensive, primarily beef, grazing operations. This is illustrated in Map 1 (ABARES 2021a).



Map 1 – Australian agricultural land use (source: ABARES 2021a)

As a result of this national production profile, Victoria accounts for a third (33.3%) of the value of Australia’s agricultural production, followed by Queensland (22.7%), New South Wales (18.8%) and Western Australia (14.1%). The contributions of each state to Australian agricultural GVP are summarised in Graph 2 (ABS 2021).



Graph 2 – Value of Australian agricultural production by state and territory (2019–2020) (source: ABS, 2021)

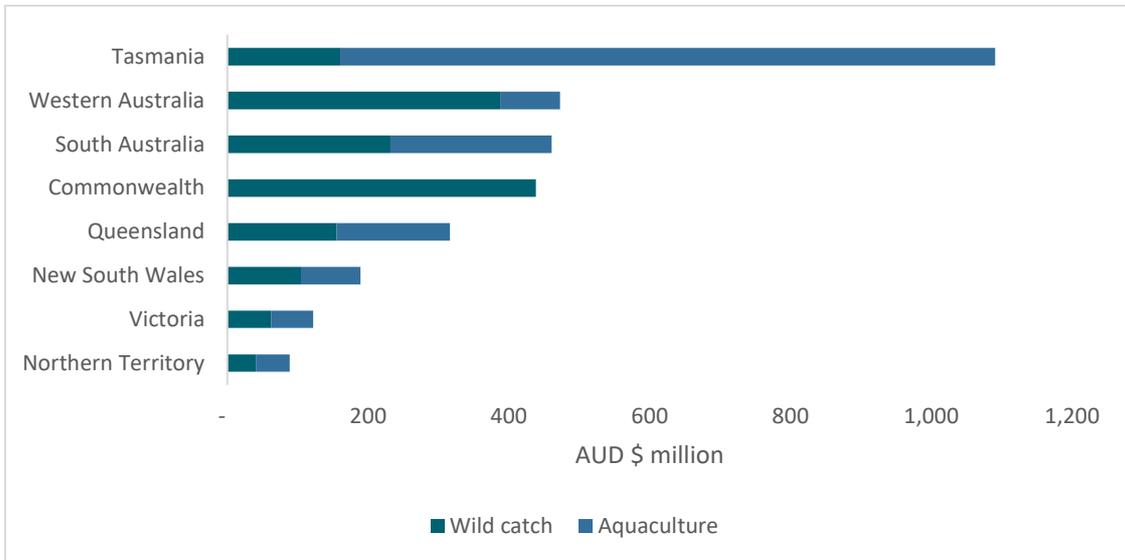
Understanding the relative concentration of agricultural GVP in the southern areas of the country (and primarily in the sheep-wheat zones and high rainfall areas of south-western and south-eastern Australia) is contextually important for this study, because as discussed later in this section, the relative area of Indigenous Estate in the southern half of the Australian continent, particularly within the more productive agricultural areas, is demonstrably much less than is the case for the northern half of the continent.

With respect to fisheries, the rights and licensing arrangements that provide the commercial fishing industry with legal access to a fishery resource are complex and differ across the Australian jurisdictions (Australian Venture Consultants 2020), a detailed discussion on which is beyond the scope of this study. However, briefly and very generally, the new Australian British Colonies and subsequent states inherited the English common law system and Imperial legislation in effect at the time (*An Act to Provide for the Administration of Justice in New South Wales and Van Diemen's Land 1828, 9 Geo IV, c.83*). In accordance with this precedence, fish found in the territorial waters of a state were considered not capable of being the possession of an individual until the fish is lawfully caught and as such every person is entitled to fish. This principle underpins fisheries regulation in every state and territory in Australia, with the arguable exceptions of Victoria and Tasmania who have each legislated (*Living Marine Resource Management Act 1995* (Tasmania); *Fisheries Act 1995* (Victoria)) for property in fish to be vested with the State.

Therefore, Australian governments manage fisheries within their jurisdiction by regulating the conditions under which a fish may be lawfully caught, including who can catch a fish, how many, where and how fish may be caught. Generally speaking, this regulation focuses on both maintaining the sustainability of the fishery and ensuring equity of access to the fishery between commercial, recreational and customary fishers. This is achieved by setting quotas for each group, and variably issuing licences, and then catch management regulations which can include quotas and other catch limits and/or input controls.

With the exception of *purse seine* aquaculture production, all aquaculture relies on hatchery-reared fish, and therefore, other than the collection of small volumes of broodstock, does not draw from a fishery resource. Land-based recirculation systems require access to land, a source of water and an ability to manage waste streams. Sea and inland-based cage operations require access to areas of marine or freshwater estates, and typically smaller areas of terrestrial estates for servicing and processing. While aquaculture production licences are the jurisdiction of fisheries legislation in Australia, the main issues typically regulated are biosecurity and the environmental impact associated with production systems.

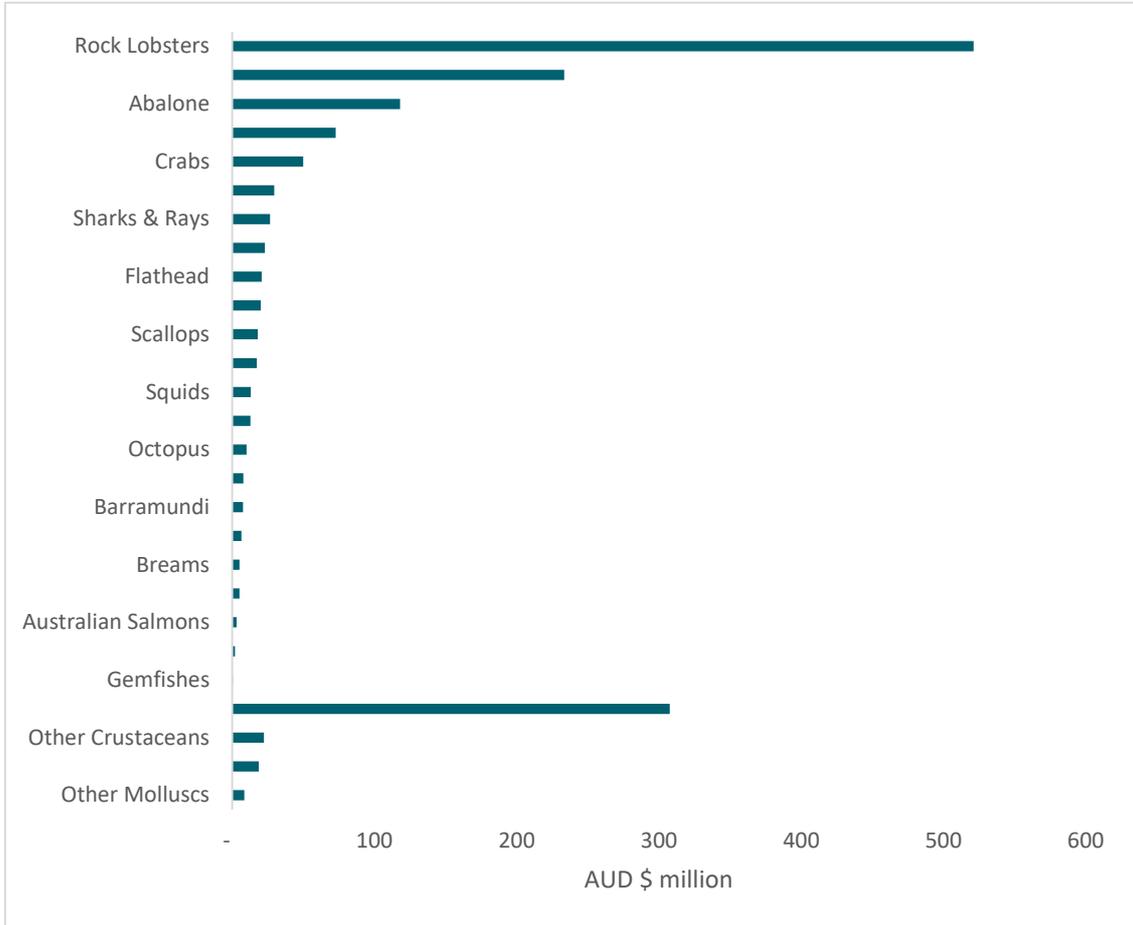
In 2019–2020, seafood and other aquatic product produced from the Australian fisheries and aquaculture sector had a total value of AUD \$3.2 billion. This was approximately equally contributed to by wild-catch and aquaculture production (ABARES 2021a). Fisheries and aquaculture production is prevalent in every state and territory of Australia except the Australian Capital Territory. Production from Tasmania is more than twice that of any other jurisdiction, accounting for just over one-third of all fisheries and aquaculture production in Australia, with the next three largest jurisdictions—Western Australia, South Australia and the Commonwealth—accounting for an additional 43%. This is illustrated in Graph 3 (ABARES 2021a).



Graph 3 – Australian fisheries and aquaculture production by state and territory (2019–2020)
(source: ABARES 2021a)

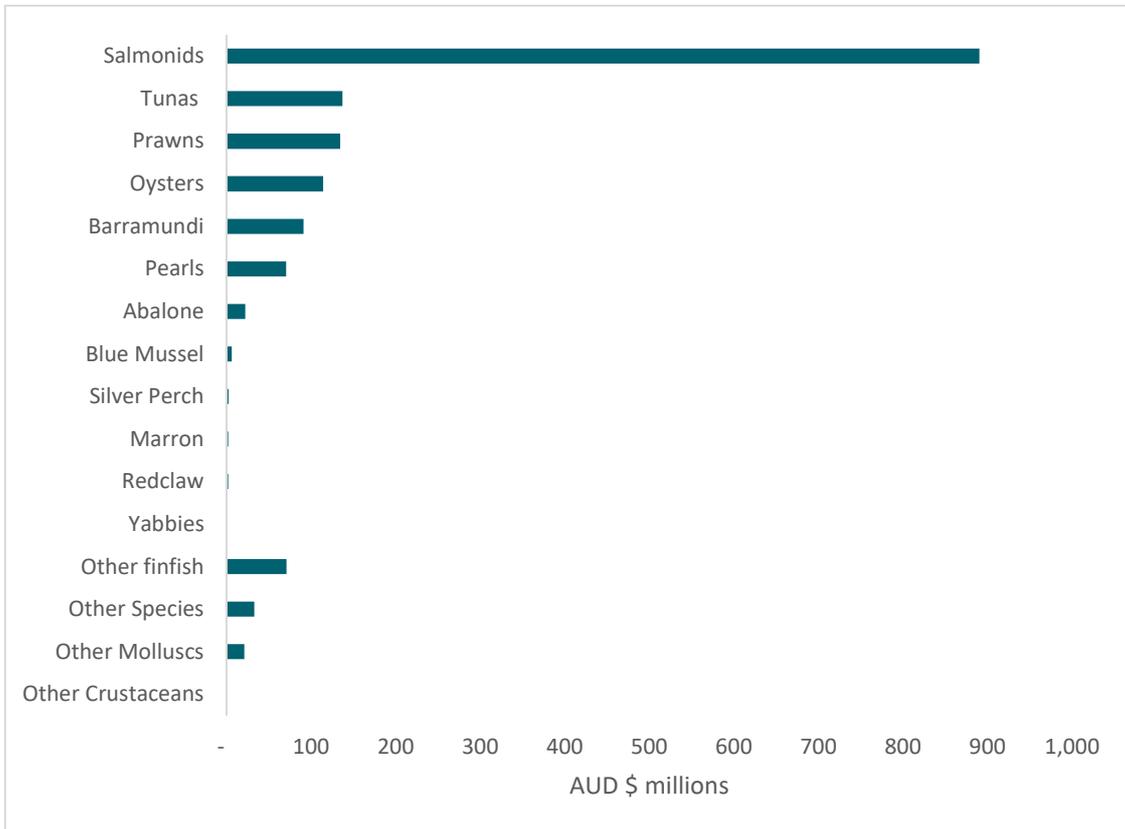
In terms of the wild catch fisheries, the Western Rock Lobster fishery in Western Australia, Southern Rock Lobster fisheries of South Australia, Victoria and Tasmania, and to a lesser extent the Tropical Lobster fisheries of the North, account for 42.6% of the value of the wild-catch sector, and constitutes the second largest sector of the Australian fisheries and aquaculture industry, accounting for 16.4% of the total value of production.

Accounting for approximately 19.1% of the value of wild catch fisheries, 65% of wild caught prawns are from Queensland and Commonwealth Fisheries. Abalone accounts for 9.6% of the value of wild catch fisheries, with 93.7% of that value produced from the southern states of South Australia, Victoria and particularly Tasmania. Graph 4 (ABARES 2021a) illustrates the value of production from Australian wild catch fisheries.



Graph 4 – Total value of Australian wild catch fisheries, by sector (2019–2020) (source: ABARES, 2021a)

With respect to aquaculture production, the largest sector of the Australian fisheries and aquaculture industry, sea cage production of Atlantic Salmon (an introduced species) in Tasmania, accounts for 55.7% of national aquaculture production and 28% of the value of all fisheries and aquaculture production. The *purse seine* production of Bluefin Tuna in South Australia accounts for 8.6% of the value of aquaculture production, with prawn aquaculture production undertaken predominately in Queensland, accounting for 8.4%. Oysters account for a further 7.2% of aquaculture production where both native and introduced species are produced in New South Wales, South Australia and Tasmania. Graph 5 (ABARES 2021a) summarise aquaculture production by sector.



Graph 5 – Australian aquaculture production by sector (2019–2020) (ABARES 2021a)

It is clear from this analysis, that like agriculture, a majority of fisheries and aquaculture GVP is derived from territorial waters in the southern half of the continent and whilst legally recognised First Nations rights pertaining to coastal waters (the intertidal zone) and claims over sea Country are a relatively recent phenomenon, they are primarily in northern Areas.

The Australian Indigenous Estate

This study respects that, on the basis that Britain’s claim to the Australian continent under the law of nations doctrine *terra nullius* has been determined under the highest jurisprudence in the Nation as being illegitimate (*Mabo v Queensland (No. 2)* (1992) 175 CLR 1) and that no Australian First Nation has ever ceded their lands to Britain, many First Nations Australians consider the entire Australian continent and its territorial waters to be at least notionally a form of Indigenous Estate.

However, for the purposes of this study, the First Nations Estate is defined as being areas of land over which First Nations peoples and communities have ownership, management or other contemporary legal rights (ABARES 2020), as determined and

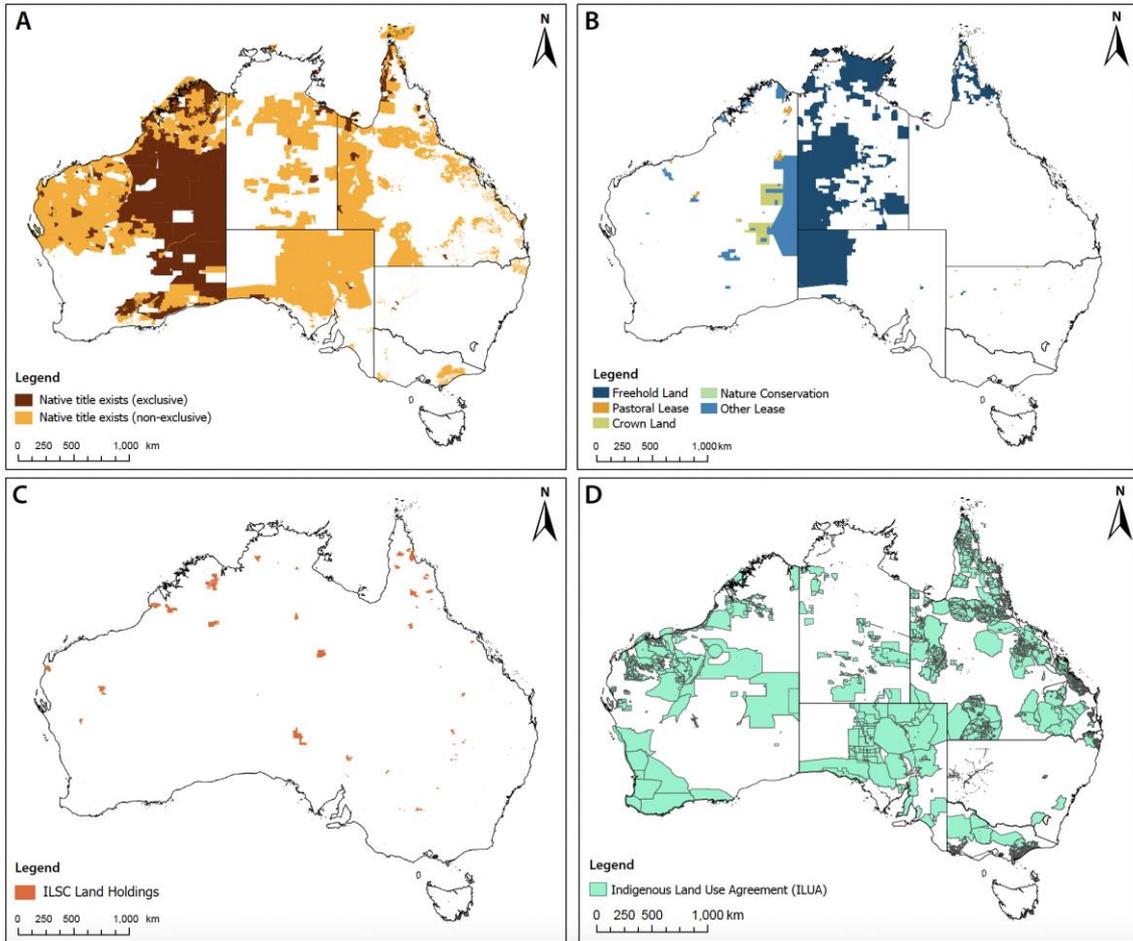
enabled under Australian legislation or instruments of that legislation. This definition of the Indigenous Estate incorporates:

- **Native Title Lands** – a unique form of tenure created in accordance with the *Native Title Act 1993* (Commonwealth), as a key component of the Australian Government’s response to the Mabo High Court determination (*Mabo v Queensland (No. 2)* (1992) 175 CLR 1). The specific nature of native title is determined from the traditional laws and customs of specific native title claimants, which are variable across First Nations groups and can include a right to conduct ceremonies on, collect natural resources from and occupy the land. Native title interests can be exclusive, whereby the native title holder may occupy and use those lands to the exclusion of others, or non-exclusive where the native title rights co-exist with other land rights and tenures, such as exploration, mining and other leases, including with specific relevance to this paper, pastoral leases and the conservation estate. Where native title rights are non-exclusive, they are subordinate to other rights in most instances.
- **Aboriginal and Torres Strait Islander (fee simple) Lands** – lands in which First Nations interests either directly own, or are a beneficial owner through, trust and legislative vehicles established to hold those lands on behalf of First Nations interests. In almost all instances the freehold land established for this purpose is inalienable, and where it can be transferred can typically only be transferred to specific entities such as Aboriginal and Torres Strait Islander Corporations and land trusts who act as agents or trustees for communal benefits. In a majority of instances, caveats apply to the use of these lands, albeit in some cases these lands can be leased for commercial purposes. Examples of such tenure include that created under the *Aboriginal Land Rights (Northern Territory) Act 1976*, *Deeds of grant in Trusts* (Queensland), the *Anangu Pitjantjatjara Yankunytjatjara Land Rights Act 1981* (South Australia), freehold land that was originally missions or reserves that is held in fee-simple by statutory Aboriginal Land Trusts (Western Australia and South Australia) and Local Aboriginal Land Council freehold blocks (New South Wales).
- **Indigenous Land and Sea Corporation (ILSC) Land** – initially established under the *Land Fund and Indigenous Corporations (ATSIC Amendment) Act 1995* (Commonwealth) (as the Indigenous Land Corporation) and now operating under the *Aboriginal and Torres Strait Islander Act 2005* (Commonwealth) (and as the ILSC since 2019), the ILSC was established by

the Australian Government as a response to the Mabo High Court determination. Being the beneficiary of an annual financial contribution in perpetuity from the Australian Government, the function of the ILSC is to acquire lands, grant those lands to First Nations interests and support First Nations interests in managing and improving those and other First Nations lands. Lands that are held and granted by the ILSC also include caveats that limit their fungibility.

- **Indigenous Protected Areas (IPAs)** – are established whereby First Nations interests voluntarily submit lands in which they have an interest to the National Reserve System, thereby committing those lands to the national conservation estate. In return, the Australian Government provides resourcing for the First Nations interests to establish and operate an Indigenous Ranger Programme to manage the IPA land.
- **Indigenous Land Use Agreements (ILUAs)** – are voluntary agreements between First Nations parties who have a legal or recognised interest in lands and parties who wish to access or use those lands, setting out the rights and obligations of each party with respect to land access and use. They are a key instrument under processes prescribed by the Native Title Act but can also be used with respect to non-native title lands.

The geographical extent of the tenures that define key elements of the Indigenous Estate which this study considered, are illustrated in Map 2.

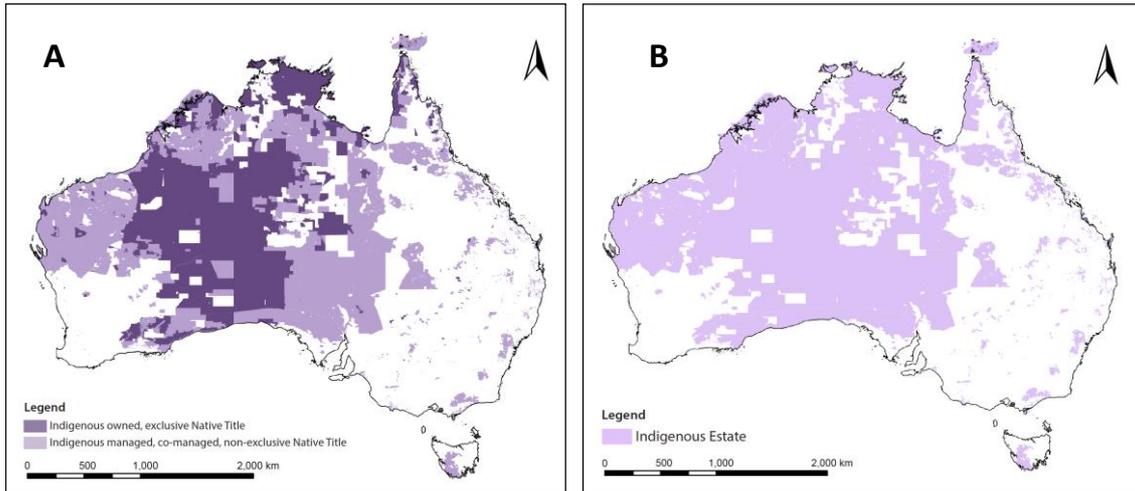


Map 2 (A), (B), (C) and (D) – The geographical extent of different forms of First Nations Tenure that define the Indigenous Estate (source: Jacobsen, Howell & Read 2020; NNTT 2022; Deloitte Access Economics 2021)

To combine these tenures, the study obtained data from relevant Commonwealth agencies including the ABARES, the National Native Title Tribunal (NNTT), and the ILSC.

ABARES's (2020) Australia's Indigenous Land Estate dataset provided a baseline for four derived categories that combined the attributes of Indigenous ownership, Indigenous management or co-management, and other special rights (Jacobsen, Howell & Read 2020). This dataset includes tenure and management data related to native title, freehold land, and management and use agreements. It identifies the total area of land in Australia's Indigenous Estate as 438 million hectares (including 134 million hectares of land under Indigenous ownership, 174 million hectares of land under some form of Indigenous management, and 337 million hectares of land subject to other special rights) (Jacobsen, Howell & Read 2020).

The study incorporated additional data sourced from NNTT and ILSC pertaining to exclusive and non-exclusive native title recognition and ILSC land holdings that was current as of 22 March 2022. Where differences in these datasets and the ABARES (2020) mapped estate occurred, the most recent data were used. The resulting map is visualised in Map 3.



Map 3 (A) and (B) – The First Nations Estate derived by this study: (A) by recognised rights and (B) cumulative First Nations Estate

The exclusion of ILUAs from the definition of the First Nations Estate (see Map 2(d)) for the purposes of this study, is in recognition of the fact that, while First Nations interests in these lands are formally recognised, specific usage of these lands has also been formally assigned to a third party. However, they are captured in the discussion on the Indigenous Estate because, as detailed in a subsequent section of this report, some large ILUAs incorporate significant agricultural production.

First Nations water rights

Water is an important input to all forms of agricultural production, with many forms of production critically dependent on significant volumes of relatively high-quality water at specific times of the year. The Australian continent is characterised by very low average annual rainfall of 466 millimetres over the period 1961 to 1990 and significant rainfall variability (BoM 2022). The Australian rainfall pattern is concentric around the continent’s extensive arid core, which extends to the coastline in the central west and along the Great Australian Bight. Outside of these areas, there is a broken margin of more humid conditions which results in increased precipitation as it approaches the coast, particularly along the eastern coast of the continent and the northern tropical



areas (Geoscience Australia 2022). Highly seasonal and variable rainfall across the continent means that in some areas, including some of the more productive areas, agricultural production is dependent on heavy downfalls that typically occur at a particular time of year, and because of variability, is also subject to drought.

As a result, significant sectors of the Australian agricultural industry are at least partially dependent on access to surface and groundwater diversions. Agreed to by the Council of Australian Governments in 2004, the National Water Initiative (NWI) (Commonwealth Government 2004) is a shared commitment by Australian governments to increase the efficiency of Australia's water use, thereby improving productivity and leading to greater certainty for investment in rural and urban communities, as well as better environmental outcomes. The NWI requires all jurisdictions to provide for First Nations access to water resources and inclusion of First Nations people in water planning and policy.

In 2010, it was estimated that water allocations to First Nations interests were less than 0.1% of the total freshwater diversions in Australia (Jackson & Langton 2011). Furthermore, the majority of these allocation are categorised as cultural flows, with limited ability of First Nations interests to use them for commercial agricultural purposes.

There is evidence that there has not been any substantive improvement in water allocations for First Nations interests since 2010. For example, across the ten catchments that comprise the Murray Darling Basin within the jurisdiction of New South Wales, First Nations entities collectively currently hold entitlements equivalent to 0.2% of the available surface water (Hartwig, Jackson & Osborne 2020). However, while many water resources in the southern, particularly south-eastern areas of the nation are fully allocated, rendering re-allocation at least politically and economically challenging, much of the northern water resource is not allocated presenting an opportunity for improving the current circumstance.

Importantly, the 2020 National Agreement on Closing the Gap includes a commitment to develop a new target that measures progress towards securing Aboriginal and Torres Strait Islander interests in water bodies inland from the coastal zone under state and territory water regimes. The Joint Council on Closing the Gap, which governs this Agreement, announced following its meeting on 3 December 2021, that it was agreed to defer consideration of the Inland Waters target to the next Joint Council meeting

where it will consider the finalised statistical baselining exercise to improve understanding of existing levels of Indigenous corporations' water ownership².

The contemporary First Nations agriculture, fishing and aquaculture industries

Agriculture, fishing and aquaculture operations are often described as having a strong alignment with many First Nations economic development aspirations. This alignment is derived from three key aspects of present day First Nations society and culture. Firstly, the vast majority of agriculture, fishing and aquaculture primary production assets are located in rural, regional and remote Australia, where around 65% of First Nations people reside (ABS 2017a) and often are the main or only local industry. This means that in many instances engagement with the agricultural, fishing and aquaculture industries is the most logical pathway for economic development for many First Nations people. Secondly, this geographical alignment is substantially amplified whereby engaging with the local agricultural, fishing or aquaculture industry facilitates economic development whilst allowing First Nations people to continue to live and work on their traditional lands. Finally, the natural resource orientation of these industries provides further cultural benefits in the form of allowing people to 'connect with Country' and practice the use of TEK.

Economic engagement by First Nations Australians with the present-day agriculture, fisheries and aquaculture industries is diverse. It includes a wide range of sectors and geographical locations; farm, fisheries and aquaculture workers, managers and owners; enterprises that are owned by sole operators as well as First Nations organisations; and business models that are based purely on conventional primary production, purely on TEK enabled production systems and on hybrid models that blend aspects of TEK and conventional production methods.

The development of robust First Nations agriculture, fishing and aquaculture industries can deliver two key benefits for Australian primary industries. Firstly, it can deliver new products in the form of traditional produce, diversifying markets for the industry. Secondly, by virtue of the social and environmental dividends that can accrue from First Nations business models and the application of TEK oriented production systems,

² Seventh Meeting of the Joint Council on closing the Gap. 3 December 2021, Communique: <https://www.closingthegap.gov.au/sites/default/files/2021-12/joint-council-communique-3-december-2021.pdf>



it can assist the industry with market access, the development of new markets and enhanced access to finance by improving its ESG credentials.

Discussed in greater detail in a subsequent section of this report, the contemporary Australian First Nations agricultural, fisheries and aquaculture sector is relatively small. However, there is a strong likelihood that it will continue to grow, driven by demand from both niche and mainstream markets, and facilitated by a trajectory of Australian jurisprudence that suggests increasingly stronger economic rights for First Nations Australians, evidenced in particular by the following High Court judicial outcomes:

- **The Wik Peoples v The State of Queensland & Ors; The Thayorre People v The State of Queensland & Ors [1996] HCA 40.** Referred to as the ‘Wik Case’, the High Court of Australia held that the mere granting of a pastoral lease does not confer exclusive possession, with the rights and obligations of the holder of a pastoral lease dependent on the specific lease terms and the law under which it was granted and does not necessarily extinguish native title rights. However, if there is any inconsistency between the rights of the native title holders and the rights of the holder of the pastoral lease, the pastoral lease prevails.
- **Western Australia v Ward (2002) 213 CLR 1.** Referred to as the ‘Ward Case’, the High Court of Australia confirmed that proof of native title does not require occupation of lands but is based on traditional laws and custom, that native title can co-exist with other land rights (such as pastoral leases) and that the native title cannot be extinguished outside of the Native Title Act.
- **Northern Territory v Arnhem Land Aboriginal Land Trust (2008) 236 CLR 24.** Referred to as the ‘Blue Mud Bay Case’, the High Court determined that coastal Aboriginal land granted under the Aboriginal Land Rights (Northern Territory) Act includes the intertidal zone and that the holder of a licence to fish cannot enter and take fish from the intertidal zone on Aboriginal land without the permission of the Traditional Owners.
- **Akiba v Commonwealth (2013) 250 CLR 209.** Referred to as the ‘Akiba Case’, the High Court of Australia determined that Commonwealth and Queensland legislation, which prohibited taking of fish and other aquatic life for commercial purposes without a commercial fishing licence, did not extinguish native title rights of certain communities in the Torres Strait to take resources from defined

areas of water and trade those catches in accordance with custom and tradition.

- **Griffiths v Northern Territory of Australia (No 3) [2016] FCA 900; Northern Territory of Australia v Griffiths [2017] 256 FCR 478; Northern Territory v Griffiths (2019) 269 CLR 1.** Referred to as the ‘Timber Creek Cases’, the High Court established detailed guidance as to how compensation for the impairment of native title rights and interests should be calculated which includes economic and cultural loss elements as well as compensation for the time value of money.

Understanding the basis for the trajectory of the emerging Australian First Nations agricultural, fisheries and aquaculture sectors is important background, as a major tenet of this study is that industry and governments’ plans to substantially grow Australia’s primary industries do not pay adequate attention to the unique and significant role that First Nations agriculture, fisheries and aquaculture operations can perform in supporting these ambitions.

Toward \$100 billion in GVP: what is the role for First Nations agriculture?

In 2018, the Australian agricultural industry’s peak body, the NFF, released a plan to grow the farm-gate value of Australian agricultural production from AUD \$60 billion to AUD \$100 billion by 2030 (NFF 2018). According to ABARES, this will require the industry to increase its current rate of growth from 3.4% to 5.4% per annum. Through its Ag2030 initiative, the Australian Government is working with industry to achieve this goal (DAWE 2020, 2021, 2022).

Table 1 (NFF 2018 & DAWE 2020, 2021, 2022) summarises the pillars of the NFF plan and the broadly corresponding themes of the Australian Government’s Ag2030 policy platform.

Table 1 – National Farmers’ Federation \$100 billion by 2030 Roadmap and Australian Government Ag2030 policy platform (source: NFF 2018; DAWE 2020, 2021, 2022)

National Farmers’ Federation: \$100 billion by 2030 Roadmap	Australian Government Ag2030
<p>Pillar 1: Customers and the value chain</p> <ul style="list-style-type: none"> • Agriculture is ranked Australia’s most trusted industry. • Australia’s freight cost per tonne-kilometre is competitive with major agricultural exporting nations. • An average tariff faced by agriculture exports of 5%. • A 50% reduction in agricultural exports experiencing non-tariff barriers each year. 	<p>Theme 1: Trade and exports Increased and improved market access and streamlined exporting processes to provide producers with greater opportunities.</p> <hr/> <p>Theme 4: Supply chains Supporting Australian producers to grow their profitability and competitiveness and ensuring the sustainability of their industry.</p> <hr/> <p>Theme 5: Water and infrastructure Investment in regional infrastructure and transport, digital connectivity and water security projects to support local jobs and improve the efficiency of the agricultural industry.</p>
<p>Pillar 2: Growing sustainability</p> <ul style="list-style-type: none"> • The net benefit for ecosystem services is equal to 5% of farm revenue. • Australian agriculture is trending towards carbon neutrality by 2030. • Halve food waste by 2030. • A 20% increase in water use efficiency for irrigated agriculture by 2030. • Maintain Australia’s total farmed area at 2018 levels. 	<p>Theme 3: Stewardship Providing Australian producers with the appropriate tools to adapt to a changing climate and build a sustainable agricultural base for the future.</p>
<p>Pillar 3: Unlocking innovation</p> <ul style="list-style-type: none"> • Australia becomes a Top 20 nation for innovation efficiency. 	<p>Theme 6: Innovation and research</p>

National Farmers' Federation: \$100 billion by 2030 Roadmap	Australian Government Ag2030
<ul style="list-style-type: none"> • Every Australian farm has access to infrastructure and skills to connect to the Internet of things. 	Greater access to technologies to support Australian producers increase their productivity and competitiveness.
<p>Pillar 4: People and communities</p> <ul style="list-style-type: none"> • Double the number of tertiary and vocational agriculture graduates. • Increase the available workforce by 25%. • Achieve gender parity in the agricultural workforce and double the number of women in management roles. • A mean score of 5 for Physical Capital sub-measure in the Regional Wellbeing Survey. • Zero farm fatalities. • Close the gap between the psychological wellbeing of farmers and the broader community. 	<p>Theme 7: Human capital</p> <p>Investing in preparedness, resilience and the agricultural workforce to strengthen and ensure the sustainability of agricultural businesses.</p>
<p>Pillar 5: Capital and risk management</p> <ul style="list-style-type: none"> • 90% of family farms have documented business plans, including succession plans. • 90% of Australia's farmers employing multiple financial tools to manage risk. • Year on year increase in equity investment in Australian farm businesses. 	<p>Theme 2: Biosecurity</p> <p>Safeguarding Australia from exotic pests and diseases to deliver lower costs for producers and support market access.</p>



Both the NFF Roadmap and the Ag2030 policy platform give only limited regard to the role that First Nations primary production can perform in achieving the industry’s and government’s aspirations. As summarised in Table 2 (NFF 2018), the NFF Roadmap gives only fleeting mention of First Nations interests under Pillar 2 (Growing Sustainability) and Pillar 3 (Capable People, Vibrant Communities). While it is encouraging that NFF recognises First Nations land interests under its discussion in Pillar 2, implying that the goal is to minimise sterilisation of agricultural production from the exercising of native title rights, underplays the value that can be delivered by supporting a growing First Nations agricultural sector on existing and new agricultural lands. Furthermore, while Pillar 4 recognises the opportunity to create opportunities for First Nations people in the industry, there is no metric by which this is to be measured.

Table 2 – National Farmers’ Federation \$100 billion by 2030 Roadmap and First Nations Agriculture (source: NFF 2018)

Aspiration	Actions	Impacts	Metric
Pillar 2: Growing Sustainability			
We have stemmed the loss of productive farmland, improved the health of our landscapes, and brokered lasting co-existence arrangements with other landholders.	Partner with Indigenous landholders on a sustainable native title regime.	<ul style="list-style-type: none"> • Native title uncertainties resolved • Agreed principles for co-existence • Cooperation on land use planning 	Maintain Australia’s total farmed area at 2018 levels.
Pillar 4: Capable People, Vibrant Communities			
A career in Australian agriculture is an accessible aspiration for all.	Work with Indigenous leaders to grow opportunities for Aboriginal and Torres Strait Islander people in agriculture, including within industry leadership.	<ul style="list-style-type: none"> • Reduced disadvantage in Indigenous communities • Attract new labour and skills • Better representation of Indigenous agriculture 	Achieve gender parity in the agricultural workforce and double the number of women in management roles.



Similarly, while the Australian Government’s Ag2030 plans and report cards recognise the important role that First Nations can perform in biosecurity and environmental stewardship through the growing Indigenous Ranger sector (see Table 3), it is silent on the opportunities for First Nations primary production. This is summarised in Table 3 (DAWE 2020, 2021, 2022).

Table 3 – Ag2030 and First Nations Agriculture (source: DAWE 2020, 2021, 2022)

Report	Reference
Theme 2: Biosecurity	
Delivering Ag 2030 (October 2020)	\$33.0 million over 4 years for Biosecurity Indigenous Rangers
Theme 3: Stewardship	
Delivering Ag 2030 (October 2020)	\$4.2 million over 2 years from four new Indigenous River Ranger Groups across the Murray Darling Basin

A key objective of this study is to demonstrate that First Nations interests in agriculture, fisheries and aquaculture can make a much broader and valuable contribution to the objectives of the NFF Roadmap and Ag2030 plans.

Purpose of this study

As the basis for improved engagement between the Nation’s mainstream primary industries and the emerging First Nations agriculture, fisheries and aquaculture industries in national primary industry strategic planning, this study seeks to demonstrate:

1. That, depending on how the Indigenous Estate is defined, at least a meaningful portion of agricultural GVP is produced from the Indigenous Estate.
2. The extent to which First Nations interests currently benefit from primary production that occurs on the Indigenous Estate is minimal.
3. That there is an emerging First Nations agriculture, fishing and aquaculture industry that is diverse and is presented with opportunity to grow through:
 - a. Existing First Nations enterprise;
 - b. Activation of the Indigenous Estate on which there is currently no or limited primary production; and



- c. Collaboration, and enhanced production on areas of the Indigenous Estate that are the subject of co-existing tenure.
4. That through the activation of these opportunities, the First Nations agriculture, fisheries and aquaculture sectors can perform a significant role in helping achieve the growth objectives for Australian primary industries.

The specific Terms of Reference for this study were to address these objectives by:

1. Preparing a baseline of the nature, size, and value of primary production, focusing on agriculture, in the Indigenous agricultural economy in Australia.
2. Mapping the biocultural assets (i.e. land cover, land use, soil type and quality, water resources, communities, cultural heritage, etc.) of the Indigenous Estate.
3. Preparing pilot environmental-economic accounts for the Indigenous Estate, integrating environmental and economic information.
4. Reporting on case studies of regional agricultural investments on the Indigenous Estate.
5. Devising a simulation that estimates increasing output from converting existing land and water assets covered by Indigenous rights and interests into primary production.
6. Applying a range of land use scenarios over ten- and 20-year timeframes (for example, low – 5%; medium – 10% and high – 20% conversions).

By virtue of a dearth of reliable data and incompatibility of existing datasets (as discussed in a subsequent section of this report), a reliable baseline detailing the nature, size and value of primary production, focusing on agriculture, in the Indigenous agricultural economy in Australia has not been established. The inability to access reliable data has also resulted in the Terms of Reference (5) and (6) not being able to be completed.

The study has attempted to progress toward this objective of establishing a reliable baseline by identifying and describing a substantive, but likely not exhaustive, database of First Nations primary industries enterprises, examining other studies that have attempted to do likewise and undertaking deeper analysis of a small sample of First Nations primary industries' case studies. This is discussed in the next section.



FIRST NATIONS PARTICIPATION IN THE MODERN AUSTRALIAN AGRICULTURE, FISHING AND AQUACULTURE INDUSTRIES

Russell Barnett, Honorary Associate Professor, First Nations Portfolio, Australian National University

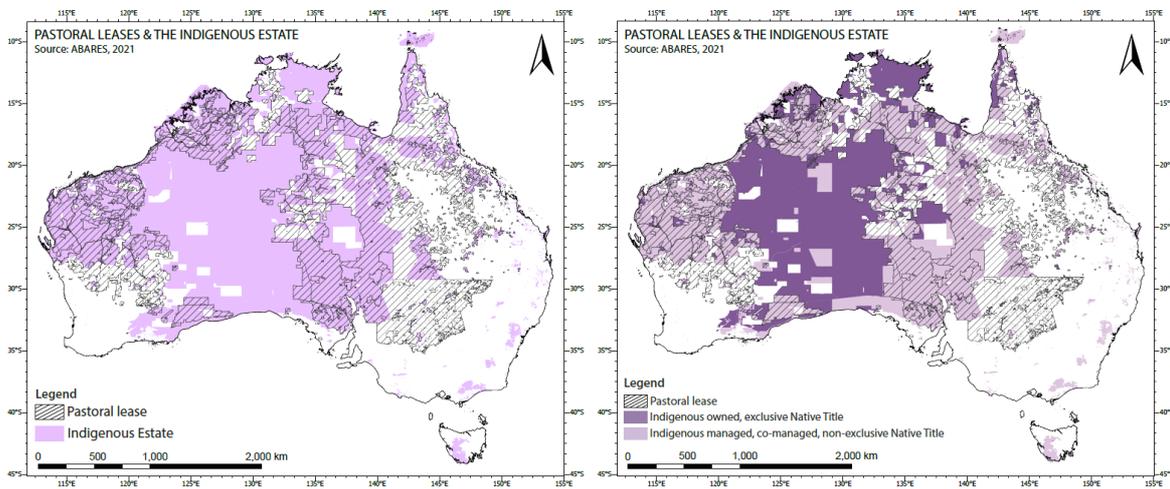
The value of agricultural production from the Australian Indigenous Estate

Notwithstanding that, as mentioned in this report's introduction, many First Nations people consider the entire Australian continent and its territorial waters to be at least notionally the Indigenous Estate, for the practical purposes of this study, the Indigenous Estate can be considered at two levels:

- **Land that is recognised under legal instruments** – whereby such boundaries incorporate all forms of native title tenure, Aboriginal freehold land and IPAs, as well as areas of land that are the subject of ILUAs. As mentioned previously, this is an important distinction because it includes the ILUAs that are a component of the Noongar Southwest Settlement and Yamatji Nations Settlement, which collectively incorporate almost the entire Western Australian Sheep-Wheat Zone (see Map 1 and Map 2). In 2019 – 2020, the Western Australian Sheep-Wheat Zone produced agricultural value of approximately \$6 billion (DPIRD 2022a, 2022b, 2022c, 2022d), representing 10% of national agriculture value. Furthermore, the state waters associated with the Noongar Southwest and Yamatji Nations Settlement, also incorporate the vast majority of the Western Rock Lobster fishery, one of the largest wild catch fisheries in Australia. However, from a practical perspective, as a result of these settlement agreements future claims over these production assets and resources can no longer be made and therefore, for practical reasons have not been included in the definition of the Indigenous Estate for the purposes of this study.
- **Land that is registered as tenure in which First Nations have an interest or rights in accordance with specific state and Commonwealth legislative instruments is the Indigenous Estate** – whereby, in the context of the subject matter, the more practical lens through which the Indigenous Estate can be viewed is that Indigenous Estate where First Nations interests have legislated rights and interests that can be exercised, even if they are non-exclusive and subordinate. This incorporates ILSC purchased and granted properties, other forms of Aboriginal freehold, and exclusive and non-exclusive native title lands.

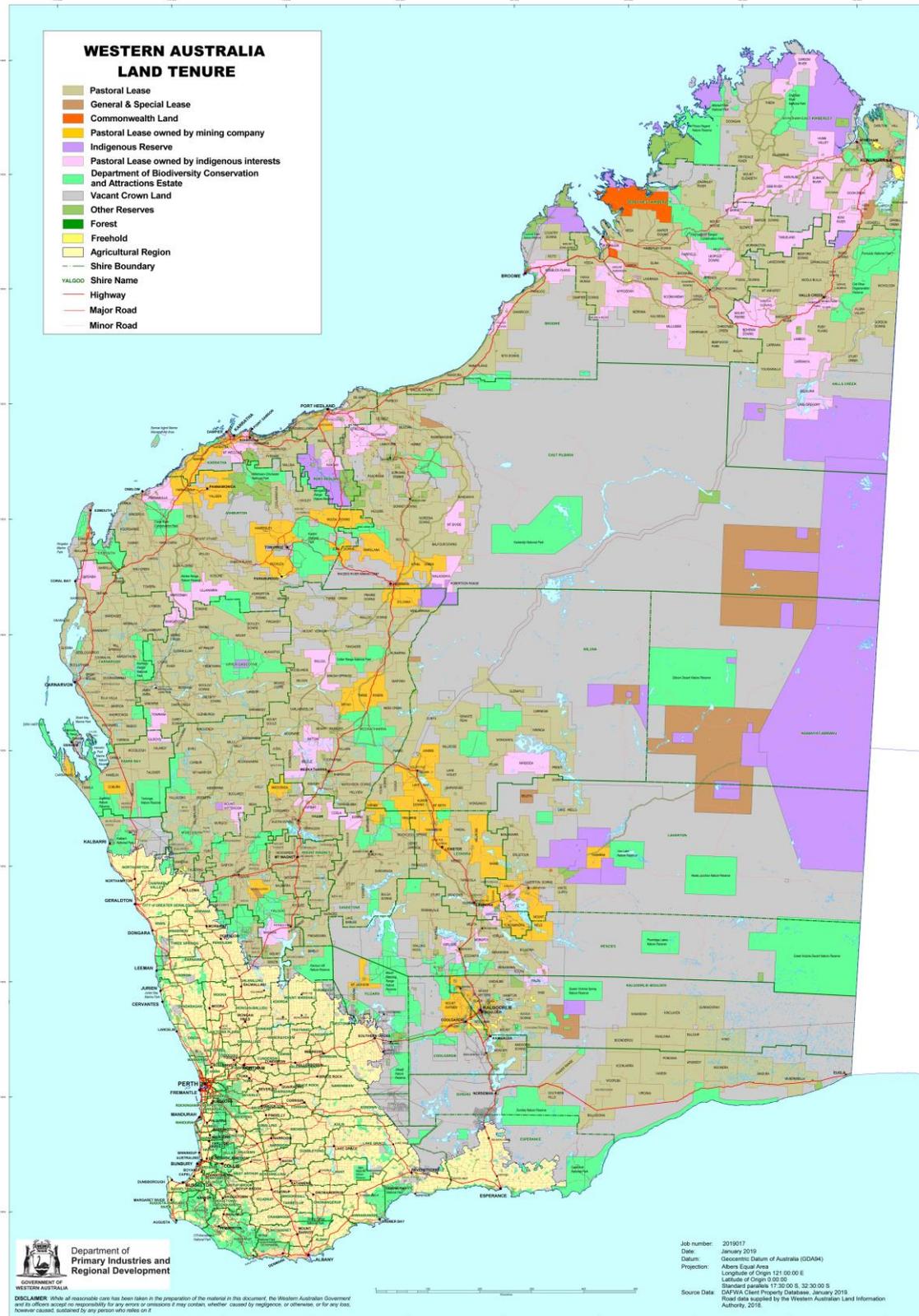


As can be seen in Map 4, with the exception of very small areas of the Indigenous Estate, which is primarily ILSC granted properties, various reserves and other First Nations land, the vast majority of the more productive Western and Eastern Wheat-Sheep and southern high rainfall zones, from where the majority of Australian agriculture value is derived, are not included in the Indigenous Estate. This tenure paradigm also applies to a significant area of southern and central Queensland and Cape York where primarily beef cattle grazing occurs on fee simple tenure. However, a significant portion of the Indigenous Estate that is characterised as Indigenous managed, co-managed or non-exclusive native title, shares tenure with pastoral leases.



Map 4 – Indigenous Estate and Pastoral Leases (source: ABARES 2021b)

While there are numerous First Nations-owned pastoral leases, including, for example, over 50 in Western Australia covering approximately 6.5 million hectares (Goodwin 2017) (see Map 2) (DPIRD 2019), the majority of this pastoral estate is not owned by First Nations interests.



Map 5 – Indigenous Owned Pastoral Leases – Western Australia (source: DPIRD 2019)



A data deficient environment

The main Australian government agencies responsible for the collection of primary economic and social data, on primary production and regional communities are the ABARES and ABS. Biophysical (e.g. for land cover and condition) and administrative data (e.g. on land tenure and ownership) are held by other national (e.g. Geoscience Australia, Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the NNTT) and State or Territory agencies. Since the implementation of the native title regime, First Nations economic and social indicators and the Indigenous Estate are reasonably described. Therefore, it is reasonable to expect that these datasets can be integrated and analysed in order to arrive at an estimate of the value of agricultural production that is derived from the Australian Indigenous Estate.

However, regardless of how the Australian Indigenous Estate is defined, quantifying the value of agricultural production that is derived from that estate is challenged by several related characteristics of the data and the structure of datasets. This compounds to the extent that, attaining a reliable estimate is unresolvable without undertaking further primary data collection. The challenge is presented by the following related characteristics of the relevant data and datasets:

- **Incongruent data polygons** – because the data collected for each of the datasets is collected for different reasons, the geographical segmentation of data is different across the datasets and in some cases, vastly different. The Australian Statistical Geography Standard Statistical Areas of varying sizes (SA1–SA4), Local Government Area, Natural Resource Management Region (NRM) and Broadacre Cropping Regions that are used are not directly comparable. As a result of overlaps, mismatches and other incongruities, a dataset available at one level of statistical geography cannot be easily overlaid or paired with that available at another without relying on preconceived assumptions, and without introducing an unknowable but likely very significant quantum of error into the final output.
- **Insufficient data polygons** – the nature and value of agricultural production can be highly variable within an area, driven by not only the value of production of different sectors within that area, but other factors such as specific production systems, soil condition and microclimates. Therefore, accurate estimates of value require reasonably comprehensive surveying and relatively small polygons of data analysis.



- **Inconsistent data collection methods and practices** – different reasons for collecting the data have also resulted in different data collection methods and data processing protocols across the datasets. For example, at a reliable methodological level such as in the Population Census, participation by Indigenous agricultural workers and owner-managers is mandatory but reliant upon self-reporting and is carried out at a household, rather than at an enterprise, level. The ABS 5-yearly Agricultural Census of around 90,000 enterprises and a smaller annual survey of around 25,000 enterprises are drawn from the Australian Business Register that have an estimated value of agricultural production of greater than \$40,000. These surveys are mandatory. On the other hand, the ABARES annual farm surveys provide detailed information on around 1,500 enterprises, also drawn from the Australia Business Register but are voluntary, relying on a small sub-set of selected entities, and do not capture Indigeneity of participants, enterprise owners or individual workers. At the more specific technical level, differing policies regarding error tolerance (which in some cases is very high), data cleansing, cross-checking and preserving the confidentiality of respondents also influences the comparability of outputs. Accordingly, even assuming perfect geographic congruence between datasets, simply comparing or matching up headline figures without consideration of underlying methodological and technical process differences is likely to induce significant error.
- **Absence of cross-referencing** – the lack of any ability to cross-reference one particular enterprise or individual across multiple datasets means comparisons can only be made at an aggregate or average level. Combined with the geographic, conceptual and technical differences across datasets, comparison of averages or aggregates from one dataset to those from another is fraught and apt to mislead.

Collectively these characteristics of available data and its structure render estimating the value of agricultural production derived from the Australian Indigenous Estate as, at best, unreliable and, at worst, an impossible task.



Toward an estimate of the value of agricultural production from the Australian Indigenous Estate

As identified in Map 4, other than the occasional and relatively small ILSC granted or held property, the Indigenous Estate as defined for the purposes of this study does not include significant areas of the south-west and south-east of the Australian continent, or the productive areas of Tasmania. These areas represent the main focus of early land grants to settlers and released convicts and are overwhelmingly the subject of fee simple title that is not held by First Nations interests.

The south west area incorporates the Western Australian wheat-sheep zone which produces approximately \$6 billion of agricultural GVP (DPIRD 2022a, 2022b, 2022c, 2022d), or approximately 10% of total Australian agricultural GVP. The south-east area includes a significant portion of the eastern Sheep-Wheat zone and a majority of the Murray Darling Basin (MDB) (see Map 3). The Murray Darling Basin produces approximately AUD \$24 billion of agricultural value each year, representing approximately 40% of the value of Australian agricultural value (MDBA 2022). Finally, Tasmania produces agriculture value of approximately AUD \$1.8 billion (ABS 2021) representing 3% of the value of Australian agricultural production, with the Indigenous Estate in Tasmania largely confined to the unproductive World Heritage Wilderness Area.

On this basis, it can be reasonably inferred that at least half of the value of Australian agricultural production does not occur on the Indigenous Estate.



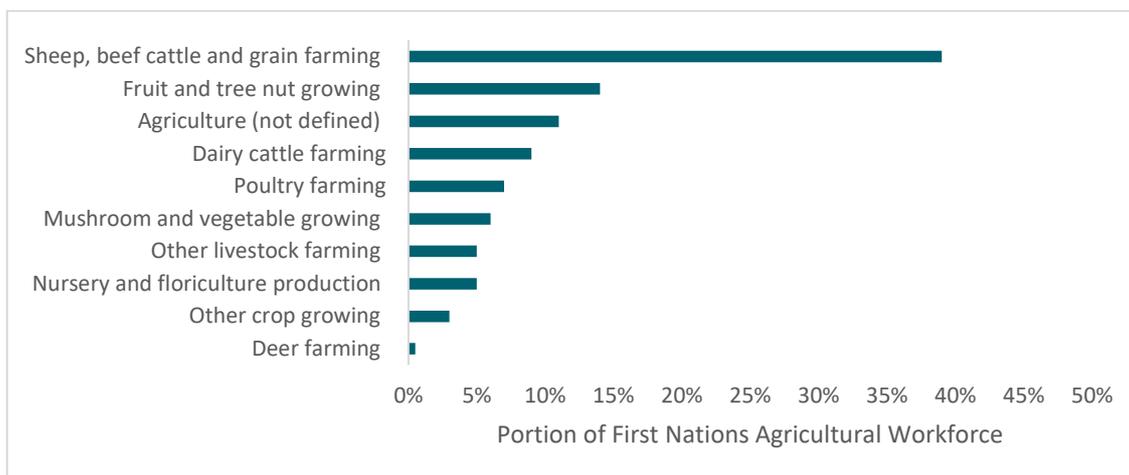
Map 6 – Murray Darling Basin (source: MDBA 2022)



First Nations employment, training and education and small business in the Australian agricultural industry

First Nations employment in the Australian agricultural industry

In 2016, approximately 4,600 Aboriginal and Torres Strait Islander people reported being employed in the agriculture, forestry and fishing industries, representing a 26.7% increase from 2011 (ABS 2017b). A majority, some 39%, of First Nations people working in the Australian agricultural industry worked in the larger sectors of sheep, beef and grain farming. This is illustrated in Graph 6 (ABS 2017b).

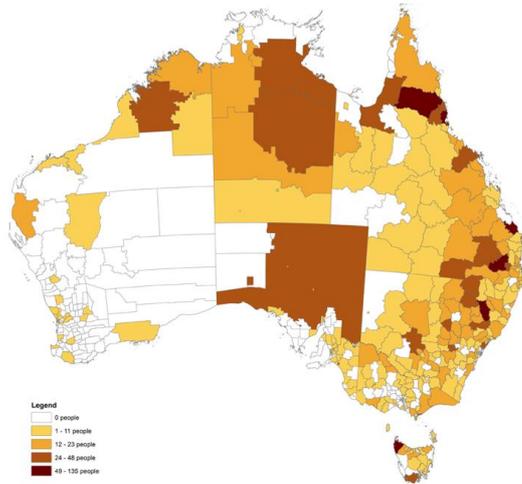


Graph 6 – Portion of Australian First Nations workforce working in sectors of the Australian agricultural industry (source: ABS 2017b)

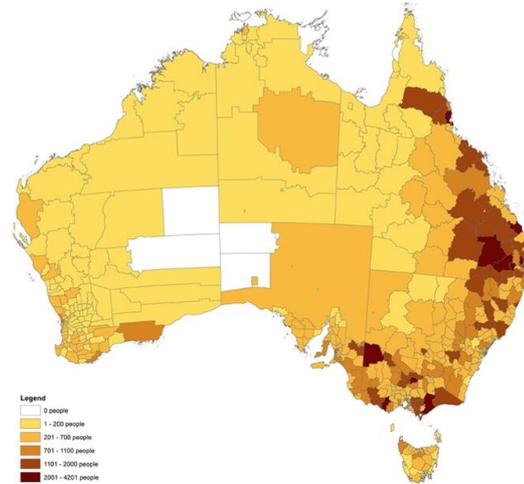
Also consistent with the geographical intensity of agricultural production, 72.6% of First Nations agricultural industry workers reside in the States of Victoria, Queensland and New South Wales, with Western Australia and South Australia accounting for a further 10% (ABS 2017b). This is illustrated in Map 4 (ABARES 2019a).



A: Geographic distribution of the Aboriginal and Torres Strait Islander Workforce



B: Geographic distribution of the Agricultural workforce



Map 7 – Geographical distribution of the Aboriginal and Torres Strait Islander (A) and Australian agricultural workforce (B), 2016 (source: ABARES 2019b)

In 2016, 53% of First Nations people working in the Australian agricultural industry were employed as labourers, with 26% employed as managers, representing an 18% increase in the portion of First Nations people employed as managers since 2011 (ABARES 2019b).

First Nations training and education in the Australian agricultural industry

Of this workforce, 68% of First Nations agricultural industry employees did not have any recognised post-school qualifications, 25% had certificate level qualifications and 4% diploma level qualifications (ABARES 2019b). Analysis of enrolment and completions of Australian First Nations students in Australian university agricultural courses from 2001 to 2016 indicates an intake of approximately 250 students and total completions of approximately 60 students, or an average of four graduates per annum (Pratley 2019).

First Nations small business in the Australian agricultural industry

In 2016 there were approximately 600 First Nation owner-managers operating businesses in the agricultural industry, representing 5.2% of the 11,500 First Nations owner-manager businesses operating across Australia (CAEPR 2018).



The size and dimensions of modern First Nations agriculture, fisheries and aquaculture sector: a sample analysis

Size of the Australian First Nations agriculture, fisheries and aquaculture sector

Recent attempts to quantify the economic contribution of the First Nations primary industries have encountered the same data availability and reliability issues that this study has encountered in trying to estimate the value of production that is derived from the First Nations estate.

A study undertaken by Deloitte Access Economics (2021) endeavoured to match the Australian Business Number of 114 identified First Nations agribusinesses to the database of an aggregator of publicly released information on businesses obtained by purchasing Australian Securities and Investments Commission records on registered business details. This resulted in data for 36 of the businesses, whose collective revenue was estimated by Deloitte Access Economics at \$69.5 million, employing 433 people.

Because estimated revenue or employment was not readily available for the remaining 78 businesses, further estimates were made on the following basis:

- 20 of the businesses in the database were not registered for Goods and Services Tax (GST). Therefore, because the revenue threshold for registering for GST is \$75,000, it was assumed that these businesses generate revenue under \$75,000 and employment was estimated using a revenue ratio derived from Counts of Australian Businesses including Entries and Exits (CABEE);
- For businesses on the database that were sourced from Indigenous Business Australia, employment data was provided by the businesses, revenues were estimated using the relevant industry ratio derived from CABEE; and
- For all other businesses, average industry revenue and employment figures from CABEE were assumed to apply.

This analysis estimated that the database of 114 Indigenous agribusinesses generated revenue of \$97.2 million and employed 637 people.

This analysis is limited to the Indigenous agribusinesses identified in the database and has a heavy reliance on industry-wide averages and assumptions (a caveat that is clearly made in the Deloitte Access Economics study) and, therefore, prone to inaccuracy).



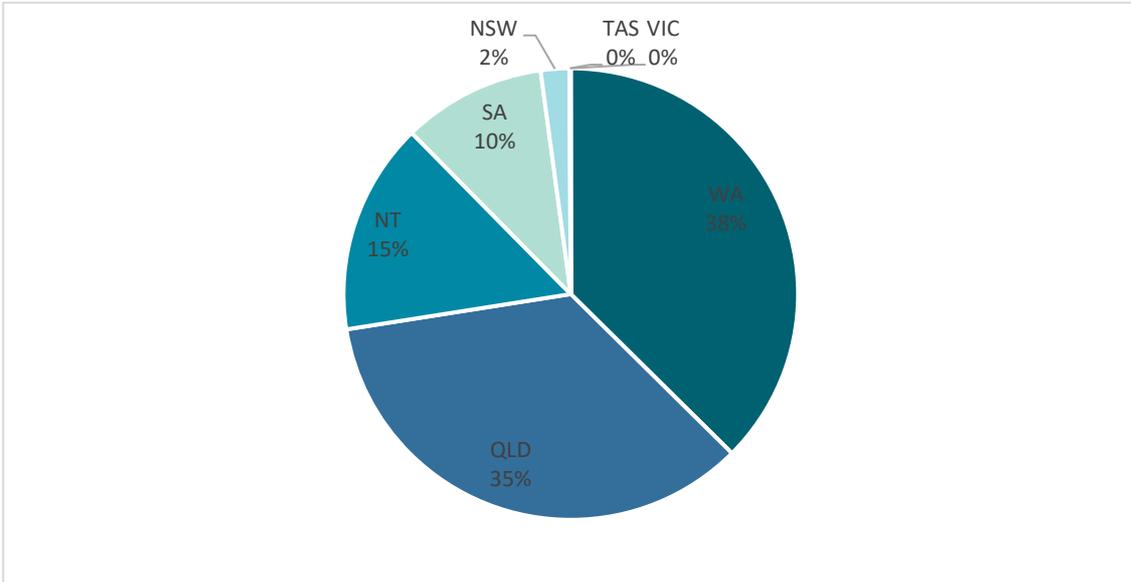
Dimensions of the Australian First Nations agriculture, fisheries and aquaculture sector

For some First Nations landholders, financial returns from agricultural property holdings are optimised by leasing the lands to existing primary producers to operate. This is particularly the case with respect to smaller land holdings that are of sub-economic scale but can be leased by an existing producer to increase their production scale or where the First Nations interest in the property doesn't have adequate capability to develop an agricultural enterprise.

However, First Nations landholders also use their land interests, however acquired, to develop agriculture enterprise, often with maximising financial return as a secondary (but nevertheless important) consideration (Rola-Rubzen 2011). These enterprises can deploy conventional primary production practice, be based exclusively on the application of TEK and in a significant number of cases, deploy hybrid models that endeavour to produce economic surplus as well as other environmental, social and cultural benefits. This range of First Nations agriculture, fishery and aquaculture business models operates in many sectors of these industries and can be found across Australia.

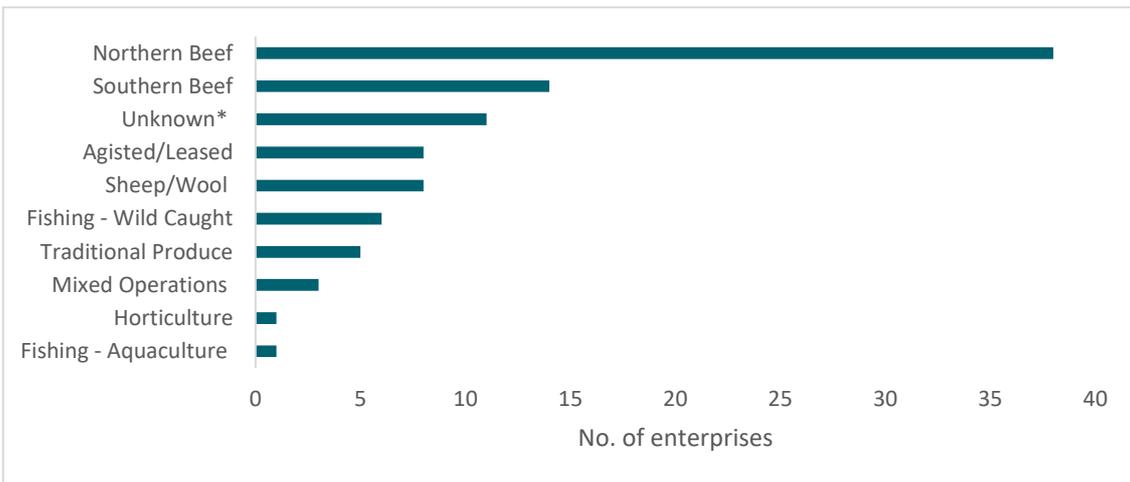
In order to illustrate the dimensions of the modern Australian First Nations agriculture, fisheries and aquaculture industries, this study: discusses the outcomes of research into the motivations for First Nations people and organisations to start enterprises more generally; discusses the dimensions of a sample of 95 Australian First Nations agriculture, fishery and aquaculture businesses; and, presents and analyses five detailed case studies on First Nations agriculture and fisheries businesses.

To assist with articulating the breadth of the Australian First Nations agriculture, fisheries and aquaculture business, a desktop review was undertaken to identify First Nations enterprises operating in these industries. While almost certainly not comprehensive, the desktop review identifies 95 such enterprises (see Appendix 1) operating on approximately 8.1 million hectares of land, or just over 2% of the 346.3 million hectares of land in Australia used for agricultural production. As illustrated in Graph 7, just over 70% of this footprint is in Western Australia and Queensland.



Graph 7 – Geographical distribution of the sample agricultural lands, by area

As summarised in Graph 8, more than half of the sample are First Nations operations in the Australian beef industry, with over a third of the sample being northern beef enterprises, a sector footprint which is consistent with the concentration of large properties in Western Australia and Queensland as summarised in Graph 7.

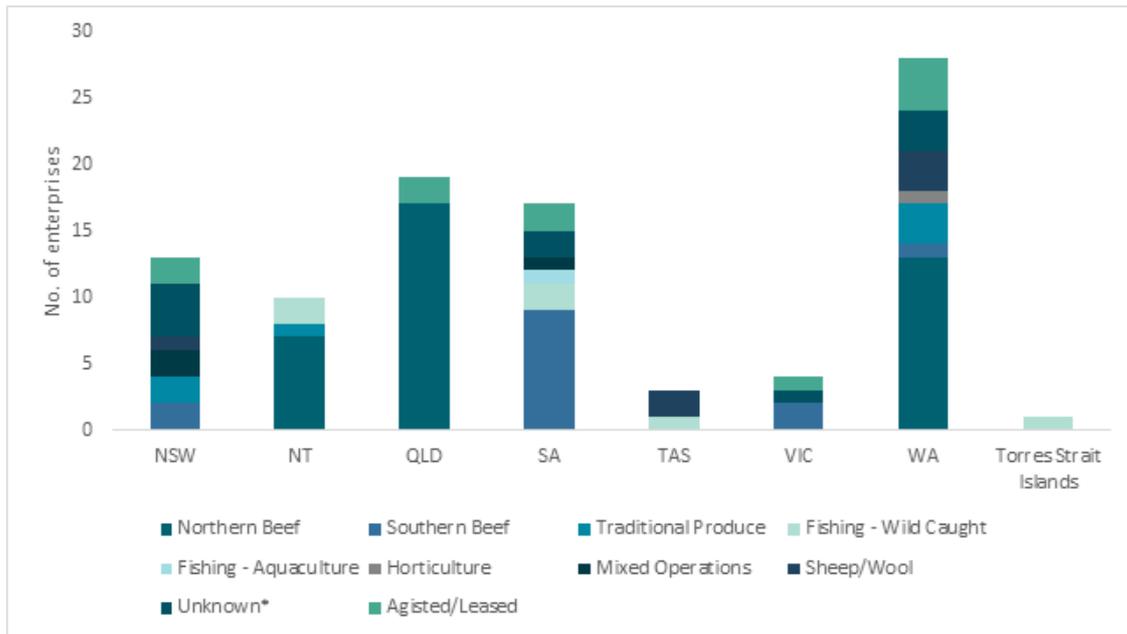


Graph 8 – Number of First Nations enterprises operating - by sector³

The dominance of northern beef in the First Nations agricultural sector also plays out in the geographical distribution, with the dominance of four of the largest states, with

³ * 'Unknown' refers to properties where it is not known what their primary agricultural activity is.

respect to First Nations agricultural businesses, driven by participation in the beef industry. This is illustrated in Graph 9.



Graph 9 – First Nations agriculture businesses – by sector and state

Of the compiled list, the ILSC has been instrumental in supporting the acquisition of land for these primary producers and funding capital costs and capacity building. In total, 76% of all the properties have either been granted by the ILSC, are currently held by the ILSC on behalf of the intended First Nations owners, or participated in funding programs offered by the ILSC.⁴ This is summarised in Table 4.

⁴ This skew toward ILSC involvement is likely a result of the ILSC database being a significant source for the desktop review.



Table 4 – Indigenous Land and Sea Corporation Involvement in the First Nations Agricultural industry

Indigenous Land and Sea Corporation (ILSC)	Number of Enterprises
Granted	49
Held	19
Funded	5
No known ILSC involvement	22
Total	95

The dimensions of modern First Nations agriculture, fisheries and aquaculture enterprise: case study analysis

To provide greater insight into the nature of First Nations agricultural enterprise and the importance of the industry to First Nations Australians, a series of detailed case studies into specific First Nations enterprises were prepared to complement this study. The full details on the case studies are published in the report:

McArthur, L, Barnett, R, Qureshi, ME & Stacey, B (2022) Case Studies Report. Baseline Study – Agricultural Capacity of the Indigenous Estate. Cooperative Research Centre for Developing Northern Australia Project AT.4.20211117.

A total of 14 regional agricultural investments were initially scoped as potential case studies. These were identified by members of the Project Steering Committee and through a preliminary literature review by the Project Research and Management Teams.

The agricultural investments were graded based on the selection criteria (McArthur et al. 2022). With a view to seeking at least one case study under each of the primary production activities used by the Australian Taxation Office, the remaining eight agricultural investments meeting the selection criteria were grouped under the three defined primary production activities (plant or animal cultivation; fishing or pearling; and tree farming or felling).

The First Nations organisations which own and operate each of the eight agricultural investments were contacted to determine their interest in being included as a potential case study and their data, including public financial records, accessed. Five First



Nations organisations affirmed interest in participating in the Project relevant to its delivery timeframe. A First Nation organisation participating in tree farming or felling activities was unable to be secured in time for the project.

Summaries of the five confirmed potential case studies were then presented to the Project Steering Committee at its inaugural meeting held on 6 December 2021. Although the project envisaged that only two to three case studies were to be undertaken, the Steering Committee determined that all five proposed case studies ought to be pursued and that they provide an even spread, as far as practical, across Australia (three in the north and two in the south of Australia).

The approximate location of the selected case studies is illustrated in Map 8.



Map 8 – General location of the five case studies

Table 5 – Summary of the case studies investigated by McArthur et al. 2022.

Case Study Parameters					
Enterprise	Location	Main production	Tenure	Production asset	First Nations Interest
Morr Morr Delta Downs Station	Carpentaria Shire, Queensland	Beef cattle breeding and growing	Pastoral leases	405,000 ha across three pastoral leases; bore licences	Direct – 100% owned subsidiary
Desert Springs Farm	Ali Curung, Northern Territory	Horticulture production of watermelon	Aboriginal Land pursuant to Schedule 1 Aboriginal Land Rights (Northern Territory) Act 1976	1,200 ha of Aboriginal lands leased to third party for horticulture production; ground water licences	Indirect – property leasing and licensing arrangement
Kuti Co	Lower Lakes and Coorong, South Australia	Wild-catch of Pigi	Non-exclusive native title	Fishing licence and 15.82% of the total South Australian Pigi fishery quota	Direct – joint venture between two First Nations owned businesses
Gumaranganyjal Roebuck Plains Station	Broome, Western Australia	Beef cattle breeding and growing	Exclusive native title	275,540 ha across pastoral and special purpose leases; water licences; export depot	Direct – 100% owned subsidiary
Yallalie Downs	Dandaragan, Western Australia	Beef cattle backgrounding	Freehold over ancestral lands	1,242 ha of broadacre farmland; bore licences	Direct – family ownership

Case Study Business Overview

Delta Downs Station	The Delta Downs Station is an aggregate of three adjoining pastoral leases in Queensland's Gulf Country - Delta Downs, Maggieville Outstation and Karumba Downs totalling 405,000 ha. These properties support a beef cattle breeding and growing operation of around 40,000 to 45,000 head of cattle. The pastoral leases and enterprise are owned and operated by the Morr Morr Pastoral Company, a wholly owned subsidiary of the not-for-profit Kurtjar Aboriginal Corporation. Its members, the Kurtjar people, are the Traditional Owners of lands that include the pastoral leases.
Desert Springs Farm	Alekarenge Horticulture Proprietary Limited has engaged Centrefarm Aboriginal Horticulture Limited to manage an area of leasable land within its Aboriginal Freehold lands. Centrefarm has leased the area to AFM Central Australia Pty Ltd, a non-Indigenous family business, to develop and operate a 500 ha horticulture operation within the lease area. This operation is currently producing 8,000 tonnes of watermelon per annum.
Kuti Co	Kuti Co is jointly owned by the Ngarrindjeri Aboriginal Corporation, which represents the native title rights and interests of the Ngarrindjeri people, and Ngopamuldi Aboriginal Corporation, which is a small business with experience in natural resource-based enterprise. Kuti Co operates a wild catch pipi business in the Coorong and Lower Lakes coastal area of South Australia that is based on fishing licences equivalent to 15.82% of the total South Australian Pipi quota. Kuti Co also holds a 22% equity interest in Goolwa Pipi Co, its downstream processing and distribution partner.
Roebuck Plains Station	Roebuck Plains is a beef cattle breeding and growing enterprise based on a 275,540 ha pastoral lease located within the Yawuru people's exclusive native title determination area near Broome in the West Kimberley Region of Western Australia, and has capacity for approximately 18,000 head. The enterprise and pastoral lease are owned by Nyamba Buru Yawuru Ltd, a subsidiary of Yawuru Native Title Holders Aboriginal Corporation. Nyamba Buru Yawuru also owns the Roebuck Export Depot located adjacent to Broome Port. It is the subject of a special purpose lease and has a holding capacity of approximately 12,000 head of cattle and is currently leased to the ILSC with the intent to revert back to Yawuru as early as possible.
Yallalie Downs	Located on the traditional lands of the Yued people of the Noongar Nation in the Shire of Dandaragan, Yallalie Downs is a 2,242 ha broadacre freehold property and beef cattle backgrounding operation owned and operated by the Beemurra Aboriginal Corporation, a family-owned business with ancestral connections to Yued Country. The Beemurra Aboriginal Corporation is also a member of Noongar Land Enterprise Group, a First Nations grower group whose members represent a diverse production portfolio including, beef cattle, sheep, honey, bush foods, sandalwood, cultural tourism and training.



Collectively, the case studies illustrate several common themes. These are discussed in the following subsections.

1. First Nations primary industry ventures start with capacity building

While at varying stages of maturity, each of the case studies reports a story of capacity building across governance, technical, agribusiness specific and general commercial capability. This can be a decadal process and is, to varying degrees across the case study sample, ongoing.

The case studies demonstrate a variety of means through which capability is developed and established. This includes leasing part of the core asset to an independent capable operator, allowing locals to leverage from that capability, joint venturing with partners who have capacity, appointing experienced directors and managers and seeking support and advice from organisations such as, and including, the Office of the Registrar of Indigenous Corporations (ORIC), the Jawun secondment program and the State and Territory departments of primary industries.

2. First Nations primary industry operations are commercial operations

While motivated by additional social, cultural and environmental factors (see below), each of the case studies represents a commercial business. Even though financial accounts were not made available for all the studies, those which did present financial information are characterised by profitability. The nature of the activities of the others suggests that, *prima facie*, they are likely to be either financially sustainable or on a pathway to financial sustainability. In all cases, some financial benefit is returned to the ultimate beneficiary; the First Nations owner of the natural resource that underpins the production asset.

Each of the subjects of the case studies is either operating near or at the optimal sustainable use of its natural resource or is on a trajectory to do so. Furthermore, each of the case studies have plans to expand and diversify.

- Desert Springs Farm is planning to increase its acreage and expand into peanut production and immediate downstream processing, and is exploring expansion into garlic, pumpkin, potatoes and cabbage production, with plans to trial lettuce, bok choy, pak choy and herbs in a yet to be constructed greenhouse.
- Roebuck Plains Station is looking to establish formal upstream and downstream beef supply chains and is exploring diversification across tourism, hunting and



resource collection, minerals exploration, carbon and offsets market opportunities.

- Delta Downs Station is seeking to expand into tourism (eco and cultural tourism) opportunities, retail butchering, market gardens and aquaculture.
- Kuti Co is seeking to increase its quota and equity interest in a related downstream processor, as well as diversifying into other local fisheries, tourism and retail.
- Yallalie Downs is seeking to increase the capacity of its operation.

3. Social dividends are central to the business model

Consistent with the research of agricultural economist, Rola-Rubzen (2011), a significant component of the business model of all the case studies is the delivery of significant social benefits to the local First Nations community. In all cases this includes various work-ready, training, employment pathways and employment opportunities and variably, financial contributions to local health, education and social initiatives.

4. Preservation of culture and Caring for Country is central to the business model

All of the case studies involve primary production assets located on traditional lands of the owner or primary beneficiary. This in itself delivers cultural benefits, facilitating re-connection to Country and immediate access to important cultural assets and practices.

Furthermore, caring for Country is an integral component of the business model for each of the case studies. In the case of Desert Springs Farm this takes the form of co-mapping of Country to identify important cultural and environmental assets that require management and preservation. Roebuck Plains Station has established an IPA that incorporates part of the pastoral lease area and has implemented sustainable grazing practices across the property with significant involvement of the Yawuru Ranger group. Delta Downs Station has a significant focus on weed control and increasing biodiversity across the properties in accordance with the Kurtijar people's Land and Saltwater Country Plan (CLCAC 2014) and, with the support of the Normanton Ranger Group, is exploring implementing an IPA over components of its land holdings. Yallalie Downs supports youth programmes at its cultural healing place and Aboriginal Astro-tourism experiences.



In the case of Kuti Co, pipi have been a traditional food of the Ngarrindjeri people for tens of thousands of years, providing an immediate and direct connection to culture. Additionally, the Ngarrindjeri Rangers oversee the implementation of Ngarrindjeri Nation Yarlumar-Ruwe (Sea Country) Plan (2006) and the Coorong and Murray Lower Lakes Working on Country Programme.

5. The governance framework is tried and tested

With the exception of Yallalie Downs, which is a family owned and operated business, all of the case studies use structures characterised by corporate separation between the ultimate beneficiaries of the primary production resource and the associated primary production enterprise. In the case of Desert Springs Farm, this relationship is largely transactional in nature involving agency, licensing and leasing arrangements, albeit the structure also caters for some First Nations beneficiary oversight (see below). Regarding the other three case studies, various holding company-subsidary corporate structures are used.

Section 46 of the *Corporation Act 2001* (Commonwealth) provides that a company is a subsidiary of another company, referred to as a holding company, whereby the holding company:

- Controls the composition of that company's board of directors; or
- Controls more than half of that company's maximum voting power at general meetings; or
- Holds more than half of the share capital issued for that company; or
- That company is a subsidiary of a subsidiary of the holding company.

Subsidiary companies are used to separate certain operations of a company into a distinct but related legal entity for a variety of purposes including:

- Protection of core assets, by reducing the exposure of a company's core assets to legal action, that might arise from the operations of the subsidiary;
- Optimisation of taxation liabilities or concessions;
- Management efficacy, separating the management functions of the parent from those of the subsidiary;
- Raising of capital for specific operations; and
- Preparing specific operations for an exit through a trade sale or listing of securities on an exchange.



Subsidiary structures are also commonplace in the not-for-profit sector, particularly for the management of an enterprise that is designed to generate revenue for the not-for-profit holding company or its purpose, or social enterprise that is designed to deliver benefit for the constituents of the holding company.

Communal decision making is an aspect of governance in many First Nations cultures and is common in native title Prescribed Bodies Corporate (PBCs). Historically, this has been cited as being a potential hindrance to efficient commercial decision making. However, in the case of three of the case studies, subsidiary structures have been used to mitigate this issue. In the case of the two larger beef breeding and growing enterprises – Roebuck Plains Station and Delta Downs Station – the productive assets and associated enterprise are held in corporations that are, as in the case of Roebuck Plains Station subsidiary to another subsidiary of the Yawuru PBC and in the case of Delta Downs Station, subsidiary to an Aboriginal and Torres Strait Islander Corporation that is owned by Traditional Owners. An interesting difference between the Roebuck Plains and Delta Downs structures is that whereby in the case of Delta Downs, the subsidiary is able to pay dividends to the ultimate holding company, because the subsidiary of the Yawuru PBC that is the holding company of the subsidiary holding Roebuck Plains is a company limited by guarantee, it cannot pay dividends to the PBC, and instead builds wealth for other investments and initiatives undertaken on behalf of the Yawuru PBC.

In the case of Kuti Co, the pipi quota, fishing licences and associated enterprise are held in an incorporated joint venture, the two shareholders of which are a PBC and another operating Aboriginal and Torres Strait Islander Corporation.

Whereas the corporate structures of Roebuck Plains Station, Delta Downs Station and Kuti Co are designed to provide a degree of separation between the broader cultural decision-making environment that is typically associated with First Nations community and traditional owner representative organisations, the governance structure associated with the Desert Springs Farm project is designed to provide some integration of Traditional Owners to ensure their oversight and due influence is not negated by the agency, licensing and leasing arrangement that determines its structure. This has necessarily resulted in a *prima facie* somewhat complex governance structure.



6. Significant collaboration between First Nations groups

Another challenge to developing First Nations enterprise more generally that is frequently espoused is high levels of fragmentation and competition for limited resources between typically small organisations. The case studies suggest a very different story, demonstrating significant collaboration between First Nations organisations to deliver mutually beneficial economic, social, cultural and environmental outcomes.

Desert Springs Farm was given effect through a collaboration between the Central Land Council (CLC) and Centrefarm. Kuti Co has received support from Jawun and Ngarrindjeri Regional Authority. Yallalie Downs is a member of an all First Nations grower group, Noongar Land Enterprises.

7. ILSC has been an important resource

With the sole exception of Desert Springs Farm, the ILSC has performed an important and diverse role in establishing and supporting each of the case study enterprises. In the case of Roebuck Plains Station, the ILSC acquired the pastoral leases on Yawuru Country and granted them to a subsidiary of the Yawuru PBC, Nyamba Buru Yawuru Limited (NBY). The ILSC also supported capacity building, by leasing the operations back from Yawuru for a period of time while NBY built its pastoral operations capability and has provided support for caring for Country initiatives.

In the case of Yallalie Downs, the ILSC acquired freehold broadacre farmland on the ancestral lands of the owner family and granted that property to them. While the three pastoral leases that comprise Delta Downs Station were acquired through different means, the ILSC has provided Delta Downs Station with land management grants to improve the properties. In the case of Kuti Co, the ILSC provided financial support to acquire the pipi fishing quota that underpins the business and an equity interest in the downstream processor.

8. Other government agencies

In addition to the fundamental role that the ILSC has performed in establishing the case study enterprises, other Commonwealth, state and territory government agencies and instrumentalities have played roles in supporting the case study enterprises.

From a Commonwealth Government perspective, the National Indigenous Australians Agency, including its Empowered Communities and Indigenous Advancement Strategy



programmes, performed a role in Kuti Co and Delta Downs Station, with Kuti Co also benefiting from support from the National Oceans Office. Yallalie Downs has benefited from support from the ILSC and Desert Springs Farm has been a beneficiary of support from CRCNA, Charles Darwin University and the Aboriginals Benefit Account (ABA).

From a state and territory governments' perspective:

- Desert Springs Farm has been supported by the Northern Territory Department of Industry, Tourism and Trade and Northern Territory Department of Primary Industries and Resources;
- Delta Downs Station has been supported the Queensland Government Indigenous Ranger Program;
- Lotterywest has supported Roebuck Plains Station; and,
- the Western Australian Department of Primary Industries and Regional Development has supported both Roebuck Plains Station and Yallalie Downs.

The nature of this support has ranged from cash grants through to planning, research and technical advisory services.

9. Limited private capital

The challenges First Nations people and entities face with accessing finance is well documented. For example, in 2017 it was estimated that while 17% of Australian adults were severely or fully excluded from accessing financial services, a full one-third of the Australian First Nations population was either unable to, or presented with significant challenges with respect to, accessing financial services (Financial Ombudsman Service Australia 2017). Other research has identified that only one in ten First Nations Australians is financially secure (Centre for Social Impact and First Nations Foundation 2019). Factors known to contribute to these circumstances include lower levels of employment, particularly among higher paid professions and vocations, lower levels of inter-generational wealth transfer among First Nations families and, as a result, limited personal assets that can be used to access finance.

With the exception of Desert Springs Farm, which has deployed approximately \$6.5 million of private capital where the productive enterprise is owned and operated by a non-First Nations organisation there has been little, if any, private capital sourced and deployed by the enterprises. This raises the question as to how investable the assets might be and which asset classes may be sources of additional capital.



Restrictions associated with the tenure on which the enterprise is based is problematic for the purposes of attracting both equity and debt capital to First Nations land-based ventures. However, for First Nations agricultural ventures that can demonstrate adequate financial performance and can measure the social and environmental impact of their business model and operations, there is a potential opportunity to attract more private capital from the emerging social impact investment asset subclass or ESG oriented investment more broadly.

The social impact investment (or 'impact investment') asset subclass has grown to meet investor demand for the alignment of social and environmental values with investment, whereby investments targeted by the asset subclass seek to produce both financial returns and positive and measurable social and environmental outcomes.

Impact investment has four core elements:

- **Intentional** – there is a deliberate and clear intention on the part of the investor to contribute to a social and/or environmental outcome, rather than that outcome simply being a by-product of the investment.
- **Financial return** – impact investment is not philanthropic – it seeks a return on the capital deployed that can range from return of capital through to full competitive financial returns.
- **Investment instrument agnostic** – impact investment can be given effect through the full range of equity, equity-like and debt instruments.
- **Measurable impact** – professional impact investment typically requires the social and/or environmental outcomes of the investment to be objectively measurable and clearly traceable to the investment.

The relatively new impact investment sector has grown rapidly in recent years. Across the full spectrum of responsible and ethical investment there is currently US\$35.3 trillion under management, representing over one-third of all professionally managed assets. Of this, 2% is characterised as impact investment, with total impact investment funds under management exceeding US\$715 billion globally, representing growth of 40% since 2018 and expected to reach US\$1 trillion by the middle of this decade (Social Impact Investment Taskforce 2014). While just under half of impact investment is deployed across Europe and North America, although small in comparison, Australia is a growing impact investment market. In 2020, impact investment in Australia totalled A\$29 billion, a 457% increase since 2017. Most Australian impact investment is focused on positive environmental outcomes, mainly in the form of green bonds.



However, while impact investments targeting social outcomes represent only 4% of funds, they account for 60% of the number of investments and have increased ten-fold since 2017 (Responsible Investment Association Australia 2018, 2021).

Being able to identify high potential agricultural land and measure and account for positive social and environmental impacts will be key to attracting impact investment to the First Nations agriculture sector.

10. First Nations primary industry faces the same challenges as most regional businesses

Not surprisingly, the case studies indicate that First Nations primary production businesses face the same challenges experienced by other regional businesses, particularly with respect to access to infrastructure. Parts of regional, and particularly remote Australia are characterised by limited transport and energy infrastructure. Four of the five case studies (Roebuck Plains Station, Yallalie Downs, Kuti Co and Desert Springs Farm) are in close proximity to major regional highways and three (Roebuck Plains Station, Yallalie Downs and Kuti Co) are located in reasonable proximity to major regional towns or cities.

These case studies demonstrate that First Nations agriculture and fisheries enterprises can deliver significant economic, social and cultural dividends to First Nations owners and communities, whilst contributing to Australian primary production.

The next Chapter discusses a method of Geographic Information Systems analysis that can be used to identify additional areas of the Indigenous Estate that are likely suitable for the development of agricultural production systems.



GIS ANALYSIS: A BASELINE ASSESSMENT OF AGRICULTURAL SUITABILITY AND PRODUCTION FACTORS ACROSS THE INDIGENOUS ESTATE

Bruce Doran, Associate Professor, Fenner School of Environment and Society, Australian National University

Anna Normyle, PhD Student, Fenner School of Environment and Society, Australian National University

This section presents the Geographic Information Systems techniques being used to conduct the spatial elements of the situational analysis. The model outputs and findings presented in this section complement the case studies (McArthur et al. 2022) and natural capital accounting analysis in the next section, to provide information which characterises the nature of agriculture across the Indigenous Estate.

Methods

Definitions and context

By definition, a Geographic Information System (GIS) is a computer system designed to capture, store, query, analyse and display geospatial data (Chang 2019). GIS emerged from the work of eminent geographer Ian McHarg in the 1960s. In particular, his seminal book '*Design With Nature*', McHarg (1969) presented a series of overlay methods using transparencies and manual coding which enabled land-use planners to consider elements of the natural landscape (e.g. soil quality, forest types, watersheds) in relation to agricultural or urban development. Factors were subjectively but explicitly ranked from 'maximally suitable' to 'minimally suitable', and the overlay enabled decision makers to determine areas most or least appropriate for particular developments prior to construction or project implementation. McHarg's manual light table overlay methods were later computerised and directly led to the rise of modern GIS software. With improved desktop computing power and greater access to spatial data in the 1980s and 1990s, the term 'Geographic Information Systems' was coined by Goodchild (1992), with the late 1990s showing broad uptake of spatial technology in research and government arenas.



From the early 2000s onwards, there has been an explosion in the use and availability of spatial data, and further advances in computing technology. Many applications of GIS are now embedded in daily routines, such as navigation using smartphones and streamlined access to satellite imagery. From a definitional perspective, GIS can be further separated into Geographic Information Science, which has a focus on scientific inquiry into how spatial data is developed, represented and analysed, or ‘GI Systems’, which are more aligned with a ‘toolbox’ or applied use of spatial technologies. This project takes a GI Systems approach, to adapt well-established spatial methods to investigate agricultural suitability across the Indigenous Estate.

Modelling approach

The GIS methods used in this project to model the spatial distribution of agricultural suitability across the Indigenous Estate are well established and have been used globally. We primarily use Weighted Linear Combination (WLC), a type of index model which involves the calculation of a suitability value for each unit area, such as a pixel, to produce a ranked map based on index values (Chang 2019). The generic process requires input variables to be standardised, assigned criterion weights and aggregated to produce the final index values (see Figure 1 for a schematic representation).

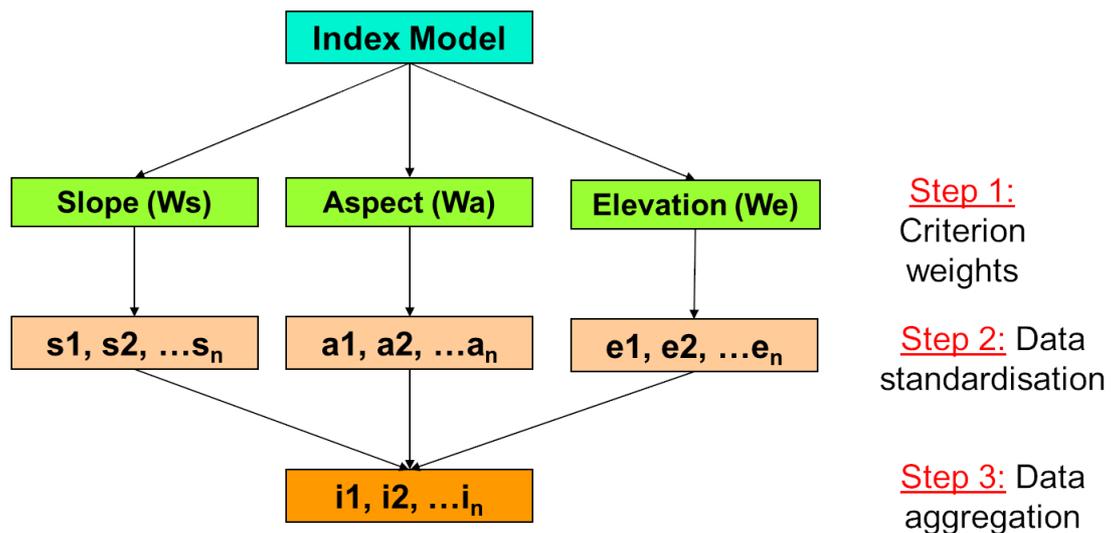
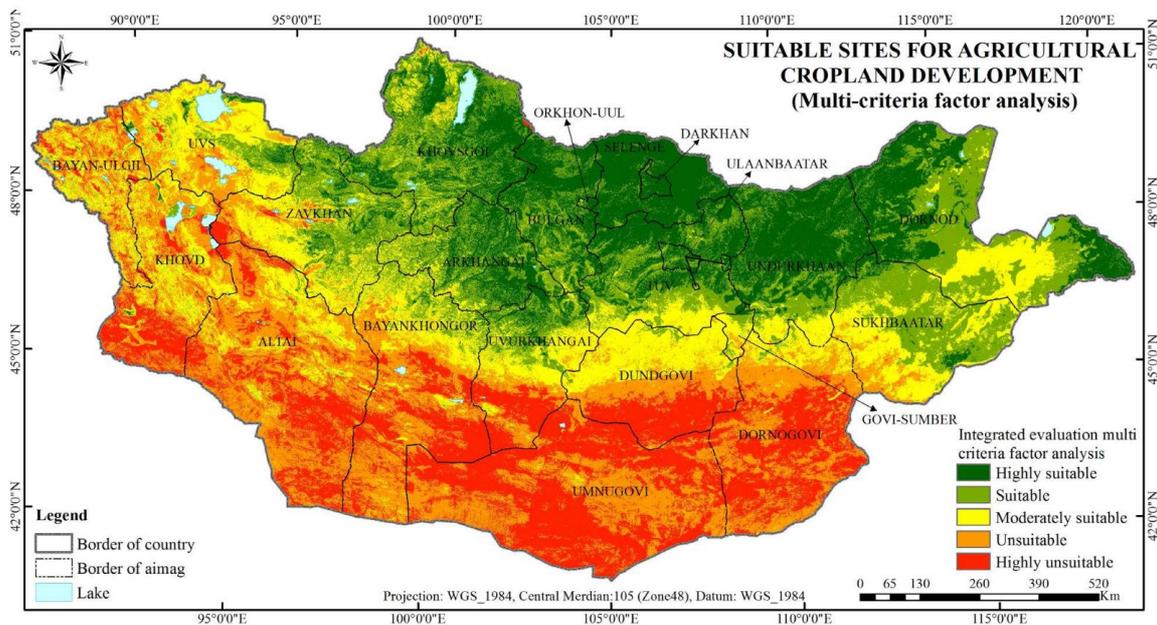


Figure 1 - Generic representation of an index model (adapted from Chang 2019).

WLC and related Multi-Criteria Decision Analysis Approach methods have been applied to different aspects of agriculture at national and regional levels, as well as for specific crops. A brief overview is provided herein.



Musakwa (2018), developed a ‘strategically located land index’ to identify suitable areas for agricultural land reform in South Africa. The analyses were presented as a series of maps with areas classified on a range from ‘unsuitable’ to ‘highly suitable’. The outputs were considered to be an invaluable tool for facilitating evidence-based decision making for land reform. Otgonbayar et al. (2017), developed a cropland suitability map of Mongolia based on multi-criteria modelling which synthesised 17 criteria for factors relating to topography, soil properties, vegetation, climate and socio-economic patterns. As with Musakwa’s (2018) study, criteria were assigned weights in a manner consistent with the generic structure of an index model (Chang, 2019) and the resultant maps were classified – in this example, from ‘highly unsuitable’ to ‘highly suitable’. The authors note the potential for the cropland suitability evaluation (see Map 9) to save time when making land management decisions and to serve as a basis for policy justification. In another example, Tomić, Ivić and Roić (2018) used multi-criteria GIS methods to examine agricultural suitability in relation to the fragmentation of land parcels across Croatia.



Map 9 - A national model of suitable site for cropland development in Mongolia (source: Otgonbayar et al. 2017: 256)

Land suitability for specific crop types has also been evaluated on national scales. Guo et al. (2010), modelled suitability for potato crops in China with results indicating the spatial extent of potentially suitable areas classed on a scale from ‘very highly suitable’ to ‘not suitable’. El Baroudy (2016), produced a country-wide suitability model for wheat



production in Egypt noting that wheat is the most important national crop but that suitability is not equal across all land covers. As with other studies, the suitability values were classified and examined from a spatial perspective. Lozano-García et al. (2020) developed a national model of agricultural by-products suitable for renewable energy production in Mexico. The study identified substantial variation in suitability values, with the authors noting that the spatial range of municipalities considered in the study provided further relevance for decision makers and investors in renewable energy. The authors also note that there is considerable merit in analysing different priority scenarios.

Index modelling approaches being used to investigate regional scale agricultural suitability include those by Al-Taani, Al-Husban and Farhan (2021), Anderson and Rocek (2018), Kaysay et al. (2018), Memarbashi et al. (2017), and Mendas and Delali (2012). A summary of research papers based on multicriteria GIS methods at the regional scale is in Table 6.

Table 6 – Research papers based on GIS multi-criteria methods for land suitability evaluation (source: adapted from Kahsay et al. 2018)

Author	Criteria used	Suitability field
Hossain and Das (2010)	Water temperature, water pH, dissolved oxygen, Nitrate-N, Phosphate-P, total dissolved solids, texture, slope, pH, soil organic carbon, land use, distance to road, distance to electricity, distance to market, distance to fry source, labour availability	Aquaculture
Feizizadeh and Blaschke (2012)	Elevation, slope, aspect, fertility, pH, temperature, precipitation, ground water storage	Rainfed and irrigated agriculture
Mendas and Delali (2012)	Easily utilisable water reserve, drainage, permeability, pH, EC, CaCO ₃ , CEC, texture, soil depth, Slope, labour availability, distance to road	Durum wheat
Walke et al. (2012)	Precipitation, temperature, LGP, RH, Slope, erosion, drainage, flooding, AWC, stoniness, texture, coarse fragments, soil depth, CaCO ₃ , gypsum, CEC, PBS, SOC, EC, texture	Cotton
Akıncı, Özalp and Turgut (2013)	Soil group; LUCS, LUCSS, soil depth, slope, aspect, elevation, erosion, other soil properties	General agriculture
Ayehu and Besufekad (2015)	Slope, soil depth, temperature, precipitation, pH, texture	Rice
Zolekar and Bhagat (2015)	Slope, soil depth, texture, SOC, WHC, pH, TN, AP, exchangeable potassium, erosion, LULC	General agriculture
Gigović et al. (2016)	Elevation, slope, aspect, visibility, precipitation, temperature, geology, soil cover, vegetation type and density, LULC, reservation, stable water, distance from settlements, distance from road, distance from cultural sites and negative factors (constraints)	Ecotourism development

Author	Criteria used	Suitability field
Pramanik (2016)	Slope, elevation, LULC, soil moisture, drainage, texture, geology, aspect, distance from roads, distance from water sources	General agriculture
Yalew et al. (2016)	Soil moisture, stoniness, soil group, water resources, elevation, slope, soil depth, distance from roads	General agriculture
Maleki et al. (2017)	Temperature, precipitation, sunshine hours, frost hazard, RH, permeability, texture, pH, elevation, slope, aspect	Saffron
Owusu et al. (2017)	LULC, slope, soil unit, flow accumulation, transmissivity, regolith, water availability, borehole, distance from roads, population density	Aquifer storage and recharge site locations
Bagdavičiūtė et al. (2018)	EC, current velocity and stability, suspended materials, marine protected areas, distance from roads, ice cover, water resources	Zebra mussel farming
Kazemi and Akinci (2018)	LULC, SOC, pH, EC, texture, erosion, precipitation, temperature, sunshine hours, slope, elevation	Rainfed agriculture
Purnamasari, Ahamed and Noguchi (2018)	LULC, slope, precipitation, temperature, water resources availability, elevation, soil group, NDVI	Cassava

In general, analyses at regional scales allow for models to be linked to localised production and planning factors. Memarbashi et al. (2017) applied a multi-criteria GIS approach to evaluate land suitability in the Sangab Plain in northeast Iran. The area is characterised by a semi-desert climate, with cold winters, warm dry summers and low rainfall. The livelihoods of people in the region are dependent upon agriculture, livestock and mining. In this context, the suitability outputs were interpreted in relation to government planning imperatives regarding the conversion of grasslands and croplands. As with other studies, the authors note the benefits of rapid GIS-based evaluation and the potential to assign different weights and priorities to model inputs to support strategic policy decisions. In a similar vein, Wotlolan et al's. (2021) multi-criteria analysis of multiple crop agroforestry in the Sigatoka Valley of Fiji was seen as being adaptable to other land use suitability applications in the Pacific region.

GIS Study Objectives

Drawing upon this background of the policy application and decision-making benefits of multicriteria analysis, the objective of this study was to develop a proof-of-concept assessment for a national-scale multi-criteria agricultural suitability model for the Indigenous Estate. The core spatial analysis was based on a national-level GIS approach (e.g. Otgonbayar et al. 2017; Musakwa 2018) which synthesised biophysical datasets to determine the relative suitability of an area for Indigenous agricultural initiatives. The key stages, process and outputs of the GIS analysis for the situational analysis are summarised in Figure 2.

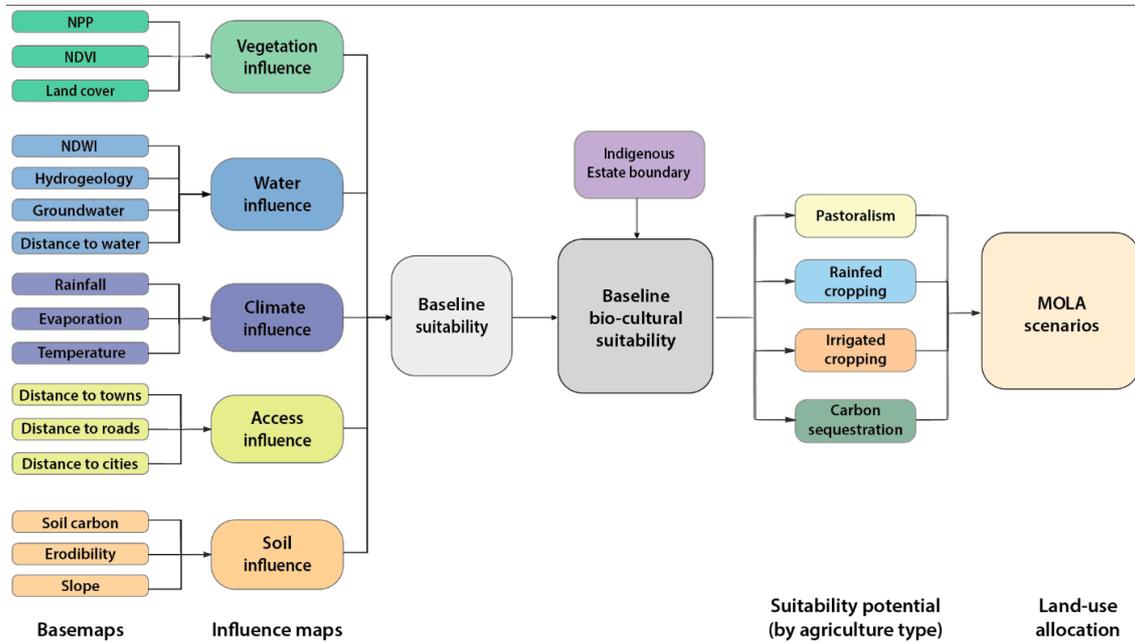


Figure 2 – Flow chart of modelling stages and outputs.

Future regional engagement could be initiated at each stage of the analysis for end users to adjust weightings based on local knowledge and priorities for potential agricultural development.

Data Processing

Creation of baseline datasets

The overarching WLC model required the sourcing and formatting of relevant baseline datasets related to vegetation, climate, water sources, accessibility and soils, for input into the integrated agricultural model.

Baseline datasets were sourced from national and international agencies including the ABS, Department of Agriculture, Water and the Environment (DAWE), CSIRO, Bureau of Meteorology (BoM) and the United States Geological Survey (USGS). For each dataset, the most current data version was applied. The study’s metadata are in Appendix 2.

Processing of datasets was undertaken to obtain standardised baseline values at the continent scale. To derive biophysical index datasets from vegetation cover, relative vegetation productivity and moisture, Moderate Resolution Imaging Spectroradiometer (MODIS) data were processed using Google Earth Engine (Gorelick et al. 2017). National-scale annual mean values from June 2019 to June 2020 were derived for

biophysical influences using a Normalised Difference Vegetation Index (NDVI), Net Primary Productivity (NPP) Index and a Normalised Difference Water Index (NDWI). These indices were standardised to derive a low to high value range between zero and one.

Where data were provided in pre-processed national grids (e.g. climatic data: mean temperature, rainfall, erosivity and soils data), these were standardised in ArcGIS Pro 2. For accessibility datasets (e.g. proximity to roads, ports and towns and cities), a Euclidean distance tool was used in ArcGIS Pro to calculate the Euclidean distance to the closest source. These data were then standardised between zero and one.

All data were cleaned and formatted with the consistent projection system, GDA 2020, and grouped into five categories for analysis on overall agricultural suitability: vegetation influences, water influences, climate influences, soil influences and access influences. Maps of the baseline datasets were also provided in an atlas-style format, to assist with communicating the modelling approach to decision makers.

Mapping of biocultural assets

GIS overlay methods were used to illustrate the nature of baseline datasets across Australia's Indigenous Estate. The core datasets were mapped against biocultural assets expressed through the Indigenous Estate boundaries defined by this study. For the purposes of this analysis, Indigenous land was classed in two ways:

- (A) Land that is owned by Indigenous People, or recognised under exclusive native title; and
- (B) Land that is recognised under some form of Indigenous management or co-management, or recognised under non-exclusive native title.

This classification facilitated the visualisation of different factors relevant to areas where Indigenous agriculture enterprise is most likely to be undertaken, and where Indigenous peoples are likely to have the greatest capacity to engage with agricultural development.

Agricultural scenario modelling

Regional land use scenario modelling was also developed. This analysis drew upon well-used GIS methods to integrate baseline data in a manner that demonstrates spatial allocation patterns according to different weightings, procedures and priorities.



The Kimberley Land Council (KLC), CLC and Cape York Land Council (CYLC) areas were selected as the regional units of the analysis as they broadly represent the case study context of this report, as well as the range of potential agricultural options available in northern Australia. The land council boundaries were clipped from the NNTT dataset (2022) and populated using the Indigenous Estate land classifications defined for biocultural asset reporting.

Two stages of combinatory analysis were undertaken. First, the baseline biocultural influence models were combined to demonstrate the relative suitability of the land council areas for the agricultural development scenarios described in Table 7. Next, the resulting land use scenario rankings for pastoralism, carbon farming, rainfed cropping and irrigated cropping were used as inputs for a Multi-Objective Land Use Allocation (MOLA) model. Based on its inputs, this model allocated the appropriate use type to certain land units across the regional case study. Four scenarios were developed by adjusting the model to bias each potential agricultural development scenario.

Table 7 – Indicative importance rankings for land-use scenario models⁵.

<i>Indicative enterprise type</i>	Relative importance score				
	Vegetation	Water	Climate	Soils	Access
Pastoral	Very High	High	Low	Low	Moderate
Rainfed cropping	Low	High	Very high	Very high	Moderate
Irrigated cropping	Low	Very High	Very High	Very High	Moderate
Carbon sequestration	Very High	Low	Low	High	Low

Dashboard visualisation

The key findings from the suitability of the proof-of-concept assessment were presented in a flexible Power BI dashboard format. Power BI is a data modelling software that aims to provide interactive visualisations and business analytics through reports and dashboards (Lachey & Price 2018). The platform was selected for

⁵ Note that engagement with traditional owners and other end users could adjust these weightings to provide a nuanced assessment of potential agricultural development



communicating the baseline agricultural data due to its accessibility and capacity to display pivot plots with multiple statistical and geographic variants (Ulag 2020). This provides end users with an interactive environment to explore and summarise data at regional scales and specific areas of interest.

In Power BI, filters enabled users to move between different native title and land council areas to explore data from the key influence models in specific areas of interest (e.g. Figure 2). This provides end users with an interactive environment to explore and summarise data at regional scales and specific areas of interest.

Caveats on analysis

As a scoping study focused on demonstrating broadly a baseline suitability of the Indigenous Estate for agriculture at a national scale, there are four limitations of the analysis.

First, for this scoping study, equal weighting criteria were applied when combining all baseline datasets for input into the influence and suitability models. We note that this is an important area where engagement with Traditional Owners and other end users should be applied to adjust these weightings to provide a nuanced assessment of potential agricultural development specific to a given region.

Second, given that the scope of this study was to provide an indicative baseline value of land suitability for agriculture, the most recent temporal version of each input dataset was deemed sufficient to demonstrate the proof of concept for agricultural suitability. Consequently, the temporal range of data inputs extends from 2010–2021 and detailed knowledge on seasonal variation has not been considered.

Third, further inputs based on regional knowledge would be needed to provide a complete picture of each influence factor modelled at a local and regional scale. For example, water quality and water rights measures based on regional data would provide an additional important indication of water availability for regional development. Likewise, access data may be impacted by local seasonal changes such as flooding in northern Australia, which may have corresponding implications for the types of agricultural development options deemed appropriate.

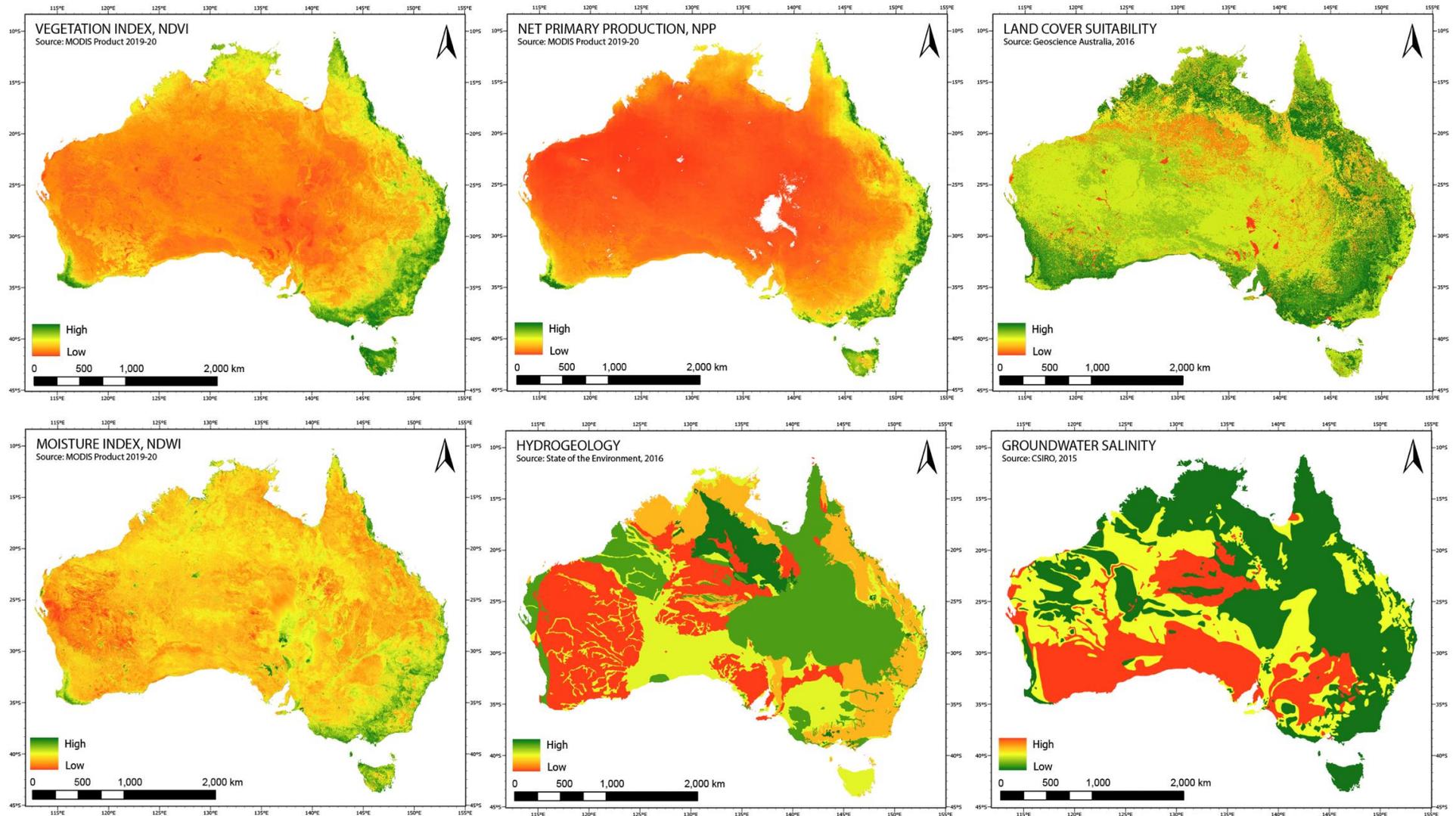
Finally, vector-based datasets such as native title boundaries, ground water salinity and estimated grazing value are subject to the Modifiable Areal Unit Problem and Ecological Fallacy, where internal variation within polygons is reduced to zero and

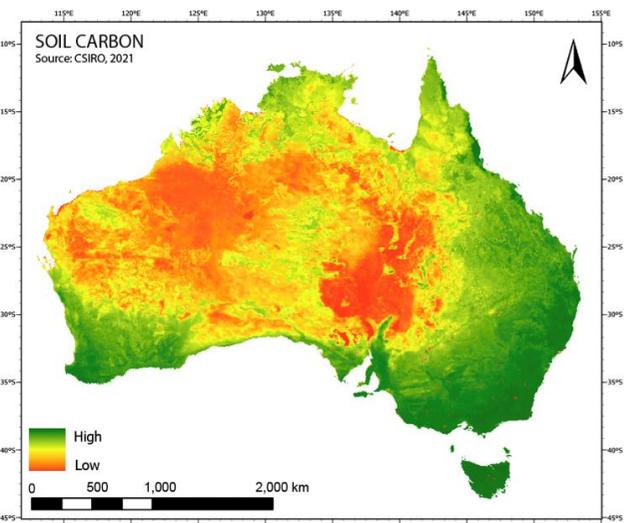
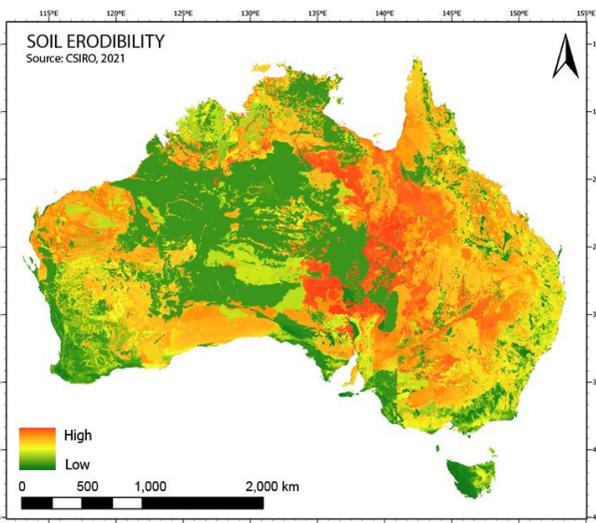
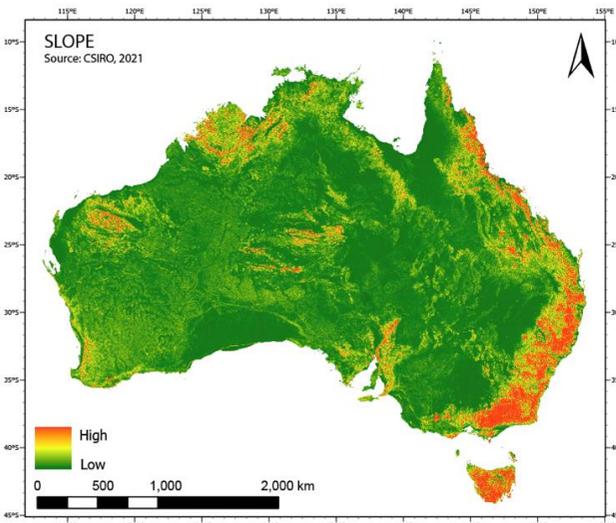
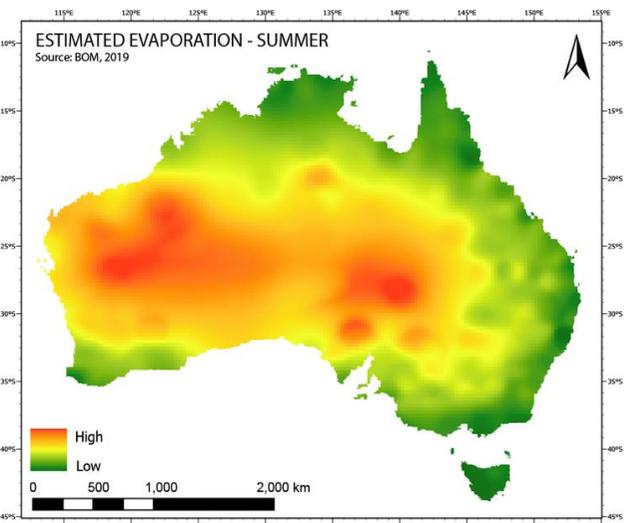
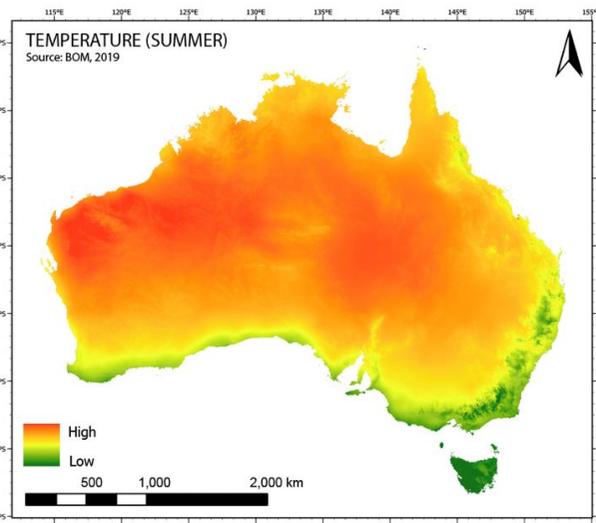
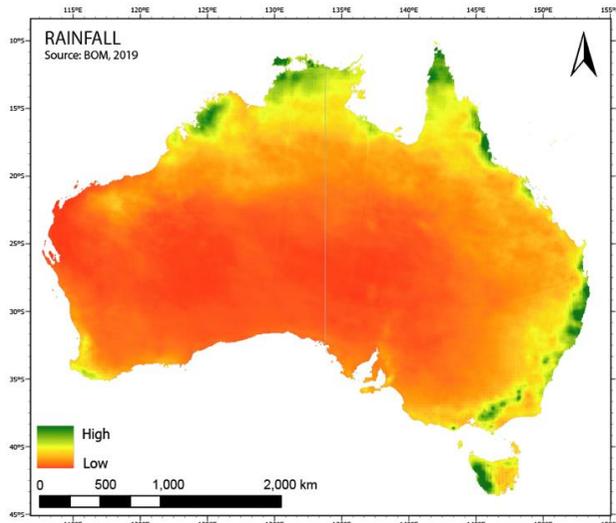
assumptions based on aggregate patterns are problematic. For example, inferences about specific Indigenous agribusinesses within a region based on suitability model outputs could be misleading. In a similar manner, the spatial resolution of the GIS models may obscure or simplify fine-scale patterns of importance at local or regional scales.

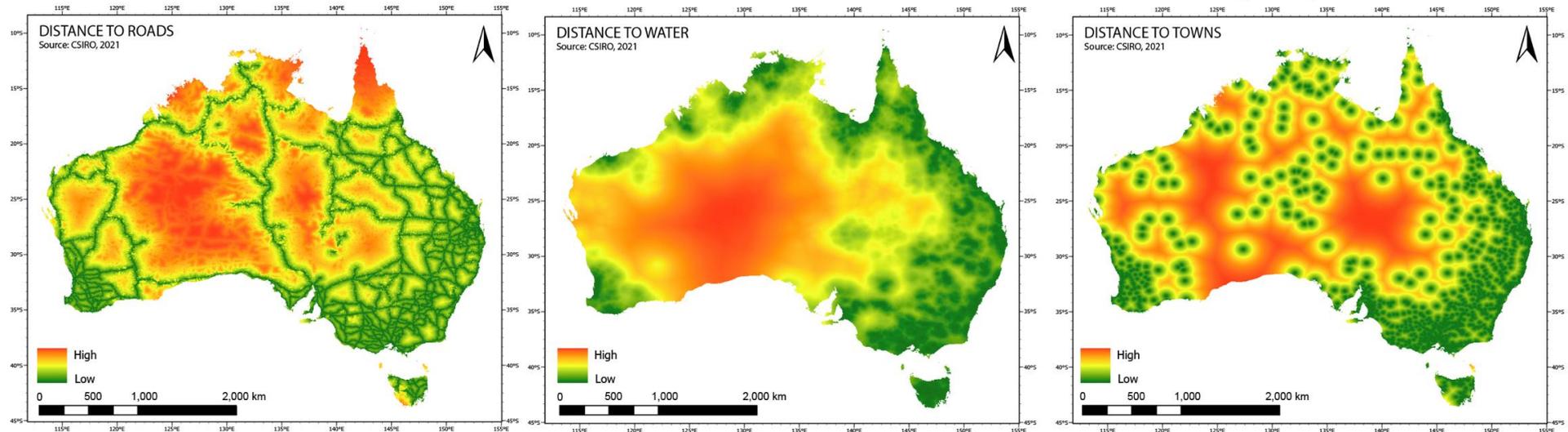
Results

Baseline National Datasets

The baseline datasets developed by this study are visualised in Map 10. Data for biophysical indices (NDVI, NPP and NDWI), soil and climate variables, and accessibility were standardised and classed according to their relative low (red) to high (green) suitability for agriculture. Map 10 shows that the central and western areas of the continent have generally lower values across all indicators, while the east coast, south-west corner of Western Australia and northern coastline are generally more suitable based on factors of agricultural development.



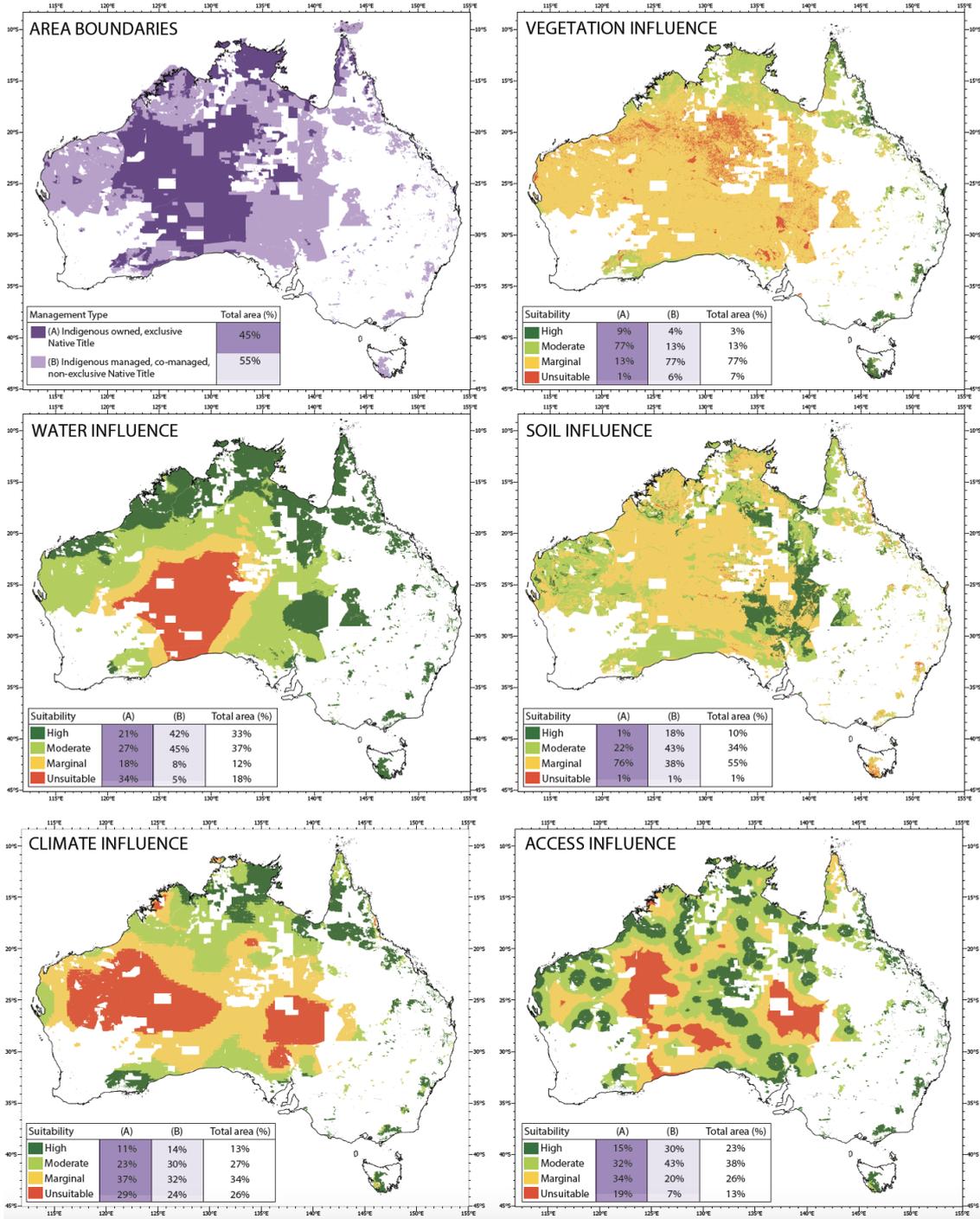




Map 10 - Sample maps of the baseline datasets incorporated in the analysis

Biocultural influence models

Map 11 shows influence maps produced for the range of key influences to agricultural development potential including vegetation, water, climate, soil and access. The data show high agricultural potential across the Indigenous Estate, particularly along the northern Australian coastline and western Queensland.



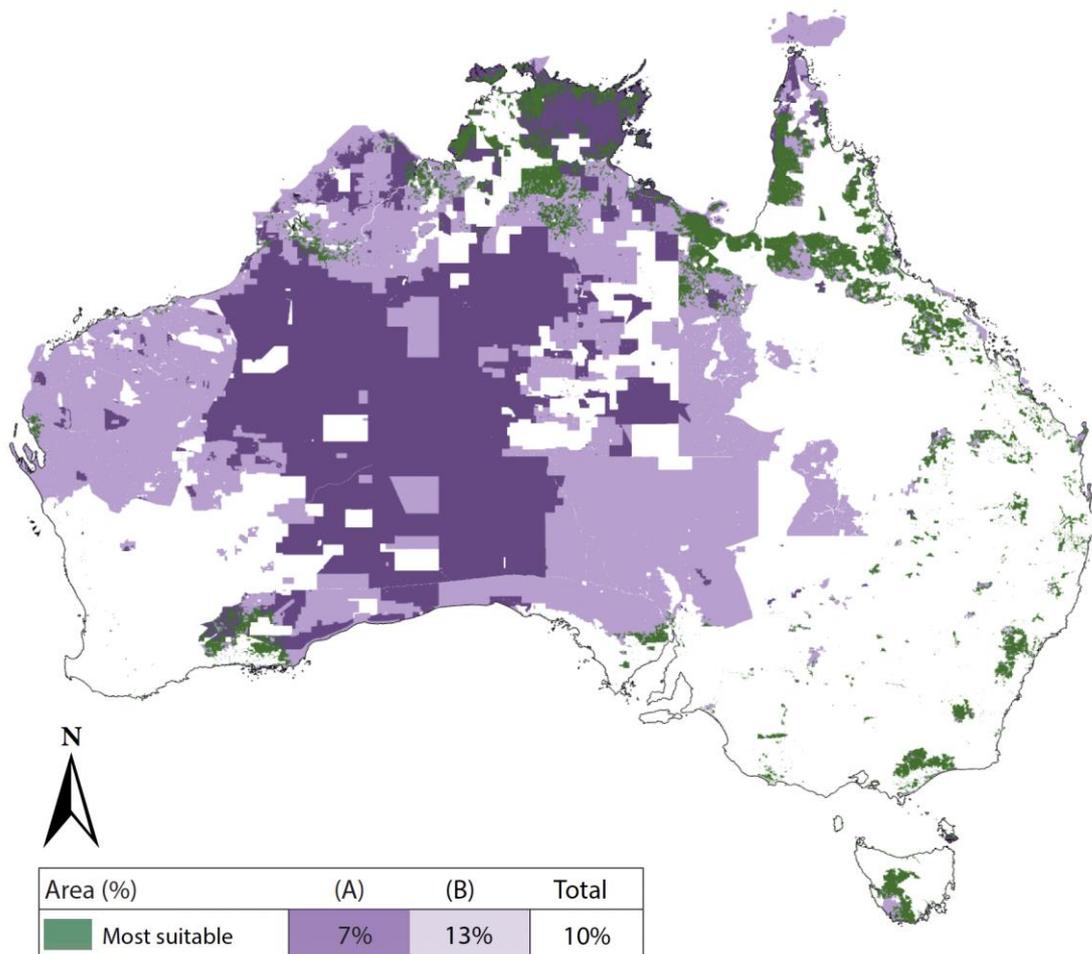
Map 11 - Biocultural models for vegetation, water, climate, soil and access influences to agricultural suitability across the Indigenous Estate. The red to green colour gradient provides an indication of the relative 'low to high' suitability for agricultural development.

Unsuitable areas in central and Western Australia tend to align with areas that are Indigenous owned or recognised under exclusive native title. Notably, Map 12 shows that areas that are Indigenous owned or recognised under exclusive native title (shown



in A) have consistently lower areas of high suitability values compared to areas that are under Indigenous management or non-exclusive native title (shown in B).

Based on extracting the agricultural suitability data, Map 12 shows the most suitable (suitability >75%) areas for potential agricultural development initiatives. Overlaying these areas with the Indigenous Estate boundary defined by this study shows that 'most suitable' areas comprise 10% of the Indigenous Estate. This includes 7% of areas that are recognized under Indigenous ownership or exclusive native title, and 13% of areas that are under some form of Indigenous management or non-exclusive native title. The model may be useful for highlighting where further engagement with Indigenous owners and managers can be initiated.



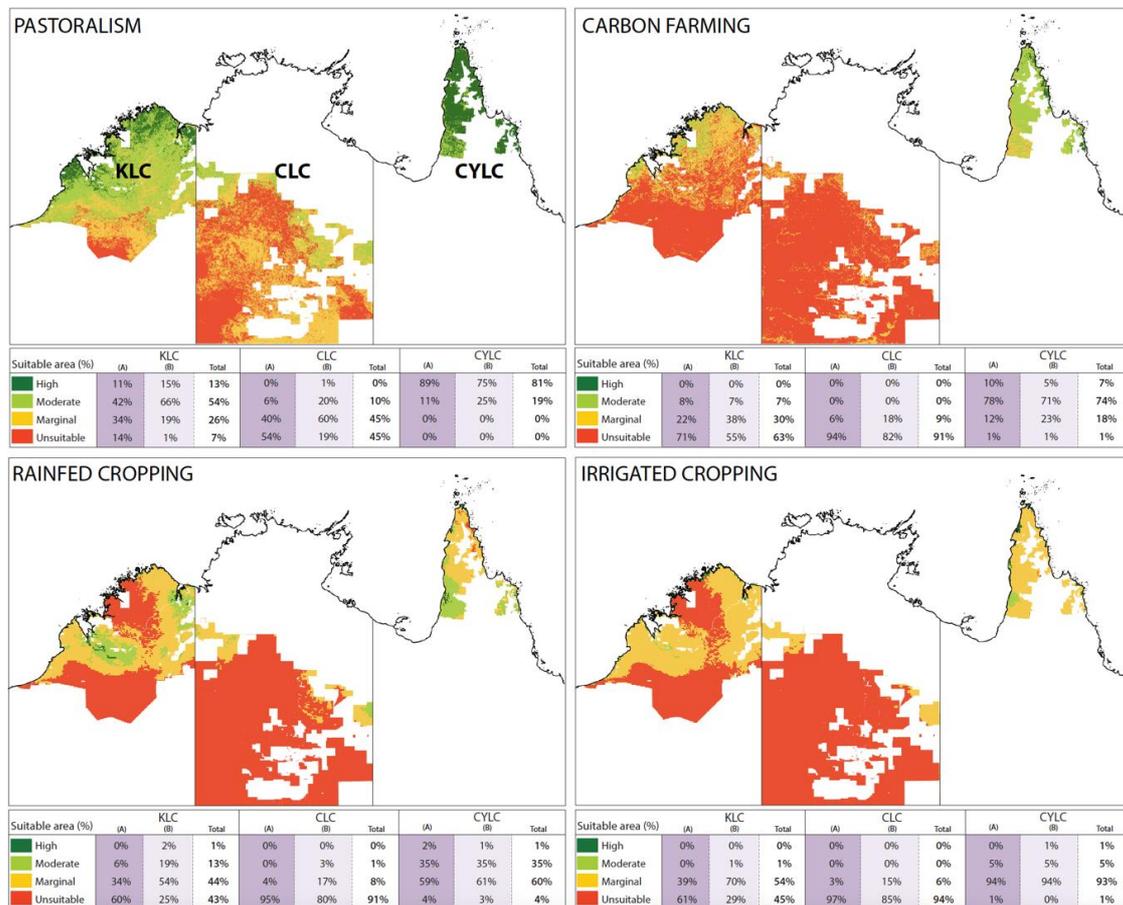
Map 12 - Areas of the Indigenous Estate identified as 'most suitable' for agriculture based on the combined influence models.



Regional agricultural suitability

Suitability was also modelled regionally for three Land Councils in northern Australia. Map 13 shows the suitability of pastoralism, carbon farming and rainfed and irrigated cropping across Indigenous Estate areas in the KLC, the CLC and the CYLC areas. In general, pastoralism is the most suitable agriculture type, with a high suitability shown across the KLC and CYLC. Few areas are shown to have high suitability for cropping activities, particularly irrigated cropping, with no areas of high suitability reported, and only a small area of moderately suitable land located in the CYLC.

Following the trend identified in the national dataset (see Map 12), areas under Indigenous ownership and exclusive native title had generally less suitable land for agricultural development than areas recognised as managed or under non-exclusive native title.



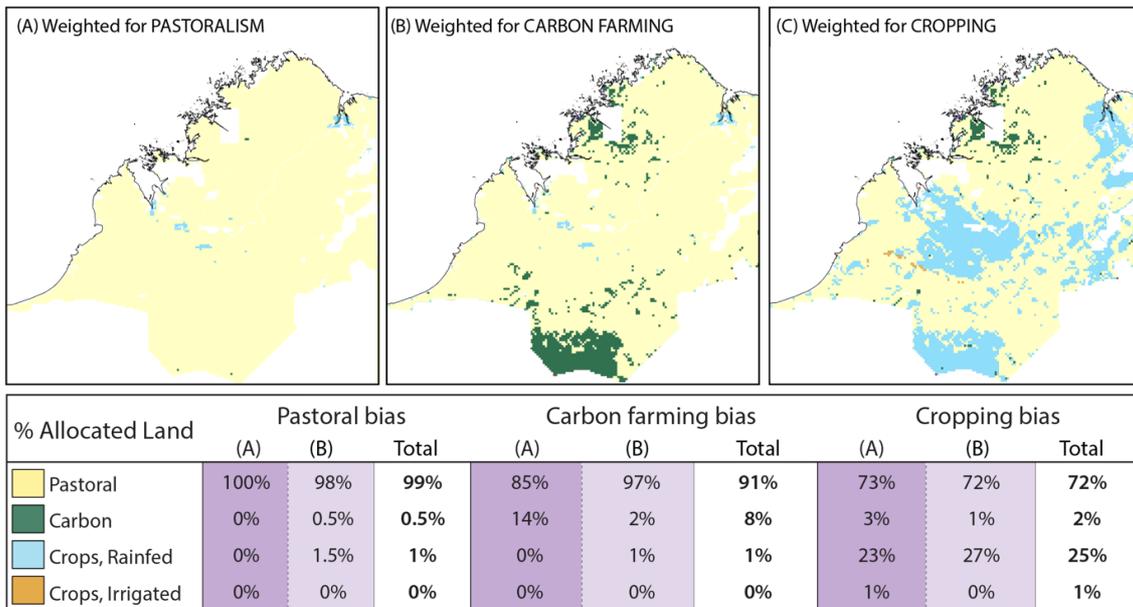
Map 13 – Agricultural suitability scenarios for pastoralism, carbon farming and cropping development across Indigenous Estate areas within three northern-Australian Aboriginal Land Councils



Multi-Objective Land Use Allocation Scenarios

The land use scenario models for pastoralism, carbon farming, and rainfed and irrigated cropping provided the inputs for a MOLA. Map 14 shows the allocation of land to each of these scenarios across the KLC in north-western Australia.

The indicative weighted MOLA provides an opportunity for further engagement with owners and managers about potential options for agricultural development. For example, Map 14(A), (B), and (C) shows potential land allocation scenarios in the KLC. In (A), the MOLA is weighted to favour pastoral activities. The output shows pastoral opportunities allocated throughout 99% of the region, with some opportunities for cropping in areas under Indigenous management/non-exclusive native title. Similarly, in (B), carbon farming opportunities are identified in the southern and coastal areas of the KLC, corresponding with areas that are Indigenous owned. In (C), weightings towards rainfed and irrigated cropping show limited opportunities for irrigation (<1%) in the region, with moderate potential for rainfed cropping across all tenure types.



Map 14 - Example weighted MOLA scenarios for pastoralism, carbon farming and cropping (rainfed and irrigated) for (A) exclusive native title and owned; and (B) non-exclusive native title and managed areas of the Kimberley Land Council.



Power BI Dashboard Visualisation

All data produced by the study were also visualized as an interactive Power BI dashboard to enable rapid overview and comparison of each region (see Figure 3 and Figure 4). Filtering allowed users to move between biocultural assets as represented by native title areas to assess land cover type, use and the relative suitability of each area for agricultural activities. The capacity of Power BI and ArcGIS-enabled dashboards to streamline data across geographic and political units (Ulag 2020), has led to a high uptake of the software by governments communicating statistics related to the COVID-19 outbreak on public platforms (e.g. Perkel 2020; Ulag 2020). The dashboard's flexibility enables a rapid overview of how particular areas compare in terms of the area of interest, land cover present and relative suitability for agriculture. The dashboard is intended to provide a tool for engagement with end users, such as Traditional Owner Groups, PBCs and Land Councils.





Figure 3 – Dashboard interface in Power BI. Filters show key outputs for different native title areas, in Gkuthaarn and Kukatj People, and Rubibi Community in Queensland. The dashboard can be explored live at: <https://cutt.ly/ASA0522>.



A proposal for strategic regional GIS assessments involving Traditional Owners

Multi-criteria GIS assessments frequently include processes to involve stakeholders when defining the relative importance of map layers and model criteria (Sarky, Wright & Edwards 2017). This recognises stakeholders or practitioners as having expert knowledge to inform modelling decisions (Berg, Mulokozi & Udikas 2021). For example, Musakwa (2018) conducted workshops with key stakeholders where participants applied a weight and rank for different criteria in relation to agricultural land reform in South Africa. In a similar vein, Mighty (2015) involved stakeholders from the Jamaican Coffee Industry to assess model weights when conducting a multi-criteria evaluation aiming to improve the competitive advantage of Jamaican coffee. Berg, Mulokozi & Udikas (2021) validated multi-criteria outputs with urban and rural farmers when assessing the suitability of small holder Tilapia farming in Tanzania.

Through workshops or interviews, participants can assess the importance of one criterion relative to another using Saaty's (1980, 1990; 2008) extensively used pairwise ranking matrix or Analytical Hierarchical Process (AHP) (see Table 8). As such, key stakeholders can be directly involved in the construction of multi-criteria outputs and scenarios, meaning that this approach to suitability modelling becomes a form of Participatory GIS (PGIS). At the regional level, PGIS has many documented advantages including being geared towards community empowerment through tailored, demand-driven and user-friendly applications of GIS (Rambaldi et al. 2006) whilst stimulating innovation, and ultimately encouraging positive social change (Corbett et al. 2006).



Table 8 – Saaty's (1980) Pairwise ranking matrix

How important is A relative to B	Preference index assigned
Equally important	1
Moderately important	3
Strongly more important	5
Very strongly more important	7
Overwhelmingly more important	9
Values in between	2; 4; 6; 8

The multicriteria GIS models and MOLA scenarios presented in this report have been developed without direct input from key stakeholders across the Indigenous Estate. This is acknowledged as a fundamental limitation of a national-level desktop analysis. However, this also presents an opportunity for strategic regional engagement with Traditional Owners through the use of PGIS methods, such as the AHP and the pairwise ranking process, outlined above. The suitability model and MOLA outputs presented for different land council areas (see Figure 5), could be further tailored through stakeholder engagement with Traditional Owners. Criteria could be assessed for regional relevance (e.g. ground or surface water quality) or new criteria could be identified and included. PGIS has further advantages in workshop settings, as complex spatial models can be presented and assessed using visual methods, enabling maps to become a common language for decision makers (Doran & Young 2013; see also Figure 5). A model for strategic regional assessments of agricultural suitability in different parts of the Indigenous Estate is presented in Figure 4. Enabling greater specificity around model weights and criteria by incorporating the expert regional and local knowledge of Traditional Owners would facilitate a finer-scale assessment of agricultural suitability, and potentially, clearer avenues for investment or government and private sector involvement. As frequently noted by Peter Yu and other eminent Indigenous leaders, government initiatives to develop parts of the Indigenous Estate have failed to embrace Aboriginal and Torres Strait Islander people (Brann 2016). A model for strategic regional engagement such as that shown in Figure 4 could assist in rectifying this entrenched problem.

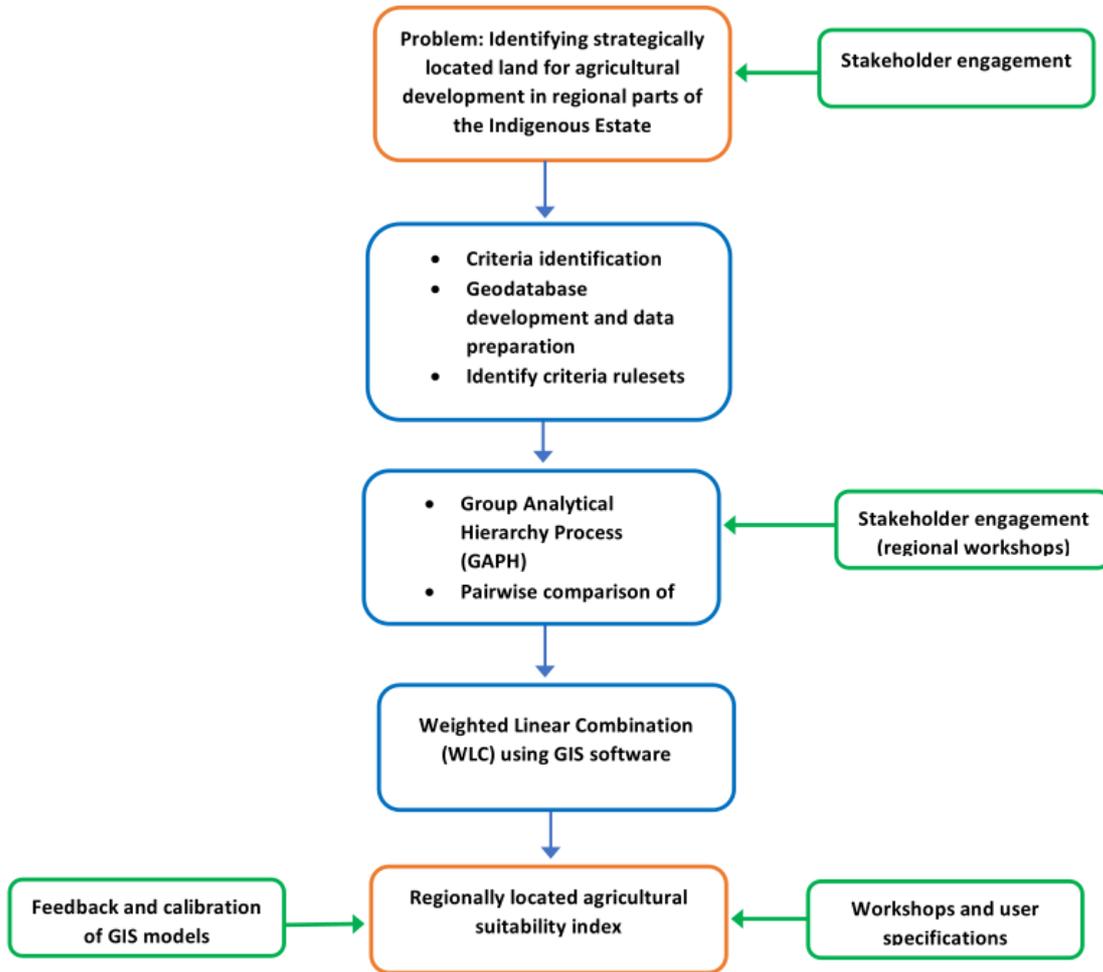


Figure 4– A proposed model for stakeholder-based strategic regional assessments of agricultural suitability (source: adapted from Musakwa 2018).

Summary and key recommendations

The key findings from the GIS analysis of agricultural suitability across the Indigenous Estate are now summarised.

Purpose and nature of GIS analysis

The GIS analysis has provided an integrated assessment of agricultural suitability across the Indigenous Estate, as defined at the start of this section. The analysis synthesizes datasets from different government bodies (e.g. CSIRO, BoM, Geoscience Australia, ABS, NNTT), with a widely adopted set of analytical techniques. This provides a comprehensive desktop overview on the nature and spatial distribution of agricultural values on the Indigenous Estate.



Key findings and interpretations

The data show high agricultural potential across the Indigenous Estate, particularly along the northern Australia coastline, the east coast and southwest Western Australia, with areas of moderate to high suitability in all states. Unsuitable areas align with low accessibility and water availability in Central Australia. According to the modelling, 10% of the Indigenous Estate is highly suitable for agricultural development. This includes 7% of areas that are Indigenous owned or recognized under exclusive native title, and 13% of areas that are recognized under some form of Indigenous management or non-exclusive native title.

All of the scenario-based outputs identify areas of high suitability for pastoralism across the Indigenous Estate. Areas consistently identified include northern Australia, southwest Western Australia, northern Victoria and the hinterland of Queensland and the Top End.

Baseline datasets and Power BI dashboard

The GIS modelling has been presented in a manner that aims to support decision makers with accessible spatial outputs:

- In addition to the synthesized model of agricultural suitability, baseline and biocultural datasets have been created on factors influencing agricultural suitability.
- The GIS outputs from the modelling have also been presented using an innovative Power BI dashboard which allows end users to interactively examine the data for specific areas. The dashboard is available live at:
<https://cutt.ly/ASA0522>.

Recommendation for strategic assessments directly involving Traditional Owners

The baseline assessment provides a national-scale summary which can be used to identify regional areas for strategic engagement.

It is recommended that further work consider strategic regional engagement, including direct liaison with Traditional Owners, to provide a nuanced assessment of potential agricultural development. A proposed model for stakeholder-based strategic regional assessments of agricultural suitability has been presented.

This section has illuminated a GIS tool that can be used to identify areas within the Indigenous Estate that are likely to be suitable as the basis for agricultural enterprise. However, in determining the suitability of an identified area, Traditional Owners must also consider the environmental and cultural values associated with ecosystems within an identified area. This will have bearing on whether agricultural development is appropriate and if so, the types of production systems that are aligned with the identified area's environmental and cultural values.

Additionally, a major benefit of First Nations agricultural enterprise is the ESG dividends that potentially accrue from TEK-oriented production systems that have associated cultural and environmental benefits, as well as the social benefits that can accrue from business models that are structured to provide benefits to the local First Nations communities. To attract ESG-oriented investment, these particular benefits must be measurable.

The next section discusses how natural capital accounting frameworks can be used to firstly, further evaluate the suitability of areas of the Indigenous Estate that are likely suitable for primary production and secondly, to measure the environmental and social outcomes from First Nations primary production enterprises.

ACTIVATING THE INDIGENOUS ESTATE: NATURAL CAPITAL ACCOUNTING

Michael Vardon, Associate Professor, Fenner School of Environment and Society, Australian National University

Anna Normyle, PhD Student, Fenner School of Environment and Society, Australian National University

This section presents the research on the application of Natural Capital Accounting (NCA) to the Indigenous Estate. These accounts and findings are designed to complement the GIS and case studies analysis to provide information which characterises the nature of agriculture across the Indigenous Estate.

The SEEA spreadsheets are at: <https://cutt.ly/2Zd4Oti>.

While NCA has been in development for 30 years, it is unknown in the public and private sectors. As such it is necessary to provide some background to NCA and the international standards which guide the design and compilation of accounts.

Background

NCA is promoted globally as an information framework that can assist decision making in the public and private sectors (Hein et al. 2020). Natural capital is defined by Bateman and Mace (2020) as: “those renewable and non-renewable natural resources (such as air, water, soils, and energy), stocks of which can benefit people both directly (for example, by delivering clean air) and indirectly (for example, by underpinning the economy)”.

Natural capital is essential for all primary production (e.g. agriculture, forestry and fishing) relying on land, soil, water, plants, animals and their complex interactions to produce marketable products. Primary production also relies on produced capital (e.g. tractors, roads, grain silos, irrigation systems, etc.) as well as inputs of knowledge, labour and other goods and services (e.g. fertilizer, petrol, electricity, fencing materials). Finance is often used to purchase land, produced capital and to fund operating expenses. Accounting has traditionally focused on factors of production (land, produced capital, labour and other production costs) and related finance.

NCA expands the scope of accounting and integrates environmental and economic information. In doing so, it provides coherent and integrated environmental and economic data that can be used in the typical policy cycle (Vardon, Burnett & Dovers 2016), modelling and analysis (Bassi 2021). NCA also serves as a bridge between economists and scientists, providing a common language and enabling better decision making for sustainable development, by including information on impacts and dependencies on natural capital (Ruijs et al. 2019).

Traditional accounting records transactions between two parties. This could be between two businesses (e.g. a farmer selling cattle to a slaughterhouse) or a business and a customer (e.g. a supermarket selling steak). NCA extends traditional accounting by recording transactions between the economy, and society more generally, and the environment. The transactions between the economy and society are recorded in physical terms (e.g. litres of water, tonnes of CO₂, hectares of land), some of which have a monetary value. NCA also records both stocks and flows. For example, water drawn from a dam by a farmer for irrigation. NCA would record as a flow the volume of water extracted from a dam and the monetary value of any associated charges for the extraction. The volume of water in the dam (the stock) is also recorded. The stock of water in the dam would be lowered by the amount of water extracted (and would increase with inflows of run-off).

System of Environmental-Economic Accounting (SEEA)

NCA is formalised through the System of Environmental-Economic Accounting. The SEEA was developed in response to the call in Agenda 21 for the values of nature to be recognised within the information systems of governments, The SEEA was developed via UN processes and the SEEA Central Framework was adopted as an International Statistical Standard in 2012, and was followed by the SEEA Ecosystem Accounting in 2021. There is also a SEEA Agriculture, Forestry and Fisheries published in 2020 that describes how the SEEA can be applied to the industries related to primary production.

The SEEA integrates environmental data with the economic data from the System of National Accounts that has played such a key role in decision making and, among other things, giving us Gross Domestic Product. The integration of environmental and economic data serves to identify the dependency of people on natural capital for the natural resource and ecosystem services they need for wellbeing and economic

growth, and the impact of people's activities on the environment. Data is integrated and harmonised through the consistent definition of concepts and establishment of recording conventions. Harmonised data from the accounts can be used in analysis and modelling, providing a bridge between environmental and economic policy and management, and transforming decision making to include impacts and dependencies on natural capital.

In 2020, 89 countries reported implementation of the SEEA Central Framework, and 34 reported the use of SEEA Ecosystem Accounting. Australia is one of the countries implementing the SEEA and a National Strategy and Action Plan was adopted by all of Australia's governments in 2018. The ABS has been compiling SEEA-based accounts since the mid-1990s (Obst & Vardon 2014).

The different parts of the SEEA cover different aspects of the interactions of people with the environment. The SEEA Central Framework is focused on natural resources (e.g. land, fossil fuels, minerals, water, fish and timber) used in the economy and the residuals like, water and air emissions and solid waste, that flow back to the environment from the economy. The SEEA Ecosystem Accounting covers ecosystem assets and ecosystem services in both physical and monetary measures (Figure 5). Ecosystem assets are the different types of ecosystems (e.g. forests, grassland, urban areas), and these assets have both an extent (i.e. area) and a condition. Ecosystems services are the contributions of ecosystem assets to economic production or human wellbeing more generally, which are often unrecognised and their value is not explicitly itemised in traditional accounting. For example, the pollination services of insects to agriculture, or the water filtration services provided by riparian vegetation. One advantage of ecosystem accounting is that it reveals ecosystem degradation and trends not shown in standard economic indicators and hence not considered in the current governance of natural resources (Warnell et al. 2020).

A key feature of the SEEA is that environmental and economic information are integrated spatially. This is often problematic as economic information is not usually available at the same spatial scale as environmental information (Vardon, Burnett & Dovers 2016).

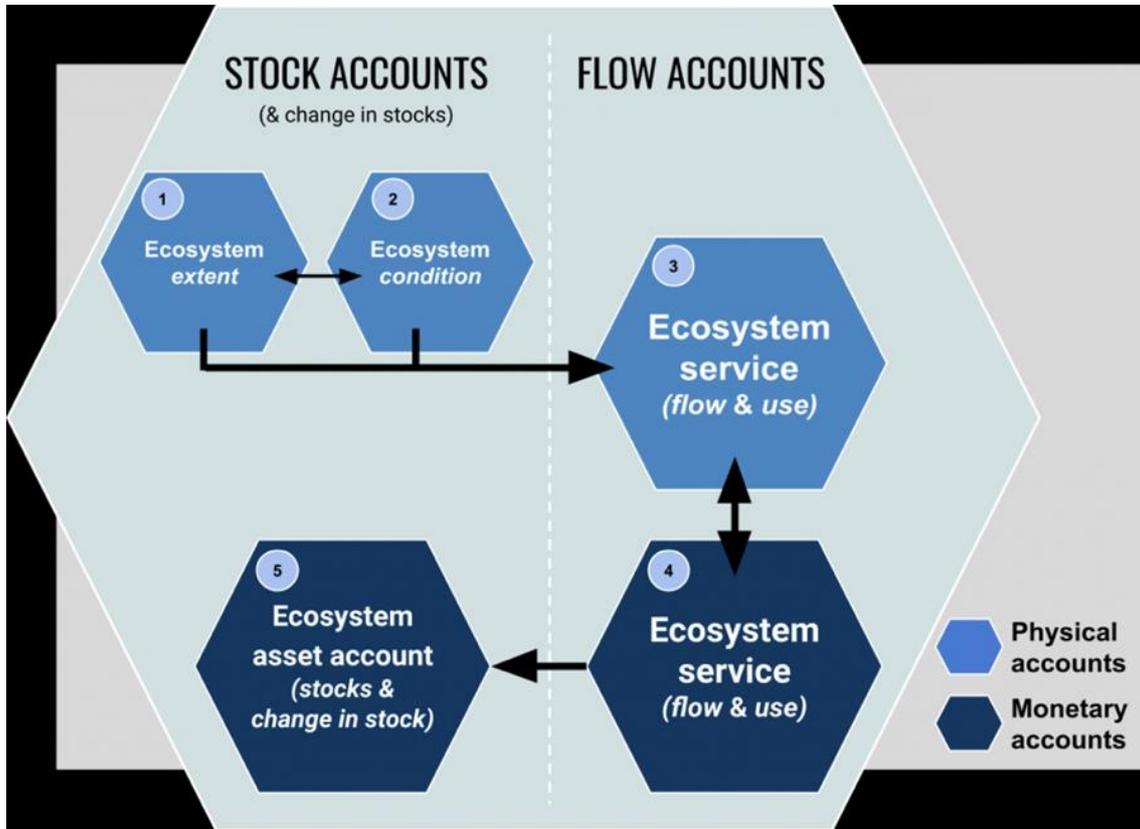


Figure 5 – Conceptual model of SEEA Ecosystem Accounting. Source: SEEA Ecosystem Accounting (United Nations 2021)

Ecosystem accounts are prepared for specific areas, known as Ecosystem Accounting Areas. These areas can be for regions defined by biophysical characteristics, such as water catchments, or by jurisdictions (e.g. national, state/territories, and local government) or management areas (e.g. NRMAs and national parks). Within these areas, a range of ecosystem assets may occur and there are a range of economic agents; that is people acting within business, government, non-government organisations or individually.

The SEEA Ecosystem Accounting recognises a range of cultural values. However, it does not provide guidance on accounting for Indigenous values nor consider the application of SEEA to Indigenous lands. Normyle et al. (2022) noted that there are no published examples of ecosystem accounting being used in the context of Indigenous land management and that Indigenous peoples’ knowledge, perspectives and groups are mentioned in just three paragraphs in the SEEA Ecosystem Accounting:



- Point 4.40, p. 82: on linking ecosystem extent accounts to economic data and “identifying the area of ecosystems (and the different ecosystem types) that are under common ownership or under the control of Indigenous people”.
- Point A5.4, p. 116: in reference to methods for measuring ecosystem condition, specifically “Method 7 may be particularly relevant in capturing Indigenous knowledge and perspectives”. Method 7 is about the use of expert opinion and says, “Several weaknesses are inherently associated with this approach”.
- Point 6.97, p. 141: in the context of linking biomass provisioning services to cultural services and “traditional harvests undertaken by Indigenous groups”.

Within Australia the SEEA has been used by government agencies and researchers. For example, the Victorian government has developed accounts to support the management of forests (McCormick & Showers 2019) and National Parks (Varcoe, O’Shea & Contreras 2015), while the Australian Government developed accounts for Geopraphe Bay in Western Australia (IDEAA, 2020) and the Australian Capital Territory for State of the Environment Reporting (Summers et al. 2017). The ABS has produced a range of accounts and several are relevant to the management of the Indigenous Estate, namely:

- National Land Account, Experimental Experts which cover various aspects of land use, land cover and land value for the years 2010, 2011, 2015 and 2016.
- From Nature to the Table: Environmental-Economic Accounting for Agriculture which is a discussion paper which examines the economic assets, inputs and outputs as well as the agricultural, forestry and fishing industries.
- Water Account, Australia which provides annual information on the use of water by all industries for each state and territory of Australia, including a breakdown of water use by different types of agricultural products (e.g. cropping, livestock farming and fruit).

The accounts from the ABS and others are sources of data and are discussed later in relation to the production of accounts for the Indigenous Estate presented in this study.

Accounting is one part of an information system that supports decision making. The other parts are basic data, analysis, and modelling (Vardon, Burnett & Dovers 2016). Accounting describes past trends and interactions, whereas policymaking requires looking forward and assessing present and future policy options (Bassi 2021).

Modelling draws on the wealth of baseline information that NCA provides to explore possible futures and policy applications. NCA and modelling have been combined in various ways to assess future impacts of alternative development pathways (Johnson et al. 2021). Several examples of using models with NCA make the case for investment in natural capital and ecosystem services. While the use of models for examining environmental or economic issues is not new, the availability of integrated environmental and economic data from NCA makes it easier to feed models and analyse the interrelationships between the economy and the environment (Banerjee et al. 2020).

Objectives

The objectives of the NCA component of Activating the Indigenous Estate are:

1. Assess how SEEA can reflect the values of Indigenous people.
2. Provide an integrated overview of the economic and environmental information available to assess and realise the potential of the Indigenous Estate.
3. Produce NCA with the available data and methods so that it could be for strategic use by Indigenous land managers and current or potential investors in the Indigenous Estate.

SEEA and Indigenous values

Figure 6 presents an adaptation of the SEEA Ecosystem Accounting conceptual model, showing the area of the Indigenous Estate as “Country” and Indigenous people as the producers and users of goods and services from Country as well as others that may benefit from the goods and services produced from country, which include nature’s resources (fish, energy, minerals) and ecosystem services. Indigenous people may be the owners or operators of enterprises that operate on country or are dependent on Country.

Figure 6 shows flows from Indigenous people to Country. This two-way representation is a departure from SEEA Ecosystem Accounting which shows one-way flows from ecosystems to society and the economy, but this is aligned with the SEEA Central Framework, where land management activity is recorded as a flow back to the environment, in this case the Indigenous Estate.

The figure also makes clear distinctions between the Indigenous Estate, which may be defined in a variety of ways, and Indigenous people as transactor, both with the environment, with each other and between non-Indigenous people. In this, the inputs to the management of the Indigenous Estate can come from Indigenous and non-Indigenous people and similarly the benefits from the Indigenous Estate may accrue to Indigenous and non-Indigenous people. There are some outstanding issues in accounting as to how to identify, categorise, measure and account for cultural services and specific places within areas that have cultural significance.

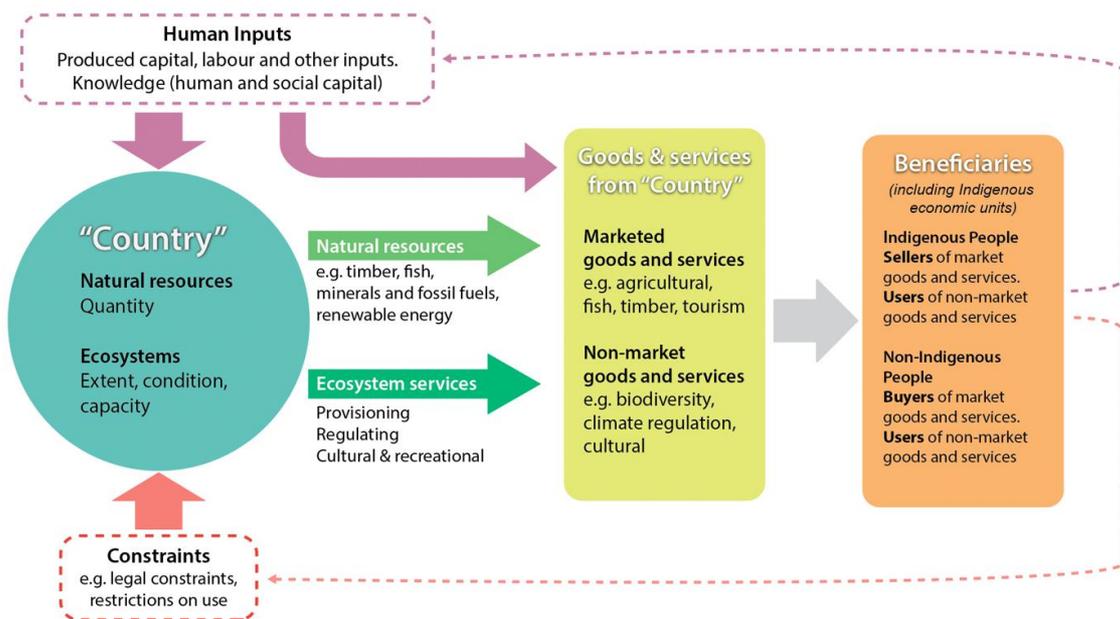


Figure 6 – Conceptual model of ecosystem accounting for Indigenous people

Data sources and methods for account production

The selection, design and preparation of accounts for particular areas involved consideration of many factors, including the possible uses of NCA and the data available. A systematic search of the literature was also conducted to determine if the value of agricultural production on the Indigenous Estate had been done or attempted before.

A central aspect of the SEEA is the spatial connection of data. Environmental data are often available at fine levels (e.g. 25 m²) as presented in GIS chapter. Economic data is not available at this fine scale, with the regularly produced data on the value and profitability of agricultural production available for large regions. For example, the ABS

data on agricultural production is for areas known as SA4s (Statistical Area level 4) or NRMRs, while ABARES's data on broadacre farming is for areas approximately equivalent to the size of ABS SA3s (Statistical Area level 3). The average size of ABS SA4 and SA3s is 85,875 km² and 30,778 km² respectively, while for NRMRs it is 119,905 km². In northern Australia, where a large part of the Indigenous Estate is located, the size of the SA4s and NRMRs is far larger than average (e.g. the Kimberly NRM is 2,200,000 km² and the nearest matching SA4 (Western Australia Outback) is 926,023 km²). The physical and monetary data from the ABS Water Accounts (which are 'supply and use' accounts) is available at state level, while the BoM National Water Account (which are asset accounts) is for 11 water catchments. The spatial mismatch between the environmental and economic data for Australia is huge. The mismatch in the spatial resolution of environmental and economic data is a common problem in the production of NCA (Vardon et al. 2018).

It is recognised that government information agencies do not have unlimited resources and that decisions have to be made about the amount and type of information collected. Trade-offs must also be made between the various dimensions of data quality (relevance, accuracy, accessibility, interpretability, timeliness, coherence). There is also a need to maintain the confidentiality of data providers. New data sources and methods are being used to provide finer level spatial information, for example the Sugarcane experimental regional estimates using new data sources and methods (ABS 2021).

Defining and selecting the accounting areas

The definition of the Indigenous Estate was the first step in selecting the accounting areas of relevance to this study. Like the GIS analysis (previous Chapter), the ABARES (2020) definition of the Indigenous Estate was used for the accounting analysis: "the area of land over which Indigenous peoples and communities have ownership, management, or rights of use for customary purposes." We divided these areas in 2 core classes:

- (A) Areas recognised as Indigenous owned or under exclusive native title; and
- (B) Areas under some form of Indigenous management or non-exclusive native title.

The Indigenous Estate was then allocated into accounting areas using the NRMRs across Australia (Map 15). Other Indigenous management areas considered by the



analysis include the representative Aboriginal and Torres Strait Islander body (RATSIB⁶) areas, (such as the Land Councils presented for suitability scenarios in the previous section), and the ABS Indigenous areas⁷. ABS Indigenous areas were not used because, like the ABS SA3 and SA4 regions, they are very big and based on population size and not related to other environmental and economic information presented in the accounts. RATSIB areas, while better aligned to the GIS analysis, did not align to the ABS agricultural data, which are produced for the NRMRS and SA4 regions, nor regions used by ABARES for agricultural data which are different again⁸. Bioregions⁹, which reflect the major ecosystems in Australia, were also considered but were large regions that did not align with the ABS or ABARES's data on agricultural production, nor the RATSIB area.

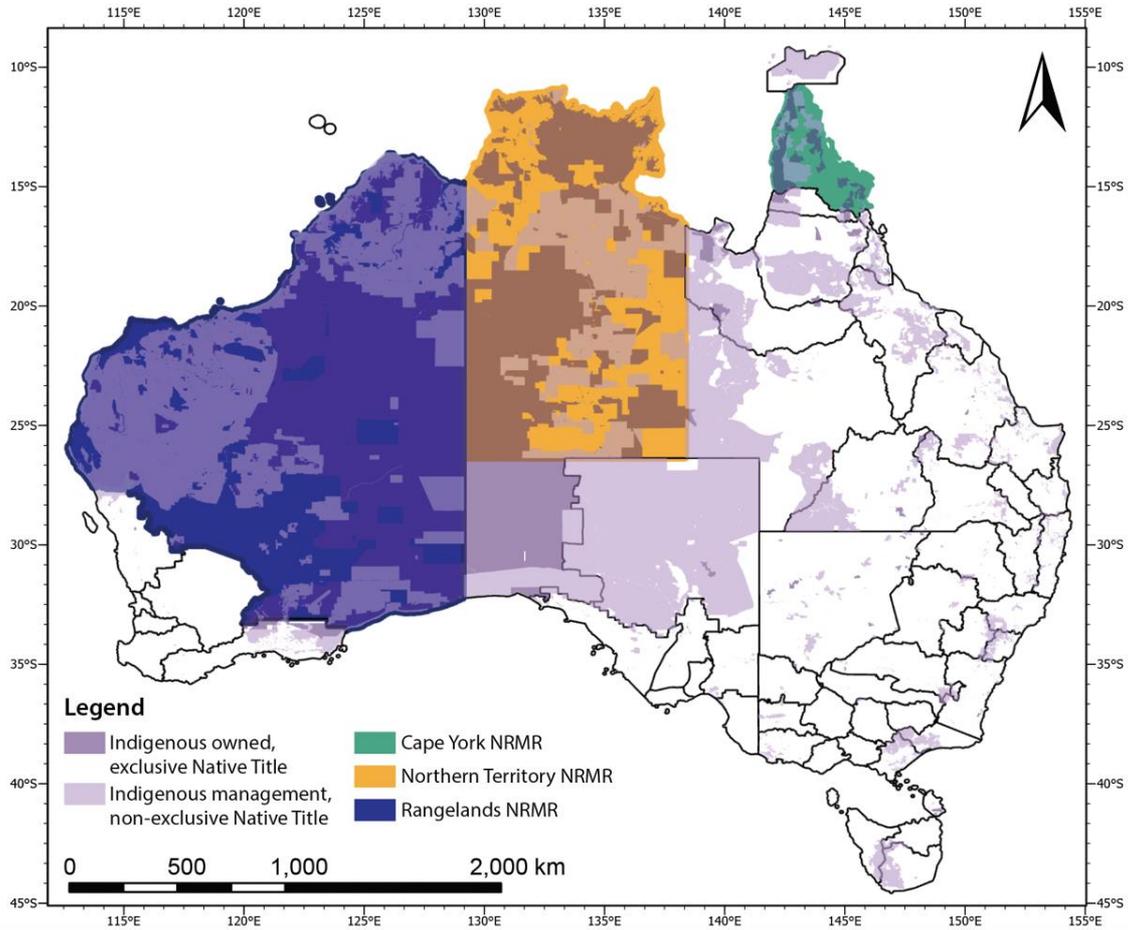
The NRMRS were used as the best regularly available agricultural data that aligned across all datasets and related to biogeography and land management organisations, albeit non-indigenous land management organisations. Three NRMRS were selected as case studies: Rangelands (Western Australia), Northern Territory, and Cape York (Queensland), as these regions contained the Land Council areas assessed in the previous chapter.

⁶ RATSIB is a body recognised by the Commonwealth under s 203AD of the *Native Title Act* (1993) *Cth* to represent native title holders and persons who may hold native title and to consult with Aboriginal and Torres Strait Islander persons within a specified area. <https://data.gov.au/dataset/ds-dga-0d32262b-e13b-4475-adc6-3618811c029a/details>

⁷ Australian Statistical Geography Standard (ASGS) Edition 3
<https://www.abs.gov.au/statistics/standards/australian-statistical-geography-standard-asgs-edition-3/jul2021-jun2026/indigenous-structure>

⁸ ABARES Australian Agricultural and Grazing Industry Survey (AAGIS) areas
<https://www.awe.gov.au/abares/research-topics/surveys/farm-survey-data>

⁹ Australia's Bioregions <https://www.awe.gov.au/agriculture-land/land/nrs/science/ibra>



Map 15 – Map of accounting areas

Account selection

Account selection and the areas for which accounts were produced were based on the: objectives of the project; potential usefulness of the different types of accounts useful for managing the Indigenous Estate; available data (Table 9) and; the time and resources available for account production.

Table 9 – Datasets used for accounts

Dataset	Spatial Coverage	Scale	Temporal coverage*
Land cover: DEA	National	25-30m	2016 and 2020
Land use: CLUM	National	50m	2003–2018
Condition: Vegetation	National	250m	2019–2020
Condition: Water	National	250m	2010–2020
Condition: Climate	National	5km	2010–2019
Condition: Soil	National	5km	2010–2017
Condition: Access	National	5km	2010–2017
Agricultural commodity	National	NRMRs, various	2016–2017 to 2019–2020*

*Some data from these sources were available for other time periods but these were not used in the preparation of the accounts.

Accounts were developed for:

- Land cover
- Land cover condition
- Land use
- Supply of agricultural commodities

A description of each account developed and the corresponding data sources and methods is provided below. An account of land value was not developed. ABS data on land value are available for each State and Territory but at this scale are not readily converted to accounts at the scale of the Indigenous Estate boundary defined by this study or the case study NRMRs. State agencies, like the NSW Valuer General, have information on the value of land¹⁰, but time and resources did not allow for the investigation of these data sources on land value.

Given the critical importance of water for agricultural production the development of water accounts for the Indigenous Estate was considered. However, it was not possible to development water accounts with the available data, time and resources. For the

¹⁰ e.g. NSW Land values and property sales map
<https://portal.spatial.nsw.gov.au/portal/apps/webappviewer/index.html?id=2536c8e4882140eb957e90090cb0ef97>

data, the ABS Water Account Australia provides state level data on water supply and use, while the BoM National Water Accounts provide data on freshwater assets for 11 regions. With additional data from other sources and the use of models it may be possible to produce fine-level ecosystem accounts for the water provisioning service and its use by agriculture.

1) Land Cover Asset Account (2016 to 2020)

Land accounts are a useful information system for data on land cover, use and value, with this information organised consistently across time and space. Land accounts can assist in showing how environmental, social and economic processes interact in a landscape.

Comprehensive, nation-wide accounting data on land cover are available via the ABS experimental land cover accounts 2010–2016 (ABS 2021b). However, the spatial resolution of the units of these accounts (250 m) and temporal coverage (only two years and most recent reference at 2016) was not as good as the Digital Earth Australia (DEA) maps of Geoscience Australia¹¹. Land cover information were extracted from DEA for the identified Indigenous Estate area for the periods 2016 and 2020.

2) Land Use Asset Account (2016 to 2020)

Land use data provide information related to the management and commodities available from a particular region. Land use data were provided from the Australian Land Use and Management (ALUM) Classification system (ALUM, 2015–2016) and the updated Catchment scale land use of Australia (CLUM, 2020). These datasets show a single dominant land use for a given area, based on the primary management objective of the land manager (as identified by state and territory agencies). Land use is classified according to the ALUM Classification version 8 (ABARES 2020) for the periods 2015–2016 and 2020.

The ALUM classification includes the class “1.2.5 Traditional Indigenous uses”, which fall under the primary class “Conservation and Natural Environments” and are defined as: “areas managed primarily for traditional Indigenous uses”, noting that “this class

¹¹ Digital Earth Australia <https://maps.dea.ga.gov.au/>

should only be applied where traditional Indigenous uses are the current prime use” (ABARES 2016).

3) Land Cover Condition Account (2020)

Proxy land cover condition for agriculture was assessed based on the influence metrics developed for the land suitability GIS analysis (Map 12). Condition metrics were derived for the Indigenous Estate for vegetation, water, climate, soil and access, with proxy scores for land cover condition defined based on the relative suitability of these factors for agriculture (measured as an index between zero and one). Some temporal variability is noted in the condition datasets (see Appendix 3) and hence reported values as noted as indicative only for the purposes of scoping.

4) Agricultural Commodities Supply Account (2016–2017 to 2019–2020)

ABS agricultural production data for 2016–2017 to 2019–2020 were used to create a supply account. In this, the account is akin to an ecosystem service supply account for a section of biomass provisioning services. The ABS data was preferred over the ABARES broadacre farming data as it covers more commodities and has lower levels of survey error. ABS commodity data are reported for cropping, livestock production, horticulture, nurseries and fruit and nut values and for each NRM. Three NRMs were selected as example accounting areas: Rangelands, Northern Territory and Cape York.

Data processing

All account data were processed in ArcGIS Pro 2.6. Land cover information from DEA and land use information from the ALUM and CLUM datasets were clipped to the Indigenous Estate boundary and summarised as area statistics for input into the accounts using the intersect tool in ArcGIS Pro. Agricultural commodity data obtained from the ABS were summarised at the NRM level.

The classes of some input data were grouped for presentation in accounts. Grouping classes makes the accounts more amenable to interpretation and analysis.

Systematic review

A systematic review was done to identify studies relevant to the production of NCA, and in particular for estimating the value of primary production from the Indigenous Estate. A systematic review is an approach that uses clearly formulated questions to

identify, select and critically appraise research relevant to the particular area of research, in this case the potential value of the Indigenous Estate for agriculture production. In this case the review was rapid in the sense that publications were only identified from a systematic search and the results were not fully analysed.

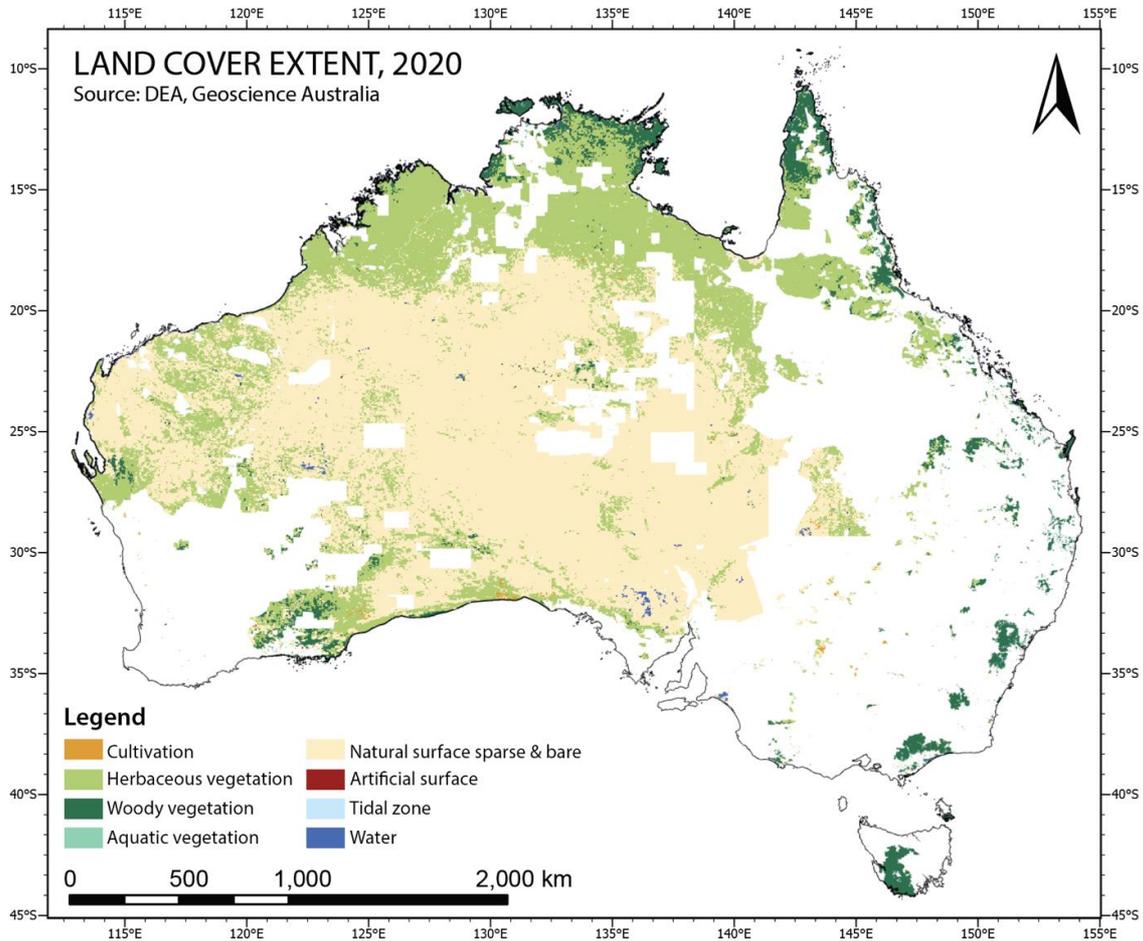
A Scopus advanced search was undertaken to identify publications potentially relevant to this study, and especially the question of valuation. A previous study by Normyle et al. (2022) had already identified that there were no studies of use or application of NCA to First Nations. “Grey” literature, which is literature published outside of traditional academic literature (e.g. reports by government or consultants), is often not well represented in indexing databases like Scopus. Some grey literature was identified in the course of this study.

The string used in systematic review for this study was “Indigenous AND Agriculture AND Australia AND value” and limited to publications since 2015. Two further limitations were used; the first to publications in “Agriculture and biological and science” and the second to publications in “Economics”. This resulted in the identification of 971 documents for the first search (Agricultural and biological science) and 32 for the second (“Economics”). The titles were then manually inspected and if the title appeared relevant then the abstract was read for potential relevance. For the “Economics” search, no publications were identified. For the “Agricultural and Biological Science” search 35 publications were identified as potentially useful. A full analysis of the content of these publications was not undertaken, but some papers were identified as useful to provide context and for the discussion of results.

Results

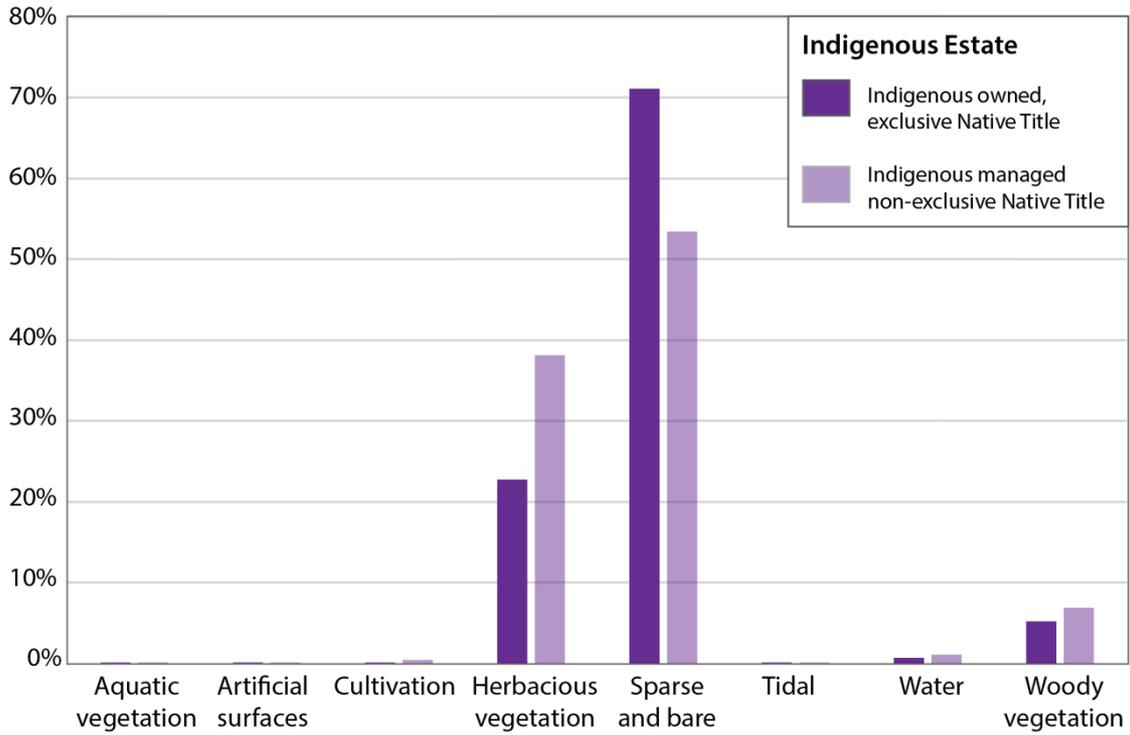
Land cover extent account

Map 16 shows land cover extent mapped for the Indigenous Estate in 2020. The estate comprises predominantly spare and bare surfaces, particularly through central and Western Australia. Herbaceous vegetation is also prominent, while woody vegetation is limited to the northern and eastern coastline, in addition to southern Tasmania.



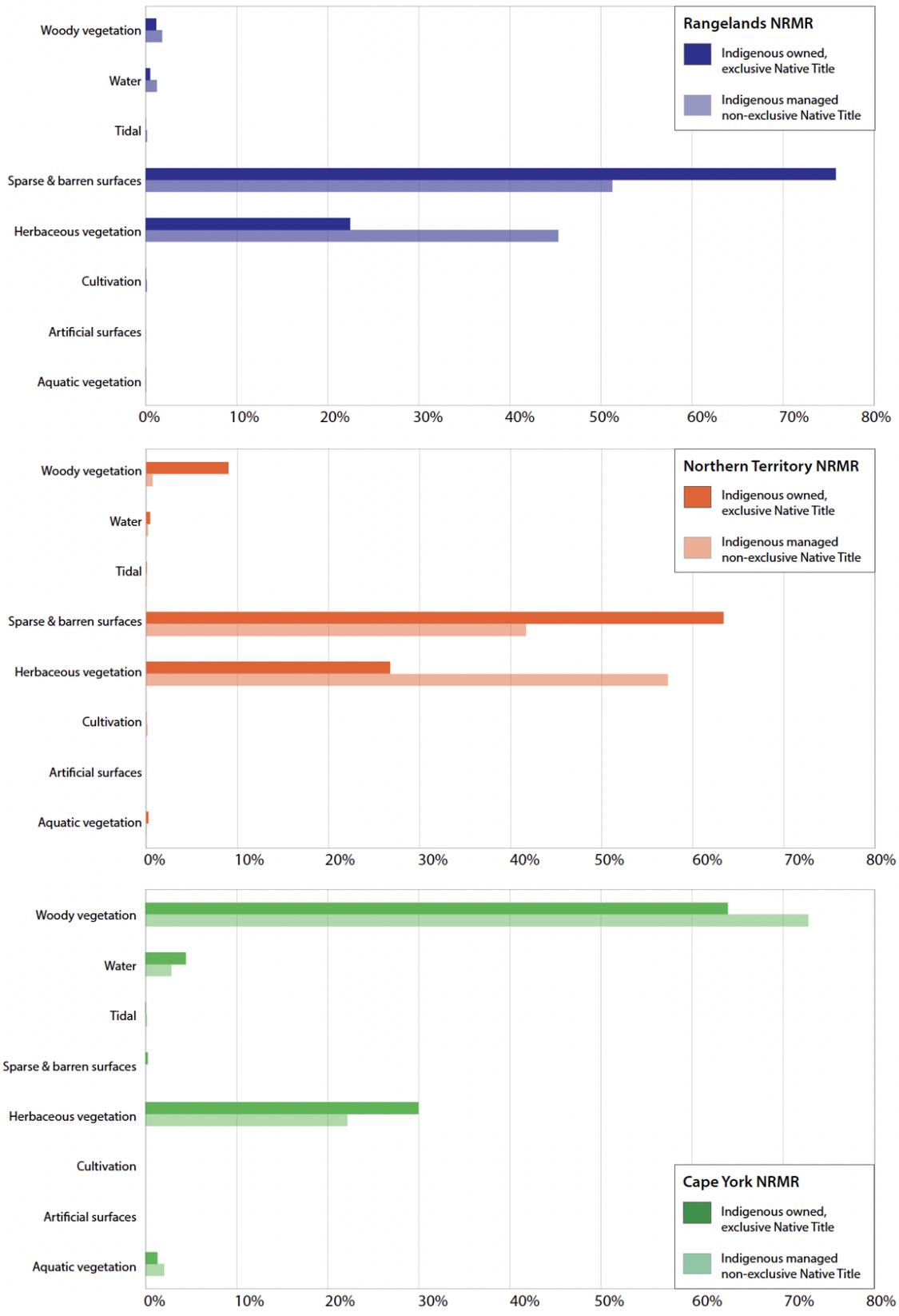
Map 16 - Map of 2020 land cover extent across the identified Indigenous Estate

In Graph 10, land cover extent data is visualised based on areas recognised as Indigenous owned or under exclusive native title, and areas under some form of Indigenous management or non-exclusive native title. Graph 10 shows that a relatively higher portion (71%, 1.6 million km²) of Indigenous owned/exclusive native title areas are located on sparse and barren areas compared to areas under some form of Indigenous management or non-exclusive native title (53% of these areas). Both categories of recognition also comprise areas of herbaceous and woody vegetation, however these areas are more prevalent where there are not Indigenous ownership/exclusive native title agreements in place.



Graph 10 – 2022 land cover extent for the identified Indigenous Estate

Further breaking down the land cover extent data to the NRMRs, shows that while Indigenous Estate areas in the Rangelands and Northern Territory support similar vegetation cover in sparse, barren and herbaceous areas, the Cape York NRMR has a higher portion of woody vegetation across both Indigenous owned/exclusive native title areas, and areas under Indigenous management (see Graph 11). Here the account data supports the scenario modelling presented in the previous chapter, which found that activities correlated to vegetation presence such as carbon farming, were more suitable in the CYLC areas.



Graph 11 – 2020 land cover extent data for the Indigenous Estate areas in the Rangelands, Northern Territory and Cape York NRM

A land cover account for the Indigenous Estate was produced for the period 2016 – 2020 (see Table10). The account shows a loss of cultivated area and a conversion of vegetated areas to sparse and barren surfaces, in addition to a minor increase in areas of water. These changes may have resulted from climatic variation due to the transition from an El Niño to La Niña season between 2016 and 2020.

Table 10 – Land cover accounts, Australia’s Indigenous Estate, 2016–2020

Total Indigenous Estate	Cultivation	Herbaceous vegetation	Woody vegetation	Aquatic vegetation	Artificial surfaces	Sparse and barren	Water	Tidal areas
	km ²	km ²	km ²	km ²	km ²	km ²	km ²	km ²
Opening stock 2016	53450	2048675	361700	5125	50	2697225	36500	3525
Managed expansion								
Other expansion								
Total additions	-	-	-	-	25	498216	8687	599
Managed expansion								
Other expansion								
Total reductions	-38504	-414652	-43193	-451	-	-	-	-
Closing stock 2020	14946	1634023	318507	4674	75	3195441	45187	4124
Net change	-38504	-414652	-43193	-451	+25	+498216	+8687	+599
Owned and exclusive Indigenous Estate	Cultivation	Herbaceous vegetation	Woody vegetation	Aquatic vegetation	Artificial surfaces	Sparse and barren	Water	Tidal areas
	km ²	km ²	km ²	km ²	km ²	km ²	km ²	km ²
Opening stock 2016	7975	713300	140375	2950	0	1424850	11925	1175
Managed expansion								
Other expansion								
Total additions	-	-	-	-	25	218295	3321	-
Managed expansion								
Other expansion								

Total Indigenous Estate	Cultivation	Herbaceous vegetation	Woody vegetation	Aquatic vegetation	Artificial surfaces	Sparse and barren	Water	Tidal areas
Total reductions	-5901	-188103	-20360	-101	-	-	-	-175
Closing stock 2020	2074	525197	120015	2849	25	1643145	15246	1000
Net change	-5901	-188103	-20360	-101	+25	+218295	+3321	-175
Managed and non-exclusive Indigenous Estate	Cultivation	Herbaceous vegetation	Woody vegetation	Aquatic vegetation	Artificial surfaces	Sparse and barren	Water	Tidal areas
	km ²	km ²	km ²	km ²	km ²	km ²	km ²	km ²
Opening stock 2016	45475	1335375	221325	2175	50	1272375	24575	2350
Managed expansion								
Other expansion								
Total additions	-	-	-	-	-	279921	5366	774
Managed expansion								
Other expansion								
Total reductions	-32604	-226549	-22833	-351	-	-	-	-
Closing stock 2020	12871	1108826	198492	1824	50	1552296	29941	3124
Net change	-32604	-226549	-22833	-351	0	+279921	+5366	+774



Land cover condition account

The land cover condition accounts were prepared using four land cover classes (woody vegetation, herbaceous vegetation, cultivation and sparse and barren surfaces). Five condition indicators and a condition index were used. These indicators were the same as used in the GIS analysis. Accounts were produced for the entire Indigenous Estate and for the three NRMRs (Table 11).

Table 11– Condition account for vegetation land cover in Indigenous Estate, 2020

(A) Indigenous Estate	Cultivation	Woody vegetation	Herbaceous vegetation	Sparse and barren
Vegetation	0.51	0.75	0.5	0.44
Water	0.71	0.82	0.71	0.39
Climate	0.6	0.66	0.55	0.39
Soil	0.75	0.64	0.67	0.63
Access	0.79	0.81	0.76	0.4
Combined condition score	0.672	0.736	0.638	0.491

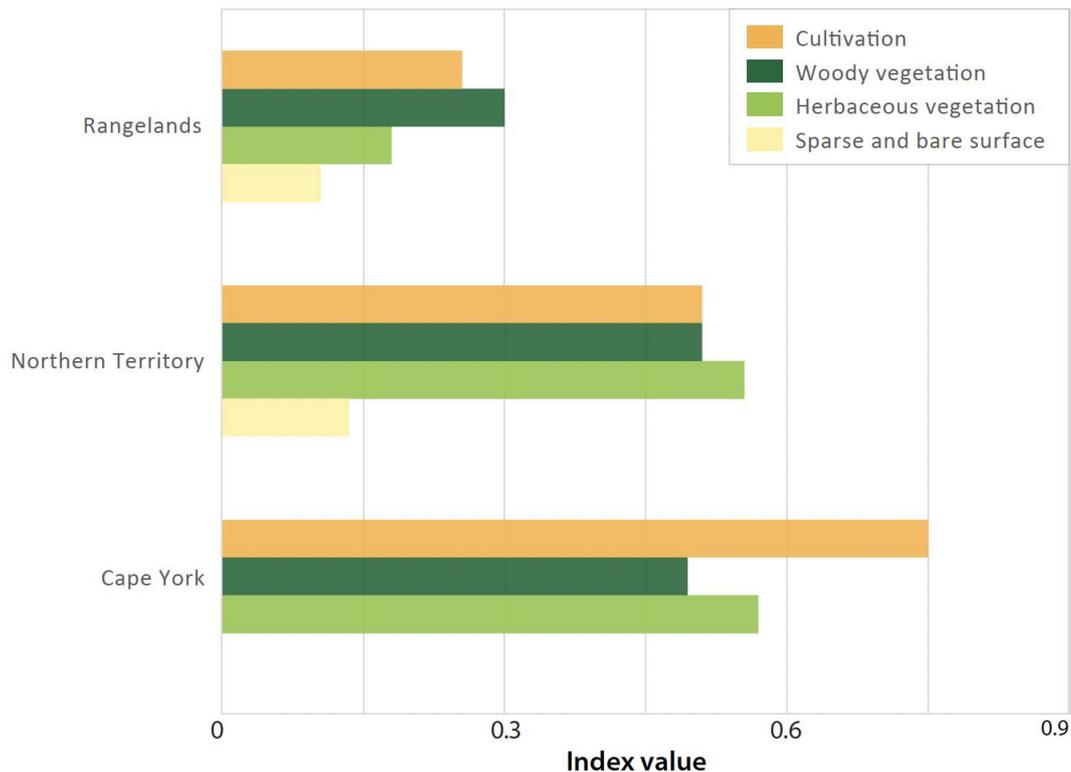
(B) Rangelands NRM	Cultivation	Woody vegetation	Herbaceous vegetation	Sparse and barren
Vegetation	0.48	0.53	0.48	0.45
Water	0.61	0.61	0.66	0.55
Climate	0.62	0.52	0.46	0.36
Soil	0.75	0.67	0.66	0.6
Access	0.61	0.71	0.72	0.58
Combined condition score	0.614	0.608	0.596	0.456

(C) Northern Territory NRM	Cultivation	Woody vegetation	Herbaceous vegetation	Sparse and barren
Vegetation	0.43	0.66	0.52	0.43
Water	0.78	0.77	0.74	0.55
Climate	0.59	0.65	0.63	0.48
Soil	0.8	0.63	0.64	0.56
Access	0.8	0.68	0.7	0.49

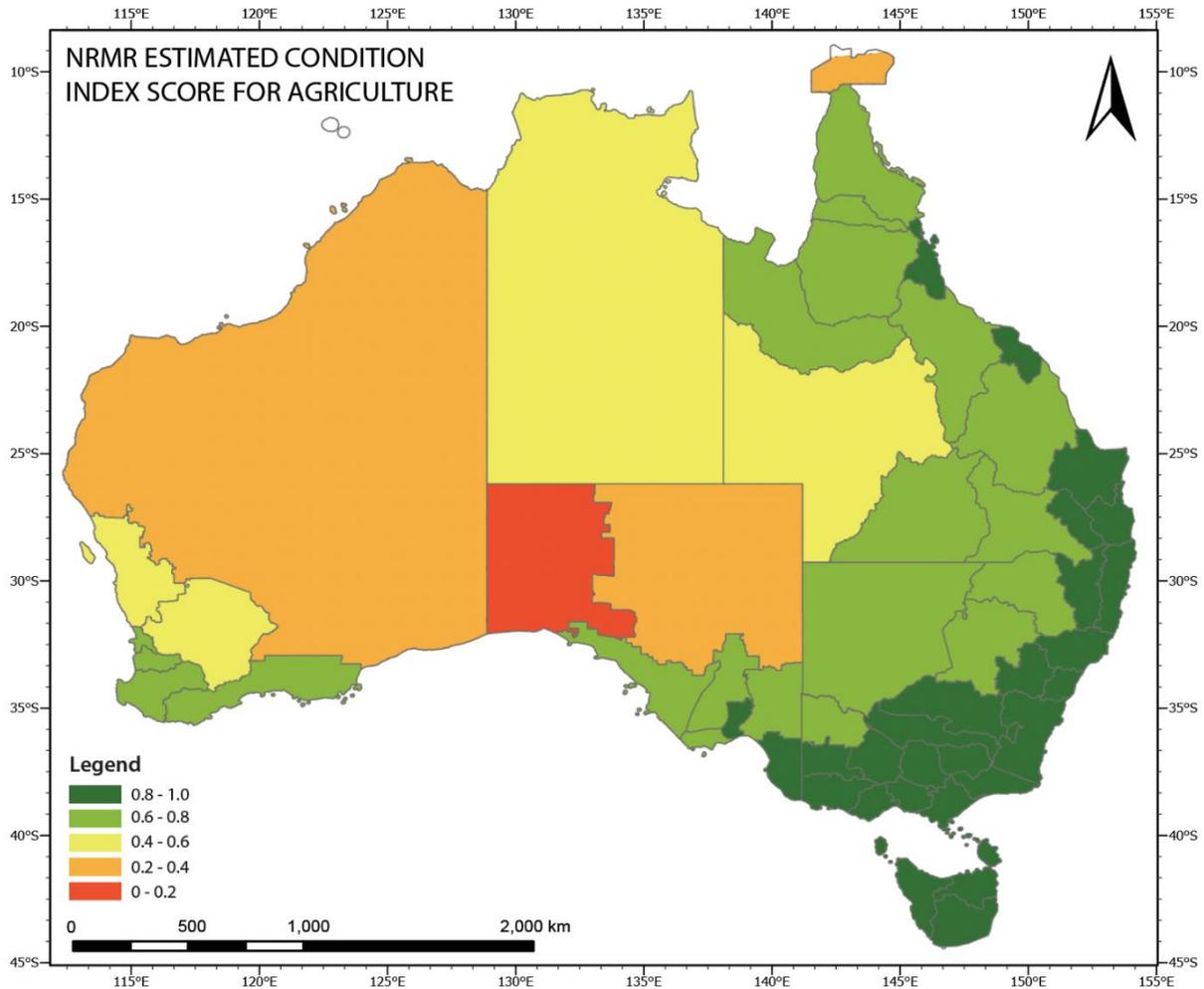


Combined condition score	0.722	0.678	0.646	0.502
(D) Cape York NRM	Cultivation	Woody vegetation	Herbaceous vegetation	Sparse and barren
Vegetation	0.6	0.75	0.6	-
Water	0.84	0.82	0.83	-
Climate	0.75	0.69	0.63	-
Soil	0.71	0.70	0.73	-
Access	0.83	0.69	0.63	-
Combined condition score	0.826	0.803	0.684	-

A general view of condition for each NRM is shown in Graph 12. A more detailed spatial view of the condition, and the metrics used to estimate an index for relative condition for agriculture is presented in the GIS chapter (Map 13). The comparison between Map 17 and Map 13, is an example of the spatial mismatch between the economic data and environmental data and the need for accounts to provide information for a common area of reference for both types of data.



Graph 12 – Mean condition scores for vegetation within the Indigenous Estate in the year 2020



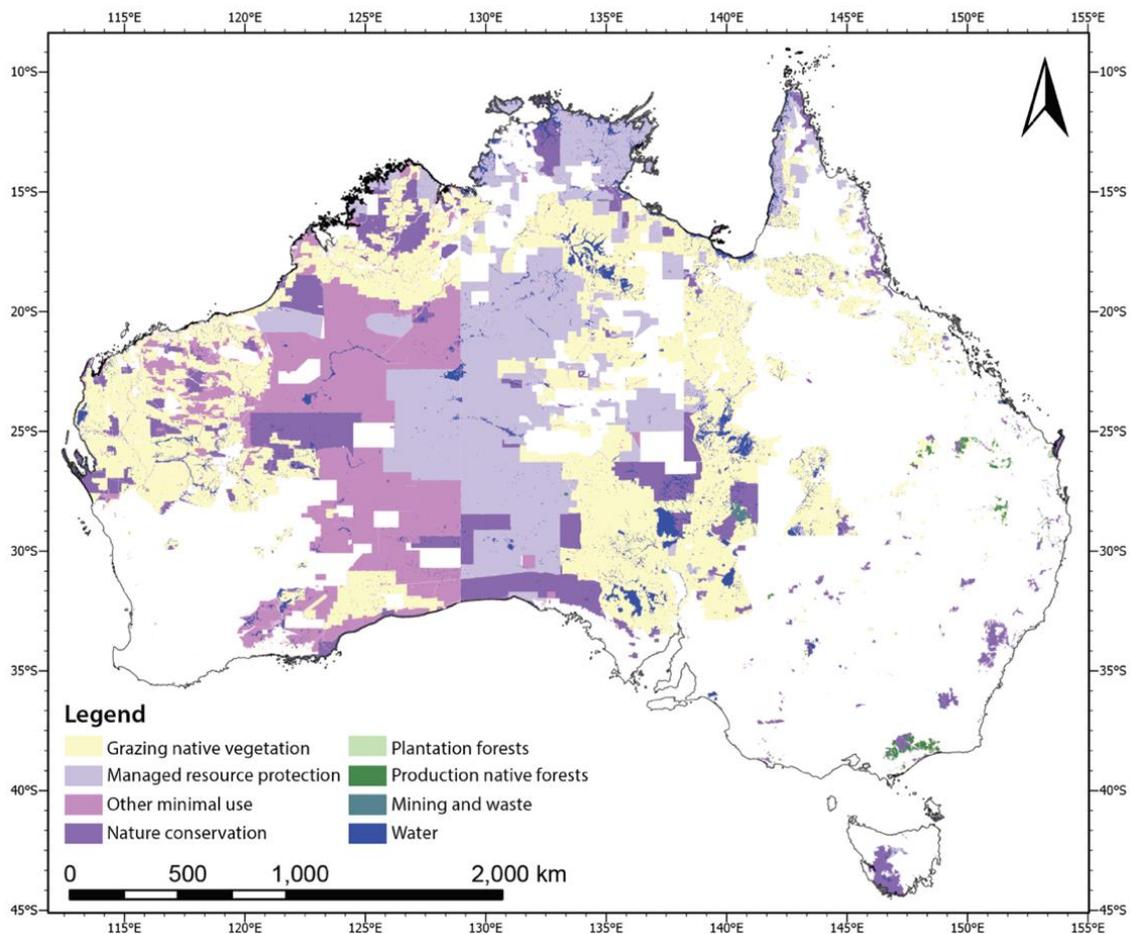
Map 17 – Relative condition for agriculture score by NRMR. Red indicates low condition, yellow is moderate and green indicates high condition. The condition scores are based on water, climate, vegetation, soil and access indicators and are not seasonally adjusted

The condition data show sparse and barren vegetation to be in the lowest condition across all indicators. Vegetation in the Cape York NRMR is generally in better condition than the Indigenous Estate areas of the Rangelands and Northern Territory NMRs, and the national average. A condition comparison of the mean condition scores in the three NMRs is shown in Graph 12.

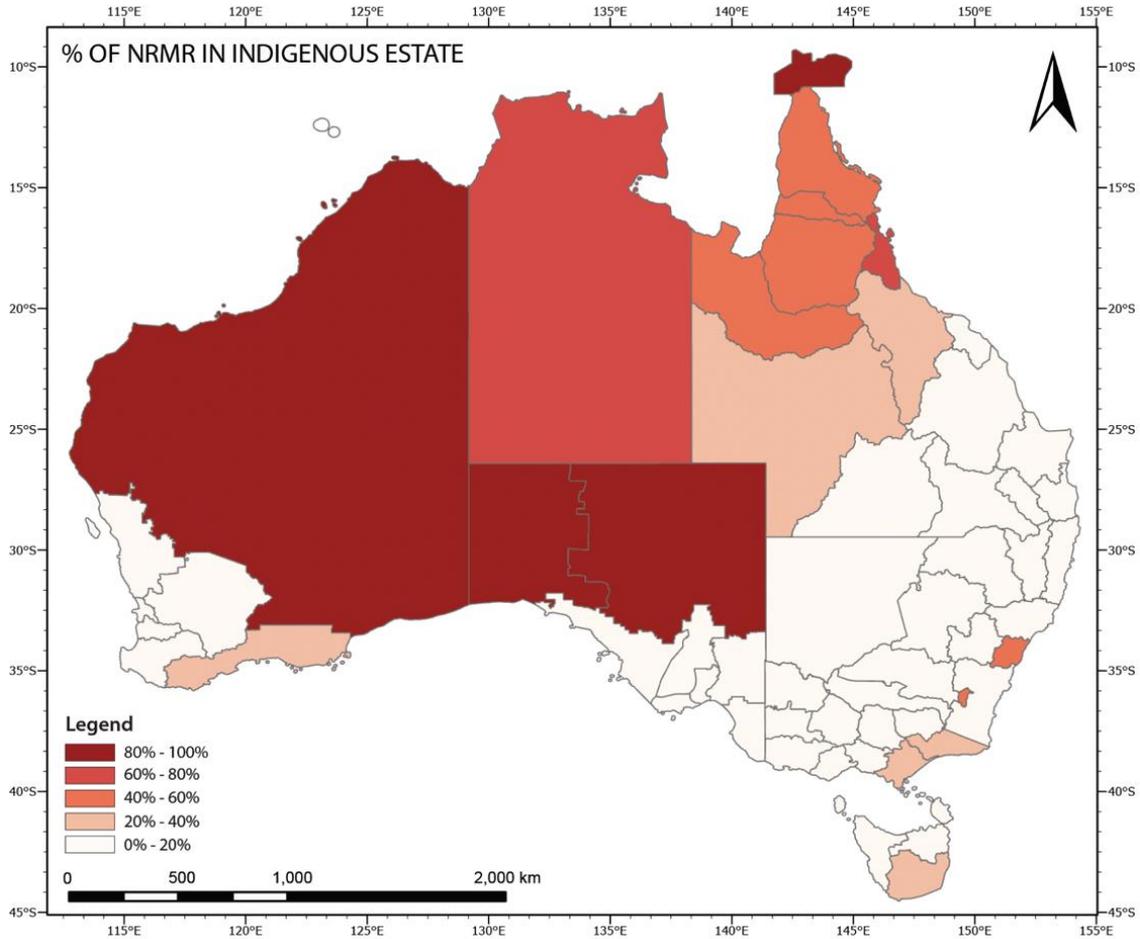
Land use account

Land use accounts for the Indigenous Estate were produced for the year 2020. Map 18 shows much of the Indigenous Estate is used for native vegetation grazing, managed resource protection and minimal use areas, with no areas of intensive horticulture or irrigation identified within our defined Indigenous Estate boundaries. While some small areas of land use for forestry production are noted in coastal areas of eastern Australia, the intersection of these areas with the Indigenous Estate is minimal. The ABARES (2016) definition of “Traditional Indigenous use”, which excludes agricultural uses, made-up 31% of land use within the Indigenous Estate.

The percentage of the Indigenous Estate within each NRMR varies across Australia (see Map 19). The NRMRs with the greatest percentage of Indigenous Estate are in South Australia (Alinytjara Wilurara and South Australian Arid Lands), Western Australia (Rangelands) and the Torres Strait.

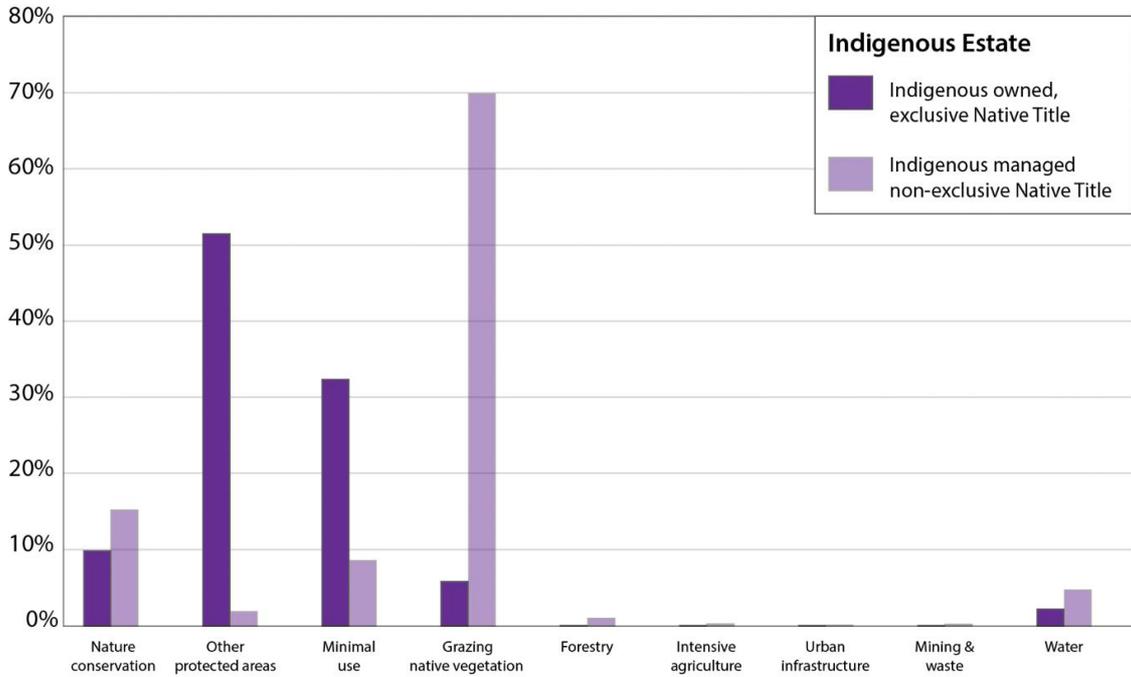


Map 18 – Map of land use for the Indigenous Estate in 2020



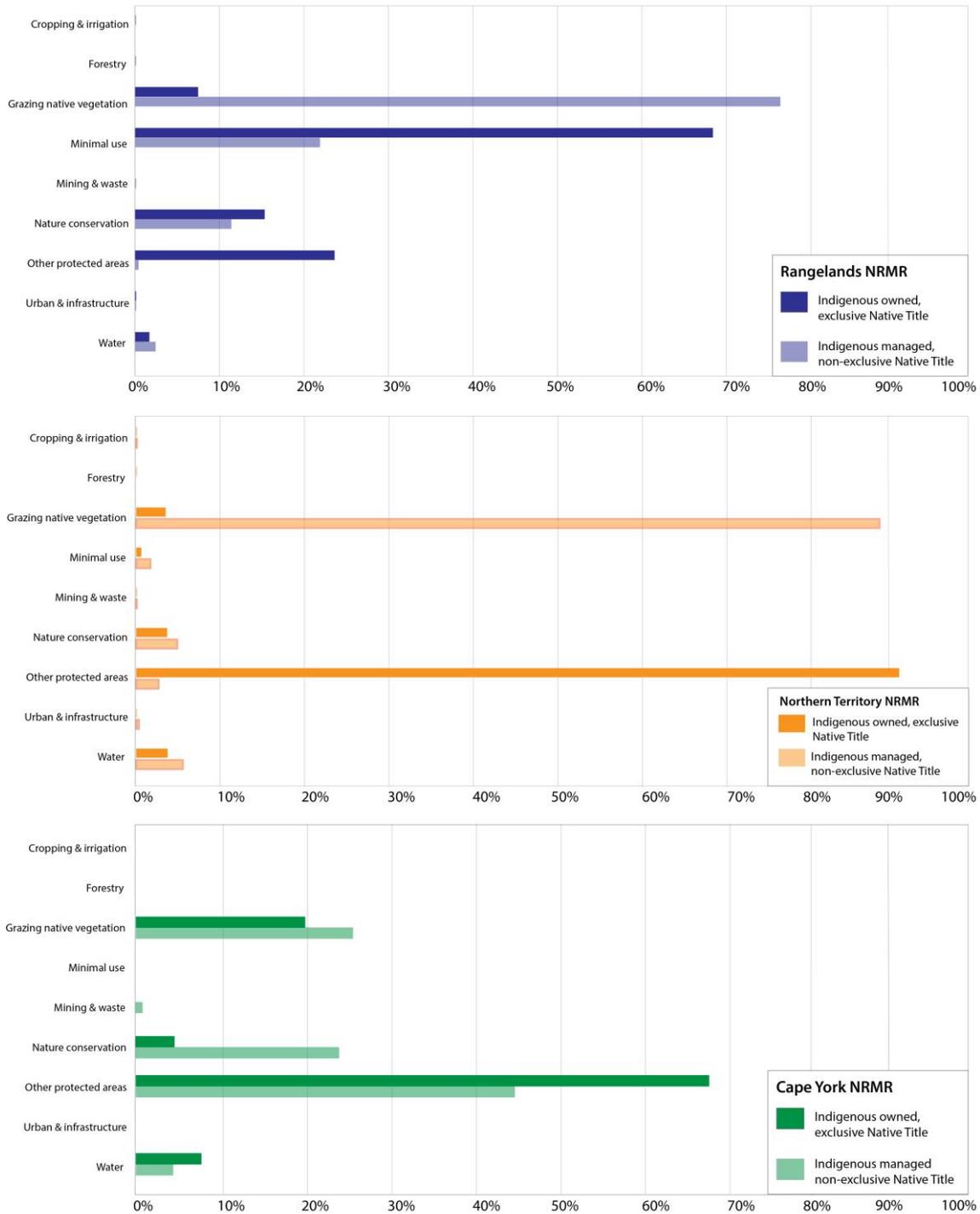
Map 19 – Portion of each NRMR that is part of the Indigenous Estate

Graph 13 shows the 2020 land use data by areas recognised as Indigenous owned or under exclusive native title, and areas under some form of Indigenous management or non-exclusive native title. Areas of ‘native vegetation grazing’ comprise the majority of the land use on the managed/non-exclusive native title areas, while owned and exclusive areas are reported as ‘minimal use’ (32% of these areas), or as ‘other protected areas’ (51% of these areas).



Graph 13 – 2020 land use data for the identified Indigenous Estate

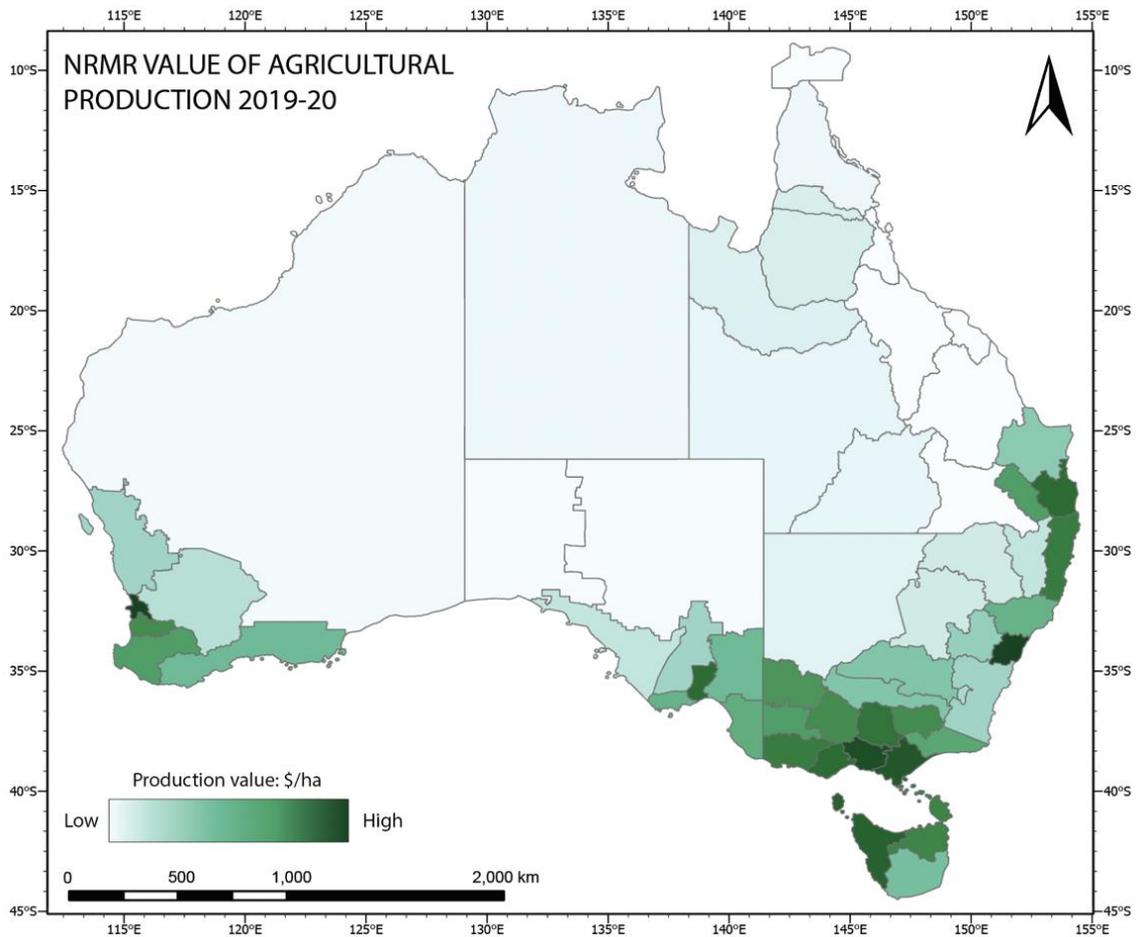
Breaking down the land use data to the three NRMRs of interest shows a similar trend, where ‘other protected areas’ is predominately comprised of Indigenous owned/exclusive native title land (see Graph 14). The NRMR data also show that native vegetation grazing is more prevalent across the Northern Territory and Rangelands NRMRs compared to Cape York. All regions also have areas of nature conservation, with these being most prevalent in the management/non-exclusive native title areas of Cape York, where management rights are likely to overlap with conservation-designated areas such as reserves.



Graph 14 – Comparative land use for the Indigenous Estate for the Rangelands, Northern Territory and Cape York NRM

Supply of agricultural commodities

ABS agricultural production data were available at the NRMRs level, but not for the Indigenous Estate. Map 20 shows the variation in the value of agricultural production, with most value recorded in south-eastern Australia.

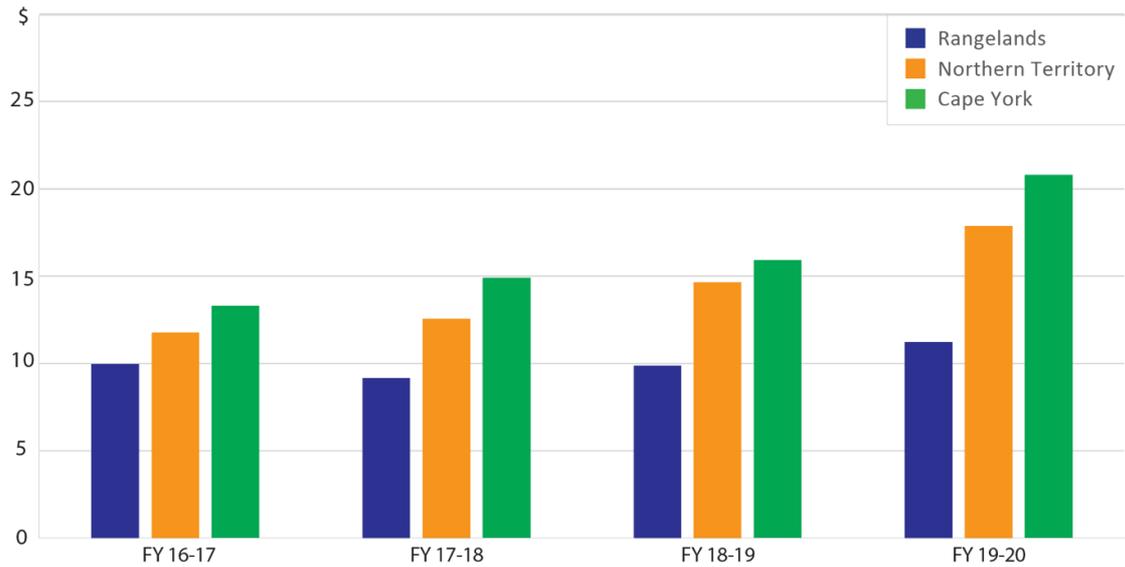


Map 20 – Relative value of agricultural production in 2019–2020 by NRMR. Note that values are adjusted by the NRMR area used for agricultural production.

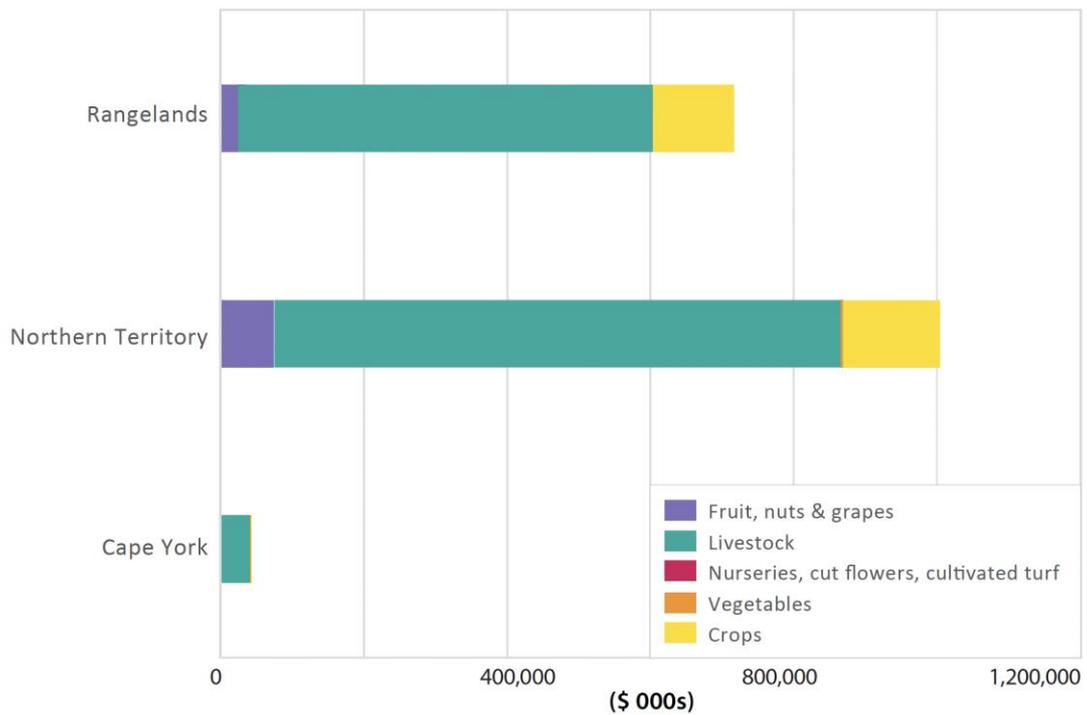
Graph 15 summarises the agricultural production value for three NRMRs with large areas of Indigenous Estate. The displayed values have been standardised to show production relative to the land used for agricultural production within each NRMR. The data show that agricultural production value increased across all NRMRs between the 2016–2017 financial year and the 2019–2020 financial year, with the highest production value located in the Cape York NRMR.

An example of the corresponding agricultural commodity production for 2019–2020 for these NRMRs are shown in Graph 16. Livestock production had the greatest value in

all three NRMRs, mirroring the results of the GIS agricultural development scenario modelling that showed pastoral development to be the most suitable agricultural development option. Detailed agricultural commodity accounts by commodity type and NRMR for the 2016–2017 to 2019–2020 financial years are provided in Appendix 3.

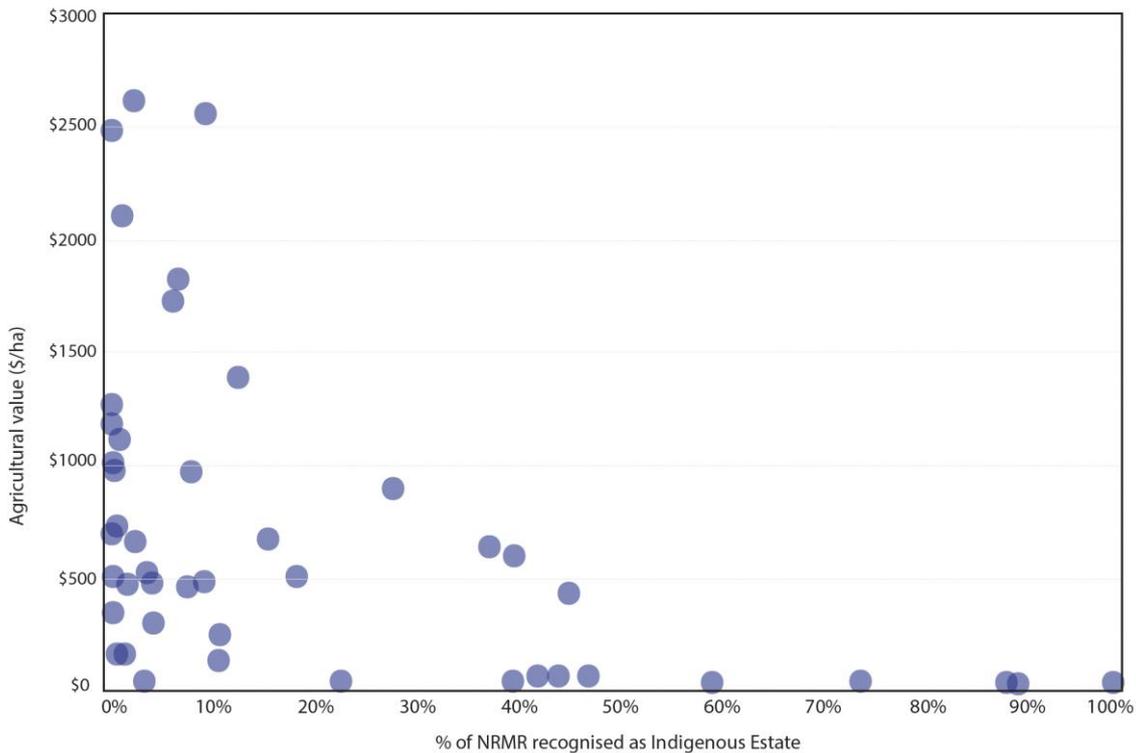


Graph 15 – Agricultural production value per square kilometre for financial year 2016–2017 to 2019–2020



Graph 16 – Agricultural production values per commodity, Rangelands, Northern Territory and Cape York NRMRs, 2019–2020

Graph 17 shows the percentage area of the Indigenous Estate against the total value of agricultural production for each of the 56 NRMRs. The trend is that the greater percentage area of the Indigenous Estate, the lower the value of agricultural production.



Graph 17 – Percentage area of the Indigenous Estate by the value of agricultural production (\$/ha) for all NRMRs

Systematic review

The 35 studies identified are listed in Annex 2 of Appendix 3. Each study was allocated to one or more classes, and this is also shown in Annex 2. Of the studies identified: 15 were of Indigenous land and sea management; ten agricultural production; nine Environmental management; four Marine industries; three Ecosystem services; two Sustainable development, and; one Forestry. Forestry and marine industries are almost certainly under-represented in the review as the search string used “Agriculture”.

The systematic review indicates that the current and potential value of the Indigenous Estate has not been seriously investigated before in Australia. While some literature was identified, within these papers there was no definition of the Indigenous Estate and no overall assessment of its current economic activity nor of its economic potential.



Discussion

The available environmental data can be assembled into accounts, revealing information of relevance to management of the Indigenous Estate and assessing its current and potential use for agriculture. The land cover condition account shows the relative potential of different parts of the Indigenous Estate for agricultural production for the NRM examples presented, and similar accounts could be produced for any area of the Indigenous Estate of interest. The land cover extent and condition accounts could be extended to estimate ecosystem services, beyond the biomass provisioning services associated with agriculture, such as climate regulation (which includes carbon storage and carbon sequestration). Extended ecosystem service accounts could identify opportunities in emerging markets for carbon credits and biodiversity offsets, through initiatives like the Agriculture Biodiversity Stewardship Package. Estimating recreational and cultural ecosystem services could also identify opportunities for tourism.

The available economic data are at a scale that are not able to be fitted to areas of relevance to management of the Indigenous Estate. While estimates of the value of agriculture production could not be produced for the Indigenous Estate per se, the accounts showed the NRM examples with the highest percentage areas of Indigenous Estate tended to be associated with the NRM examples with the lowest levels of agricultural production (Graph 17). While much of this can be explained in terms of the extent and condition of different land cover types (e.g. Table 11), the information can also be used to identify areas that may be suitable for higher levels of agricultural production. That is, areas with condition levels similar to, or higher than, other NRM examples, but with lower values of agricultural production.

Accounts for NRM examples provide an indication of value for areas that overlap with areas of relevance to management of the Indigenous Estate. The Northern Territory NRM example has a far greater production value than the other NRM examples, but this NRM example is also considerably larger in size and hence had a greater area used for agriculture.

A confounding factor in interpretation of the accounts is the use of the Indigenous Estate by non-Indigenous owners or operators of enterprises, which is the case for areas of non-exclusive native title. Going forward it may be useful to distinguish between the Indigenous Estate used by:

- Indigenous people for agricultural production.



- Non-Indigenous people for agricultural production that benefits Indigenous people through, for example, payments of rent.
- Non-Indigenous people for agricultural production without benefit to Indigenous people.

These distinctions would help to link the broad-level accounts (such as those produced for the NRMRS) to the individual Indigenous enterprises to develop a case for investment by those using frameworks for ESG to make investment decisions. In this, the broad-level accounts help make the case for investments in particular areas and activities, while the enterprise level accounts make the case for investments in particular enterprises. The goods and services produced by Indigenous enterprises using ESG reporting (which can include natural capital accounting) could also command price premiums from consumers.

Incorporation of the Indigenous values into the accounts would help to identify development opportunities on the Indigenous Estate consistent with these values. The SEEA does not provide guidance on this (Normyle et al. 2022), but the overall conceptual model can be adapted to a First Nations context (Figure 6). Methods to identify and measure Indigenous values require further research. This includes the identification, definition and measurement of ecosystem services of greatest relevance to Indigenous people, and in particular, the cultural services. The issue of cultural services also raises the question of how to account for traditional Indigenous knowledge and values.

Limits of data

Additional data and modelling are needed to be able to more closely align agricultural production data to areas of relevance to management of the Indigenous Estate. Collaborations with the ABS and ABARES, who have access to unit record data on agricultural production, would assist with this task (and it is recognised that there are limits to this so that the confidentiality of survey respondents is maintained).

The adding of an “Indigenous Enterprise” flag to the to Australia Business Register used by the ABS and ABARES for the collection of agricultural and other economic data could assist with future estimates of the value of agricultural production from the Indigenous Estate by Indigenous Enterprises. A key task would be to get agreement on the definition of an Indigenous Enterprise.

A key data issue is that what is available has a mismatch of reference years, scales and boundaries and that the timeliness of data on land use and land cover is poor. Information from different states and territories is not usually directly comparable due to a range of factors including; for example, the classifications of vegetation types for environmental information. Collaboration between national and State and Territory agencies would help resolve these issues.

Conclusion

The exercise has shown that NCA based on SEEA can provide information on the Indigenous Estate. The accounts themselves, and in particular the biophysical accounts for land cover extent and condition, can be used for identifying areas suitable for agricultural development and hence guide investments that will help activate these areas. The comparison of the value of agricultural production of NRMRs (Map 20) by percentage area of the Indigenous Estate (Graph 17) highlights disparities but, with information on condition (Map. 17), can be used to identify NRMRs with the greatest agricultural potential. The areas with the greatest agricultural potential are shown in the GIS chapter (Figure 24), but because of the spatial resolution of the economic data, the extent to which this potential has been realised in the Indigenous Estate is unknown.

The construction of the accounts demonstrates that available environmental and economic data can be used to produce accounts, but the level of spatial detail available in the outputs from the ABS and ABARES does not allow an estimate of the current value of agricultural production on the Indigenous Estate. Finer level economic data would increase the relevance of accounts for its management, while the identification of Indigenous enterprises in the Australian Business Register used by both the ABS and ABARES would be able to link the use of the Indigenous Estate to the benefit of the Indigenous people.

STRATEGIC RECOMMENDATIONS AND PATHWAYS

Key priority actions for sector development	Action owner and key partners	Intended industry impacts
<p>FIRST NATIONS PRIMARY INDUSTRIES ECONOMIC DATA</p> <p>Work with First Nations, ABS, ABARES and DAWE to establish adequately reliable agricultural, fisheries, aquaculture and forestry economic data pertaining to the Indigenous Estate and Indigenous primary production enterprises.</p> <p>Optimisation of this dataset will require extensive First Nations inclusion in design, collection and analysis and a First Nations data sovereignty framework.</p>	<p>Primary responsibility: DAWE</p> <p>Partners: ABS, ABARES and First Nations primary producers</p>	<p>Reliable data for policy and industry decision making.</p>
<p>DEVELOP A PORTFOLIO OF FIRST NATIONS PRIMARY INDUSTRIES CASE STUDIES</p> <p>The case studies presented in this study indicate a functioning and productive First Nations primary industries sector. A greater number of similarly positive stories are required to negate the all too common negative dialogue and to generate stakeholder (including investor) confidence in the First Nations primary industry sectors.</p> <p>Commencing with the potential additional case studies summarised in in this report and exploring potential additional case studies from the dataset contained in Appendix 1, develop and publish case studies detailing a range of First Nations primary production enterprises across Australia.</p>	<p>Primary responsibility ANU</p> <p>Partners: ILSC, CRCNA and First Nations primary industry participants</p>	<p>Demonstration of sector benefits to key stakeholders and development of investment pipeline for ESG-oriented investment.</p>
<p>IMPACT INVESTMENT ATTRACTION STRATEGY</p> <p>Engage with the global social impact investment sector to develop a framework for identifying potential flow across First Nations primary production in Australia.</p>	<p>Primary Responsibility: DAWE</p>	<p>Attraction of private capital to the First Nations primary production sector.</p>

Key priority actions for sector development	Action owner and key partners	Intended industry impacts
Based on the Natural Capital Accounting framework, establish a framework for measuring impact associated with First Nations primary production businesses.	Partners: ILSC	
<p>ESTABLISH A FIRST NATIONS PRIMARY INDUSTRIES TASKFORCE</p> <p>Comprised of expert representation from ANU, DAWE, ILSC, ISER, CRCNA and NFF, the taskforce will be charged with developing strategies and initiatives designed to:</p> <ul style="list-style-type: none"> ▪ Use the GIS analysis to identify opportunities, and activate primary production from underutilised areas of the Indigenous Estate ▪ Develop opportunities and frameworks for ESG-oriented collaborations on shared tenure, including the application of Natural Capital Accounting to measure ESG impact ▪ Identify and advocate for changes to legislation as necessary to optimally facilitate increased production from the Indigenous Estate and ESG collaborations ▪ Contract the capability building timeframe that is typical of First Nations primary industry enterprise ▪ Identify opportunities and develop strategies to optimise market access, enter new markets and develop new products (e.g. traditional produce, carbon and biodiversity products) from greater participation by the First Nations agricultural sector 	<p>Primary responsibility: DAWE</p> <p>Partners: ILSC, ANU, CRCNA and NFF</p>	Whole of industry ownership and leadership



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Appendices

Appendix 1 – Sample of First Nations Primary Production Enterprises

New South Wales

NAME OF PROPERTY/ BUSINESS	OWNERS	TRADITIONAL OWNERS	INDUSTRY	SIZE (HA)	DESCRIPTION
BOLLANOLLA FARM	ILSC		Bush Foods - Finger Lime	128	Small farm growing Fingerlimes, chemical free lemon grass, Asian ginger, Davidson plumbs and guava. Business' name is Bolla Nolla Fingerlimes and Farm Fresh Produce.
CANGAI CREEK STATION	Cangai Creek Aboriginal Corporation		Unknown	1,904	Minimal agricultural activities.
COMPTON DOWNS	Yatama Ngurra Land Enterprises Ltd		Unknown	26,821	Minimal agricultural activities.
COWGA	BALLOT Land Enterprises Ltd	Ngemba People	Unknown	9,377	BALLOT is an acronym for Brewarrina Aboriginal Local Land Owners Trust.
DJANABA FARM	Jocelyn King		Bush Foods		Establishment of small-scale native food production.
GLENHOPE	Nari Nari Tribal Council	Nari Nari People	Unknown	4,580	Operated in conjunction with Nimmie Cairra. Also subject to environmental restoration work.
ILLAROO FARM	Mia Mia Properties Incorporated		Sheep	461	Privately owned sheep farm.

NAME OF PROPERTY/ BUSINESS	OWNERS	TRADITIONAL OWNERS	INDUSTRY	SIZE (HA)	DESCRIPTION
JUBAL	Jubal Aboriginal Corporation	Bundjalung Nation	Beef - Southern	725	Active pastoral property. Representing largely one family.
MERRIMAN	ILSC	Various	Sheep	16,624	Agistment to a third-party operator. Hosts the Merriman Sheering School. An active wool producing property.
NIMMIE CAIRA (GAYINI)	Nari Nari Tribal Council	Nari Nari People	Mixed Operations	84,214	An active agribusiness, as well as the host of ecotourism site. The property also holds significant environmental assets, that in partnership with The Nature Conservancy, the Murray Darling Wetlands Working Group to restore these assets. Property has a commercial agribusiness including grazing, dryland and irrigated cropping, ecotourism and carbon sequestration.
TOOGIMBIE AND LORENZO	Nari Nari Tribal Council	Nari Nari People	Unknown	1,016	Operated in conjunction with Nimmie Caira. Formerly an agricultural property, now a conservation property under an IPA.
TRELAWNEY STATION	Tamworth Local Aboriginal Land Council (TLALC)	Various	Mixed Operations	766	A mixed farming property, with diversified income from accommodation and conference facilities.
WEILMORINGLE & ORANA	ILSC	Moorawarri People	Sheep	16,851	Agistment to a third-party.

Northern Territory

NAME OF PROPERTY/BUSINESS	OWNERS	TRADITIONAL OWNERS	INDUSTRY	SIZE (HA)	DESCRIPTION
MANINGRIDA WILD FOODS	Maningrida Wild Foods	Various	Fishing - Barramundi, Mud Crabs		A 100% Aboriginal owned social enterprise supplying fresh fish to the remote Maningrida and neighbouring communities. An important employer in the town too.
BANKA BANKA WEST	ILSC		Beef - Northern	154,300	
FISH RIVER	ILSC	Various	Beef - Northern	182,500	Pastoral property. Uses traditional fire management receiving carbon credits.
GUNBALANYA STATION	Leased by ILSC	Yolngu People	Beef - Northern	80,000	A pastoral property running beef and buffalo. Operates a small abattoir and retail butcher shop in the community of Gunbalanya, as well as supplying to wholesalers and retailers throughout the Northern Territory. Run under a Pastoral Land Use Agreement between the ILSC, Gunbalanya Meat Supply Pty Ltd, the Arnhem Land Aboriginal Land Trust and the Northern Land Council.
KING VALLEY STATION	Banajtjari Aboriginal Corporation		Beef - Northern	1,222	Pastoral property located near to Katherine.
NAMUL-NAMUL STATION	Namul-Namul Aboriginal Corporation C/- NLC		Beef - Northern	49,653	Pastoral property located in the Roper Valley of the Northern Territory.

NAME OF PROPERTY/BUSINESS	OWNERS	TRADITIONAL OWNERS	INDUSTRY	SIZE (HA)	DESCRIPTION
OORATIPpra STATION	Ooratippra Aboriginal Corporation	Alyawarr Language Group	Beef - Northern	432,036	Pastoral property currently leased by the neighbouring station. Can run up to 4,000 head of cattle. The Alyawarr Language Group have exclusive native title over the station, determined in 2011, covering the entirety of the station.
WARRIGUNDU STATION	Alawa 1 Aboriginal Land Trust		Beef - Northern	322,700	Cattle operation.
YAGBANI ABORIGINAL CORPORATION OYSTERS	Yagbani Aboriginal Corporation	Yagbani People	Fishing - Oysters		First commercial oyster farm in Northern Australia. Currently more than 80,000 black-lip oysters growing in the hatchery on tidal lined. The goal is to expand to more than 1 million.
THE NORTHERN AUSTRALIA ABORIGINAL KAKADU PLUM ALLIANCE	Various - Alliance	Various	Bush Foods - Kakadu Plum	An alliance of nine Aboriginal enterprises to harvest, market and commercialise the Kakadu Plum.	

Queensland

NAME OF PROPERTY/BUSINESS	OWNERS	TRADITIONAL OWNERS	INDUSTRY	SIZE (HA)	DESCRIPTION
BADJUBALLA	Badjuballa Aboriginal Corporation	Jiddabul and Girramay Peoples	Beef - Northern	23,923	Active pastoral property. Hosts training programs for at-risk youth connecting them back to Country.
BULIMBA STATION	Uwoykand Tribal Aboriginal Corporation (UTAC)		Beef - Northern	294,740	
CALTON HILL	Kalkadoon Tribal Council Ltd	Kalkadoon People	Beef – Northern	470,000	Cattle operation.
CROCODILE WELCOME STATION	Ang-Gnarra Aboriginal Corporation		Beef - Northern	124,000	
DELTA DOWNS	Kurtijar Aboriginal Corporation	Kurtijar People	Beef - Northern	405,000	Successful pastoral property running 40,000-45,000 cattle.
EMU CREEK STATION	Emu Creek Bar-Barrum Aboriginal Corporation	Bar Barrum People	Unknown	20,882	
GEIKIE STATION	Geikie Aboriginal Corporation	Kaatju People	Beef - Northern	82,900	Pastoral lease is held by Geikie Aboriginal Corporation, which acts for Kalan Enterprises.
GRACEVALE STATION	ILSC (Yambangku Aboriginal Cultural Heritage and Tourism	Iningai People	Beef - Northern	8,870	Previously a cattle station, it has since reduced its herd. It diversified income through tourism ventures focused on the significant rock art on the station.

NAME OF PROPERTY/BUSINESS	OWNERS	TRADITIONAL OWNERS	INDUSTRY	SIZE (HA)	DESCRIPTION
	Development Aboriginal Corporation)				
LAWN HILL AND RIVERSLEIGH PASTORAL HOLDING COMPANY	Lawn Hill and Riversleigh Pastoral Holding Company	Waanyi People	Beef – Northern	647,500	Cattle operation.
LILYVALE STATION	Kulla Land Trust	Lama Lama People	Beef - Northern		A pastoral property running cattle on the Cape York Peninsula. Leased to other operators. Also known as Tuulwa.
MEREPAH STATION	ILSC	Various	Beef - Northern	186,479	Pastoral property. Uses traditional fire burning for carbon credits.
MINDANAO	ILSC		Beef - Northern	1,379	Agistment agreement with third party operator.
MIDDLE PARK	Woolgar Valley Aboriginal Corporation	Woolgar People	Beef - Northern	133,246	An active pastoral station with significant heritage and cultural values, as well as the site of the Woolgar Massacar.
MT TABOR	Goorathuntha Traditional Owners Limited	Bidjara People	Beef - Northern	70,622	An active pastoral property managed by the Bidjara Traditional Owners.
SILVER PLAINS	Kulla Land Trust	Lama Lama People	Beef - Northern	167,231	A pastoral property running cattle on the Cape York Peninsula. Operated by the Lama Lama People. Also hosts camping on the property. Also known as Maramba.

NAME OF PROPERTY/BUSINESS	OWNERS	TRADITIONAL OWNERS	INDUSTRY	SIZE (HA)	DESCRIPTION
SOMERSET (BANANA PROPERTIES)	ILSC		Beef - Northern	1,307	Formerly an ILSC integrated pastoral businesses with Midandao and Tiamby. Currently leased to a third-party pastoral company.
STRATHGORDON	Poonko Strathgordon Aboriginal Corporation	Strathgordon Mob	Beef - Northern	121,000	The Strathgordon Mob have exclusive native title determination of Strathgordon Pastoral Lease. Property is partially leased by Carpentaria Cattle Co. for agistment.
TIAMBY (BANANA PROPERTIES)	ILSC		Beef - Northern	1,721	Formerly an ILSC integrated pastoral with Midandao and Somerset. Currently leased to a third-party pastoral company with Midandao.
URANNAH	Urannah Properties Association Incorporated	Birri Gaba Nation	Beef - Northern	65,690	An active pastoral property.

South Australia

NAME OF PROPERTY/BUSINESS	OWNERS	TRADITIONAL OWNERS	INDUSTRY	SIZE (HA)	DESCRIPTION
ANANGU PITJANTJATJARA YANKUNYTJATJARA (APY)			Beef - Southern		Participated in the North West Indigenous Pastoral Project. Currently agists cattle but working towards individuals having the ability to manage their own pastoral properties on ANY land.
ANDAMOOKA STATION	Kokatha Pastoral Pty Ltd	Kokatha People	Beef - Southern		Participated in the North West Indigenous Pastoral Project.
DIBHARRA (MILLERS FARM)	Narungga Nations Aboriginal Corporation For Land	Narungga People	Unknown	307	Pastoral property
EMEROO STATION	Bungala Aboriginal Corporation		Beef - Southern		Participated in the North West Indigenous Pastoral Project. Also an Ostrich Farm.
GLEN BOREE	Wirangu Association	Wirangu People	Unknown	11,503	
KUTI CO PIPI PROJECT	Kuti Co	Ngarrindjeri People	Fishing - Pipi		A 100% Aboriginal owned commercial enterprise harvesting pipis (or Kuti) from the lakes and Coorong Fishery.
LEIGH CREEK STATION	Andyamathanha Land Council Inc		Unknown	46,485	Some agistment. Mostly cultural and environmental activities.



NAME OF PROPERTY/BUSINESS	OWNERS	TRADITIONAL OWNERS	INDUSTRY	SIZE (HA)	DESCRIPTION
MABEL CREEK STATION	AMY Nominees Pty Ltd	Antakirinja Matuntjara Yankunytjatjara People	Beef - Southern		Participated in the North West Indigenous Pastoral Project.
MONTILLIE	Kuranya Family Association Incorporated		Unknown	474	Family operated farming property.
MT CLARENCE	Walarintja Landholding Inc (AMY Nominees Pty Ltd)	Antakirinja Matuntjara Yankunytjatjara People	Beef - Southern	178,390	Active pastoral property. Participated in the North West Indigenous Pastoral Project.
MT WILLOUGHBY	AMY Nominees Pty Ltd	Antakirinja Matuntjara Yankunytjatjara People	Beef - Southern	479,608	Active pastoral property. Participated in the North West Indigenous Pastoral Project.
MYRTLE SPRINGS STATION	Vinya Aboriginal Corporation		Sheep	89,767	Agistment to non-Indigenous operators.
NARUNGA NATION ABORIGINAL CORPORATION TRADITIONAL FISHING RIGHTS	Narungga Nation Aboriginal Corporation	Narungga People	Fishing - Traditional		Acquired the right to fish in traditional ways unrestricted from the Yorke Peninsula.



NAME OF PROPERTY/BUSINESS	OWNERS	TRADITIONAL OWNERS	INDUSTRY	SIZE (HA)	DESCRIPTION
PURPLE DOWNS STATION	Kokatha Pastoral Pty Ltd	Kokatha People	Beef - Southern		Participated in the North West Indigenous Pastoral Project.
ROXBY DOWNS STATION	Kokatha Pastoral Pty Ltd	Kokatha People	Beef - Southern		Participated in the North West Indigenous Pastoral Project.
WANNA MAR SOUTHERN BLUEFIN TUNA	Wanna Mar	Mirning and Wirangu	Fishing - Tuna		Acquired 25 tonnes of bluefin tuna quota. Tuna caught at sea, then brought into aquaculture pens for finishing. Supported by the Stehr Group as a training and operational partner. 100% Aboriginal owned.
YAPPALA STATION	Viliwarinha Yuras		Beef - Southern	17,642	Active pastoral property currently leased to a third-party cattle farmer.

Tasmania

NAME OF PROPERTY/BUSINESS	OWNERS	TRADITIONAL OWNERS	INDUSTRY	SIZE (HA)	DESCRIPTION
MURRAYFIELD STATION	Weetapoono Aboriginal Corporation	Weetapoono People	Sheep	4,097	Hosts a flock of approximately 9,000 sheep. The property also encompasses around 300 heritage sites. Run in partnership between the ILSC and Weetapoono Aboriginal Corporation.
TASMANIAN ABORIGINAL ABALONE FISHERY	Land and Sea Aboriginal Corporation of Tasmania	Tasmanian Aboriginal People	Fishing - Abalone		In March 2022, 40 units (or 9 tonnes) of the commercial abalone fishery in Tasmania has been allocated to Tasmanian Aboriginal people.
THULE FARM	Flinders Island Aboriginal Association		Sheep	2,054	Operated by Flinders Island Aboriginal Association as an active pastoral property.

Victoria

NAME OF PROPERTY/BUSINESS	OWNERS	TRADITIONAL OWNERS	INDUSTRY	SIZE (HA)	DESCRIPTION
BARONGAROOK FARM	Barongarook Aboriginal Corporation		Unknown	118	
FALBALA FARM	ILSC		Unknown	252	Grazing enterprise.
KOOREELAAH	Winda-Mara Aboriginal Corporation	Various	Beef - Southern	1,050	A beef-fattening enterprise, as well as a location for training, skills development an community member meeting place.
MARTANG	Martang Pty Ltd	Djab Warrung People	Beef - Southern	379	Active cattle operation.

Western Australia

NAME OF PROPERTY/BUSINESS	OWNERS	TRADITIONAL OWNERS	INDUSTRY	SIZE (HA)	DESCRIPTION
AVONDALE PARK	ILSC	Noongar People	Bush Foods, Sheep	851	Harvest of Bush Foods, primarily wattle seed. Pastures are leased to a third party to run herds of sheep.
BALDIVIS FARM GREENHOUSE	South West Aboriginal Land and Sea Council	Noongar People	Horticulture		Establishment of a commercial partnership that creates an Aboriginal-led and managed horticultural business covering the entire supply chain.
BOHEMIA DOWNS	Kimberley Agricultural and Pastoral Company (KAPCO)	Various	Beef - Northern		Pastoral property running beef. One of four properties owned by KAPCO.
CARDABIA STATION	Baiyungu Aboriginal Corporation		Beef - Northern	199,808	
COOMBABLA FARM	Woolah Wah Land Aboriginal Corporation	Noongar People	Unknown	643	Agistment to non-Indigenous operators.
DILLON BAY FARM	Banjelungup Aboriginal Corporation	Noongar People	Sheep	567	Located in the Great Southern.

NAME OF PROPERTY/BUSINESS	OWNERS	TRADITIONAL OWNERS	INDUSTRY	SIZE (HA)	DESCRIPTION
DOWRENE FARM	Dujimerrup Twonkup Aboriginal Corporation	Noongar People	Mixed Operations	726	Property is sub-leased for cropping and sheep enterprises. Venturing into bush foods production.
DURACK RIVER	ILSC		Beef - Northern	365,208	
FRAZIER DOWNS	Kimberley Agricultural and Pastoral Company (KAPCO)	Various	Beef - Northern		Pastoral property running beef. One of four properties owned by KAPCO.
GIBBAGUNYA	ILSC		Unknown	631	Leased to non-Indigenous operator.
GLENROY FARM	Seabrook Aboriginal Corporation	Noongar People	Unknown	1,756	Located in the Wheatbelt.
HEXTERS AND KARYIE FARM	Grahams Land and Sea Aboriginal Corporation		Unknown	1,616	Located in the Esperance-Goldfields Region.
HIGHLAND PARK	Wongutha CAPS Developments Inc	Various	Unknown	358	A boarding school for Indigenous students from around Australia, located on an active farming property.

NAME OF PROPERTY/BUSINESS	OWNERS	TRADITIONAL OWNERS	INDUSTRY	SIZE (HA)	DESCRIPTION
HOME VALLEY STATION	Balangarra Aboriginal Corporation (BAC)	Balangarra People	Beef - Northern	248,939	An active pastoral station with a successful higher-end tourism venture that services tourists travelling along the Gibb River Road.
KARUNJIE	ILSC	Nyalinga	Beef - Northern	273,941	An active pastoral station. ILSC is working with the Nyaliga Aboriginal Corporation to return ownership and management back to them. Uses traditional fire management methods, receiving carbon credits.
LAMBOO STATION	Ngunjiwirri Aboriginal Corporation	Ngunjiwirri People	Beef - Northern	360,000	Pastoral Property located nearby to Halls Creek. Runs 2300 head of cattle.
MILLIJIDDEE STATION	Kadajina Aboriginal Corporation	Kadajina Community	Beef - Northern	307,900	Pastoral Property located 300km east of Broome. Kadajina community (~16 houses) lives on the property and is home to an independent school.
MOWANJUM STATION	Mowanjum Aboriginal Corporation	Worrorra, Ngarinyin and Wunumbal People (make up the Mowanjum Community)	Beef - Northern	51,000	Pastoral Property in the Kimberley. Funded by the ILSC in 2012 to re-invigorate the cattle business.
MT ANDERSON	Kimberley Agricultural and Pastoral	Various	Beef - Northern		Pastoral property running beef. One of four properties owned by KAPCO.

NAME OF PROPERTY/BUSINESS	OWNERS	TRADITIONAL OWNERS	INDUSTRY	SIZE (HA)	DESCRIPTION
	Company (KAPCO)				
MT WITTENOOM STATION	Baratha Aboriginal Corporation	Various	Beef - Southern	83,688	A successful pastoral enterprise located in the Rangelands of WA.
MULGUL	Yaluning Aboriginal Corporation		Unknown	279,883	Leased to non-Indigenous operators.
MYROODAH STATION	Kimberley Agricultural and Pastoral Company (KAPCO)	Nyikina and Mangala People	Beef - Northern	402,769	Pastoral property running beef, currently at half capacity. At full capacity, will employ 260 Aboriginal people. One of four properties owned by KAPCO.
ROEBUCK PLAINS STATION	Nyambala Buru Yawuru Limited	Yawuru People	Beef - Northern	276,000	Pastoral property running beef. Includes the Roebuck Export Depot. Overlaps with the Yawuru Indigenous Protected Area. Supports a herd of 20,000 head of cattle. Purchased by ILSC in 1999 and divested to Yawuru in 2014. Yawuru took over operations of the station in 2022.
ROELANDS FARM AND MISSION	Woolkabunning Kiaka Aboriginal Corporation	Various - Stolen Generation	Bush Foods	227	A former mission, it now serves as a place of healing for the stolen generation who lived at Roelands Village. It has a growing bush foods enterprise.

NAME OF PROPERTY/BUSINESS	OWNERS	TRADITIONAL OWNERS	INDUSTRY	SIZE (HA)	DESCRIPTION
SWAMP RIVER FARM	Banjelungup Aboriginal Corporation	Noongar People	Sheep	282	Located in the Great Southern.
ULLAWARRA STATION	Wurrkaja Aboriginal Corporation	Tharrkari People	Beef - Northern	163,200	Pastoral property located on the ends of the Pilbara, norther of Gascoyne Junction. Largely operated by a single family.
WALITJ MIA MIA FARM	Walitj Mia Mia Aboriginal Corporation	Noongar People	Sheep	606	Privately owned sheep farm. Also operates some timber and a range of emerging niche products. One of the first Aboriginal-owned farms to operate successfully in the region, providing a case study for others.

Torres Strait Islands

NAME OF PROPERTY/BUSINESS	OWNERS	TRADITIONAL OWNERS	INDUSTRY	SIZE (HA)	DESCRIPTION
ZENADTH KES FISHERIES COMPANY		Torres Strait Islander People	Fishing - Variety		Fishes tropical rock lobster, coral trout and sea cucumber.

Appendix 2 – GIS Supplementary Data

Layer name, description and rationale for inclusion in the analysis for core datasets

Layer Name	Description	Rational for Inclusion	Dataset Information
Vegetation Datasets			
Vegetation Index, NDVI	Used to estimate the density of green on an area of land. Value range of -1 to +1, where more positive values equate to more landscape <i>greenness</i>	Used in agricultural applications as a proxy for healthy vegetation and to estimate land cover	MODIS Product, Single image derived from median values 2019-2020
Net Primary Productivity (NPP)	Shows approximate value of carbon dioxide absorbed by vegetation during photosynthesis minus carbon dioxide released during respiration	Indicated the amount of carbon available for building new plant mass. Can be used as a proxy of agricultural productivity	MODIS Product, Single image derived from median values 2019-2020
Dynamic Land Cover Dataset	Shown land cover type across Australia as 24 distinct classes`	Enabled exclusion of areas such as urban development and mining, and the extraction of water bodies & wetlands	Geoscience Australia, 2014-15
Climate Datasets			
Evaporation, Summer	Evaporation is the amount of water which evaporates from an open pan called a Class A evaporation pan. The rate of evaporation depends on factors such as cloudiness, air temperature and wind speed.	Evaporation causes the upper levels of soil to become dry and hard. When rain or irrigation water then falls onto the soil, a significant portion of the water runs off of the soil instead of soaking into the ground.	BoM, 2020

Layer Name	Description	Rational for Inclusion	Dataset Information
Minimum Winter Temperature	Lowest average temperature recorded during Australian winter	Informs temperature range when considering crop viability	BoM, 2020
Sum Daily Rainfall	Summation of precipitation during every day of the year 2020	Many agricultural activities rely on rainfall; too much rainfall may also limit access and certain activities	BoM, Summed daily figures during the year 2020
Water Datasets			
Moisture Index (NDWI)	Normalised difference water index. The index reflects moisture content in plants and soil	Presents a strong association with the plant and soil water content which is useful for informing water stress & monitoring irrigation	MODIS Product, Single image derived from median values 2019-2020
Distance to Water Source (Lakes, Rivers, Dams)	Dataset captures distance decay from major rivers, lakes and dams. High suitability when closer to water sources	Access to water is important for agricultural activities	Euclidean distance derived from CSIRO, 2016
Hydrogeology	Dataset based on more than 850,000 bore locations across Australia, with associated lithology logs, bore construction logs and hydrostratigraphy logs.	Groundwater systems are important in providing water resources for much of the country. Note that this dataset does not account for access regarding licences or rights to use groundwater	SoE 2016
Groundwater Salinity	Salinity refers to the concentrations of salts in water or soils. Salinity recorded as 0-1500 (most irrigation), 1500-5000 (most livestock), >5000 (some livestock)	High levels of salinity and acidity (if present) may be harmful to many plants and animals.	CSIRO, 2016
Soil Datasets			

Layer Name	Description	Rational for Inclusion	Dataset Information
Soil Carbon	Soil carbon is a part of the organic matter in soil. It comes from the breakdown of plants, microorganisms and animal waste material. It helps give soil its water-retention capacity, its structure, and its fertility.	The amount and form of organic carbon plays an important role in soil process and function, the underpinning ecosystem service for agricultural and landscape productivity.	CSIRO, 2016
Soil Erodibility	Erodibility describes or is a measure of the inherent resistance of geologic materials (soils and rocks) to erosion. Highly erodible geologic materials are readily displaced and transported by water.	Soil erosion decreases soil fertility, which can negatively affect crop yields.	CSIRO, 2016
Slope	Land slope values in degrees	Informs types of viable agriculture and enables exclusion of areas where slope is too great for viable agriculture	Derived from DEM (see below)
Access Datasets			
Distance to major & minor roads	Dataset captures distance decay from major roads. High suitability when closer to roads	Capacity to transport goods is important and costs increase as enterprise moves further from transport corridors	Euclidean distance derived from ABS, 2016
Distance to Towns & Cities	Dataset captures distance decay from towns. High suitability when closer to towns	Towns provide access to supplies. Costs increase further from towns	Euclidean distance derived from ABS, 2016
Distance to Ports	Dataset captures distance decay from major ports. High suitability when closer to ports	Capacity to transport goods is important and costs increase as enterprise moves further from transport corridors	Euclidean distance derived from ABS, 2016

Appendix 3 – Natural Capital Accounting Supplementary Data

Annex 1.

Supply of agricultural commodities by Natural Resource Management Region*, Indigenous Estate, 2016-17**

NRMR	Cape York	Northern Gulf	Northern Territory	Rangelands (WA)	Total value
Grapes		\$563,820.17	\$10,656,927.78	\$5,826,862.96	\$17,047,610.91
Fruit and nuts	\$753,884.87	\$79,520,047.76	\$92,062,314.02	\$29,259,066.52	\$201,595,313.17
Livestock products	\$22,057.23	\$77,120.84		\$13,376,463.92	\$13,475,641.99
Nurseries			\$15,471,602.84	\$6,179,253.36	\$21,650,856.20
All cropping	\$1,201,313.47	\$121,427,858.00	\$233,062,046.60	\$103,754,878.10	\$459,446,096.17
Total Agriculture	\$1,977,255.57	\$201,588,846.77	\$351,252,891.24	\$158,396,524.86	\$713,215,518.44

*Highest level ABS commodity grouping used. More detailed breakdowns will be used as appropriate.

** Methods for attributing ABS NRM data on agricultural production are under investigation.

Supply of agricultural commodities by Natural Resource Management*, Indigenous Estate, 2017-18**

NRMR	Cape York	Northern Gulf	Northern Territory	Rangelands	Total value
Grapes		\$2,045,711.99	\$2,359,067.52	\$3,976,613.60	\$8,381,393.11
Fruit and nuts	\$499,720.63	\$121,180,474.10	\$147,131,147.96	\$16,638,526.06	\$285,449,868.75
Livestock products		\$106,407.76		\$10,293,387.30	\$10,399,795.06
Nurseries		\$2,160,684.04		\$867,687.89	\$3,028,371.93
All cropping	\$1,804,839.93	\$166,198,603.80	\$259,820,257.00	\$91,224,364.10	\$519,048,064.83
Total Agriculture	\$2,304,560.56	\$291,691,881.69	\$409,310,472.48	\$123,000,578.95	\$826,307,493.68

*Highest level ABS commodity grouping used. More detailed breakdowns will be used as appropriate.

** Methods for attributing ABS NRM data on agricultural production are under investigation.

Supply of agricultural commodities by Natural Resource Management*, Indigenous Estate, 2018-19**

NRMR	Cape York	Northern Gulf	Northern Territory	Rangelands	Total value
Grapes			\$4,838,543.52	\$5,592,441.93	\$10,430,985.45
Fruit and nuts	\$799,141.28	\$100,449,058.10	\$116,595,795.30	\$21,615,310.96	\$239,459,305.64
Livestock products		\$828,373.53		\$13,994,590.55	\$14,822,964.08
Nurseries		\$4,939,664.98	\$8,462,241.42	\$2,529,856.15	\$15,931,762.55
All cropping		\$143,021,287.80	\$235,461,473.60	\$120,242,486.70	\$498,725,248.10
Total Agriculture	\$799,141.28	\$249,238,384.41	\$365,358,053.84	\$163,974,686.29	\$779,370,265.82

Supply of agricultural commodities by Natural Resource Management*, Indigenous Estate, 2019-20**

NRMR	Cape York	Northern Gulf	Northern Territory	Rangelands	Total value
Grapes		\$516,374.17	\$1,696,977.98	\$2,092,234.25	\$4,305,586.40
Fruit and nuts	\$1,091,614.36	\$93,278,510.30	\$149,120,651.44	\$23,874,601.63	\$267,365,377.73
Livestock products				\$8,856,314.62	\$8,856,314.62
Nurseries		\$836,714.47	\$6,272,049.26		\$7,108,763.73
All cropping	\$1,549,461.03	\$121,175,999.70	\$270,355,012.60	\$113,260,028.40	\$506,340,501.73
Total value	\$2,641,075.39	\$215,807,598.64	\$427,444,691.28	\$148,083,178.90	\$793,976,544.21

Annex 2. Categorisation of studies identified in the systematic review

	Indigenous land and sea management	Environmental management	Agricultural production	Forestry	Marine	Ecosystem Services	Sustainable development
1) Daniels, C.W., Russell, S., Ens, E.J. Ngukurr Yangbala rangers Empowering young Aboriginal women to care for Country: Case study of the Ngukurr Yangbala rangers, remote northern Australia (2022) Ecological Management and Restoration, 23 (S1), pp. 53-63. Cited 1 times	1						
2) Creighton, C., Waterhouse, J., Day, J.C., Brodie, J. Criteria for effective regional scale catchment to reef management: A case study of Australia's Great Barrier Reef (2021) Marine Pollution Bulletin, 173, art. no. 112882, .		1					
3) Read, J.L., Wilson, G.R., Coulson, G., Cooney, R., Paton, D.C., Moseby, K.E., Snape, M.A., Edwards, M.J. Improving Kangaroo Management: A Joint Statement (2021) Ecological Management and Restoration, 22 (S1), pp. 186-192. Cited 4 times.		1					
4) Mihailou, H., Massaro, M. An overview of the impacts of feral cattle, water buffalo and pigs on the savannas, wetlands and biota of northern Australia (2021) Austral Ecology, 46 (5), pp. 699-712. Cited 3 times.		1					
5) Shellberg, J.G Agricultural development risks increasing gully erosion and cumulative sediment yields from headwater streams in Great Barrier Reef catchments (2021) Land Degradation and Development, 32 (3), pp. 1555-1569. Cited 4 times.		1					

	Indigenous land and sea management	Environmental management	Agricultural production	Forestry	Marine	Ecosystem Services	Sustainable development
6) Hartwig, L.D., Jackson, S., Osborne, N. Trends in Aboriginal water ownership in New South Wales, Australia: The continuities between colonial and neoliberal forms of dispossession (2020) Land Use Policy, 99, art. no. 104869, . Cited 13 times.	1						
7) Tsatsaros, J.H., Bohnet, I.C., Brodie, J.E., Valentine, P. Improving water quality in the wet tropics, Australia: A conceptual framework and case study (2020) Water (Switzerland), 12 (11), art. no. 3148, pp. 1-36. Cited 1 time.		1					
8) Watter, K., Baxter, G.S., Pople, A., Murray, P.J. Dietary overlap between cattle and chital in the Queensland dry tropics (2020) Rangeland Journal, 42 (3), pp. 221-225.			1				
9) Faast, R., Clarke, P.A., Taylor, G.S., Salagaras, R.L., Weinstein, P. Indigenous Use of Lerps in Australia: So Much More Than a Sweet Treat (2020) Journal of Ethnobiology, 40 (3), pp. 328-347. Cited 2 times.	1						
10) Gorman, J.T., Bentivoglio, M., Brady, C., Wurm, P., Vemuri, S., Sultanbawa, Y. Complexities in developing Australian Aboriginal enterprises based on natural resources (2020) Rangeland Journal, 42 (2), pp. 113-128. Cited 2 times.	1						
11) Meadows, J., Annandale, M., Bristow, M., Jacobsen, R., Ota, L., Read, S. Developing Indigenous commercial forestry in northern Australia (2020) Australian Forestry, 83 (3), pp. 136-151. Cited 1 time.	1			1			

	Indigenous land and sea management	Environmental management	Agricultural production	Forestry	Marine	Ecosystem Services	Sustainable development
12) Shelat, K.J., Adiamo, O.Q., Olarte Mantilla, S.M., Smyth, H.E., Tinggi, U., Hickey, S., Rühmann, B., Sieber, V., Sultanbawa, Y. Overall nutritional and sensory profile of different species of Australian wattle seeds (<i>Acacia</i> spp.): Potential food sources in the arid and semi-arid regions (2019) <i>Foods</i> , 8 (10), art. no. 482, . Cited 8 times.			1				
13) Hayes, R.C., Ara, I., Badgery, W.B., Culvenor, R.A., Haling, R.E., Harris, C.A., Li, G.D., Norton, M.R., Orgill, S.E., Penrose, B., Smith, R.W. Prospects for improving perennial legume persistence in mixed grazed pastures of south-eastern Australia, with particular reference to white clover (2019) <i>Crop and Pasture Science</i> , 70 (12), pp. 1141-1162. Cited 5 times.			1				
14) Foran, B., Smith, M.S., Burnside, D., Andrew, M., Blesing, D., Forrest, K., Taylor, J. Australian rangeland futures: Time now for systemic responses to interconnected challenges (2019) <i>Rangeland Journal</i> , 41 (3), pp. 271-292. Cited 16 times.		1					
15) Waltham, N.J., Schaffer, J., Buist, J., Geyle, M., Toby, D. Working with land and sea rangers to tackle tropical wetland restoration and conservation on the north-western islands, Torres Straits, Australia (2018) <i>Wetlands Ecology and Management</i> , 26 (6), pp. 1143-1156. Cited 2 times.	1	1					
16) Silcock, J.L. Aboriginal Translocations: The Intentional Propagation and Dispersal of Plants in Aboriginal Australia (2018) <i>Journal of Ethnobiology</i> , 38 (3), pp. 390-405. Cited 9 times.	1						

	Indigenous land and sea management	Environmental management	Agricultural production	Forestry	Marine	Ecosystem Services	Sustainable development
17) Wilkinson, K., Muhlhausler, B., Motley, C., Crump, A., Bray, H., Ankeny, R. Australian consumers' awareness and acceptance of insects as food (2018) <i>Insects</i> , 9 (2), art. no. 44, Cited 45 times.	1						
18) Thurstan, R.H., Brittain, Z., Jones, D.S., Cameron, E., Dearnaley, J., Bellgrove, A. Aboriginal uses of seaweeds in temperate Australia: an archival assessment (2018) <i>Journal of Applied Phycology</i> , 30 (3), pp. 1821-1832. Cited 11 times.	1				1		
19) Connor, S.E., Schneider, L., Trezise, J., Rule, S., Barrett, R.L., Zawadzki, A., Haberle, S.G. Forgotten impacts of European land-use on riparian and savanna vegetation in northwest Australia (2018) <i>Journal of Vegetation Science</i> , 29 (3), pp. 427-437. Cited 4 times.		1					
20) Mathew, S., Zeng, B., Zander, K.K., Singh, R.K. Exploring agricultural development and climate adaptation in northern Australia under climatic risks (2018) <i>Rangeland Journal</i> , 40 (4), pp. 353-364. Cited 3 times.			1				
21) Ash, A., Watson, I. Developing the north: Learning from the past to guide future plans and policies (2018) <i>Rangeland Journal</i> , 40 (4), pp. 301-314. Cited 5 times.			1				
22) Ash, A., Gleeson, T., Hall, M., Higgins, A., Hopwood, G., MacLeod, N., Paini, D., Poulton, P., Prestwidge, D., Webster, T., Wilson, P. Irrigated agricultural development in northern Australia: Value-chain challenges and opportunities (2017) <i>Agricultural Systems</i> , 155, pp. 116-125. Cited 16 times.			1				

	Indigenous land and sea management	Environmental management	Agricultural production	Forestry	Marine	Ecosystem Services	Sustainable development
23) Berry, H.L., Botterill, L.C., Cockfield, G., Ding, N. Identifying and measuring agrarian sentiment in regional Australia (2016) Agriculture and Human Values, 33 (4), pp. 929-941. Cited 11 times.			1				
24) Dobbs, R.J., Davies, C.L., Walker, M.L., Pettit, N.E., Pusey, B.J., Close, P.G., Akune, Y., Walsham, N., Smith, B., Wiggan, A., Cox, P., Ward, D.P., Tingle, F., Kennett, R., Jackson, M.V., Davies, P.M. Collaborative research partnerships inform monitoring and management of aquatic ecosystems by Indigenous rangers (2016) Reviews in Fish Biology and Fisheries, 26 (4), pp. 711-725. Cited 24 times.	1				1		
25) Pascoe, S., Kahui, V., Hutton, T., Dichmont, C. Experiences with the use of bioeconomic models in the management of Australian and New Zealand fisheries (2016) Fisheries Research, 183, pp. 539-548.							
26) Adams, V.M., Pressey, R.L., Álvarez-Romero, J.G. Using optimal land-use scenarios to assess trade-offs between conservation, development, and social values (2016) PLoS ONE, 11 (6), art. no. e0158350, . Cited 26 times.							
27) Preece, L.D., van Oosterzee, P., Dungey, K., Standley, P.-M., Preece, N.D. Ecosystem service valuation reinforces world class value of Cape York Peninsula's ecosystems but environment and indigenous people lose out (2016) Ecosystem Services, 18, pp. 154-164. Cited 16 times.	1						
28) Hoffmann, B.D., Broadhurst, L.M. The economic cost of managing invasive species in Australia (2016) NeoBiota, 31, pp. 1-18. Cited 93 times.			1				

	Indigenous land and sea management	Environmental management	Agricultural production	Forestry	Marine	Ecosystem Services	Sustainable development
29) Descovich, K., Tribe, A., McDonald, I.J., Phillips, C.J.C. The eastern grey kangaroo: Current management and future directions (2016) Wildlife Research, 43 (7), pp. 576-589. Cited 17 times.		1					
30) Simpson, B.S., Bulone, V., Semple, S.J., Booker, G.W., McKinnon, R.A., Weinstein, P. Arid awakening: New opportunities for Australian plant natural product research (2016) Rangeland Journal, 38 (5), pp. 467-478. Cited 4 times			1				
31) Ferguson, I., Levetan, L., Crossman, N.D., Bennett, L.T. Financial mechanisms to improve the supply of ecosystem services from privately-owned Australian native forests (2016) Forests, 7 (2), art. no. 34, . Cited 4 times.							
32) Bennett, S., Wernberg, T., Connell, S.D., Hobday, A.J., Johnson, C.R., Poloczanska, E.S. The 'Great Southern Reef': Social, ecological and economic value of Australia's neglected kelp forests (2016) Marine and Freshwater Research, 67 (1), pp. 47-56. Cited 165 times							
33) Stoeckl, N., Chaiechi, T., Farr, M., Jarvis, D., Álvarez-Romero, J.G., Kennard, M.J., Hermoso, V., Pressey, R.L. Co-benefits and trade-offs between agriculture and conservation: A case study in Northern Australia (2015) Biological Conservation, 191, pp. 478-494. Cited 10 times.							
34) Sangha, K.K., Le Brocque, A., Costanza, R., Cadet-James, Y. Application of capability approach to assess the role of ecosystem services in the well-being of Indigenous Australians (2015) Global Ecology and Conservation, 4, pp. 445-458. Cited 16 times.	1					1	

	Indigenous land and sea management	Environmental management	Agricultural production	Forestry	Marine	Ecosystem Services	Sustainable development
35) McKellar, L., Bark, R.H., Watson, I. Agricultural transition and land-use change: Considerations in the development of irrigated enterprises in the rangelands of northern Australia (2015) Rangeland Journal, 37 (5), pp. 445-457. Cited 4 times.			1				
Total	12	9	10	1	4	3	2



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