




NT Agribusiness

Assessment of Value-Add Opportunities Across the Northern Territory Agribusiness Sector

DITT, NT Government

30 May 2023



Project name		Feasibility Assessment of Value and Opportunities Across the Northern Territory Agribusiness Sector					
Document title		NT Agribusiness Assessment of Value-Add Opportunities Across the Northern Territory Agribusiness Sector					
Project number		12588166					
File name		Final Report_Value Add Opportunities for Northern Territory Agribusiness.docx					
Status Code	Revision	Author(s)	Reviewer		Approved for issue		
			Name	Signature	Name	Signature	Date
S0	0	Seamus Hoban, Duncan Hood, Alisher Ergashev	Pascal Tremblay		Wennie van Lint		2 Dec 2022
S4	1	Seamus Hoban, Duncan Hood, Alisher Ergashev	Wennie van Lint		Wennie van Lint		31 Mar 2023
S4	2	Seamus Hoban, Duncan Hood, Alisher Ergashev	Wennie van Lint		Wennie van Lint		12 May 2023
S4	3	Seamus Hoban, Duncan Hood, Alisher Ergashev	Wennie van Lint		Wennie van Lint		18 May 2023
S4	4	Seamus Hoban, Duncan Hood, Alisher Ergashev	Wennie van Lint		Wennie van Lint		29 May 2023

GHD Advisory

24 Mitchell Street, Level 7

Darwin, Northern Territory 0800, Australia

T +61 8 8982 0100 | F +61 7 3319 6038 | E drwmail@ghd.com | [ghd.com](https://www.ghd.com)

© GHD 2023

This document is and shall remain the property of GHD. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

Executive Summary

The Northern Territory (NT) Government aims to achieve a \$40 billion economy by 2030, leading to more jobs and higher living standards for all communities. To support this goal, the Territory Economic Reconstruction Commission (TERC) outlined a strategy to grow Agribusiness in the Territory using a combination of Sustainable Development Precincts and a clear whole-of-sector strategic direction, co-designed by Territory Government and industry (TERC, 2020).

In response to a recommended action from TERC (2020), the NT Department of Industry, Tourism and Trade (DITT) engaged GHD to identify and evaluate opportunities to add value to the NT agribusiness including the following target industries:

- Livestock - Cattle
- Other Livestock
- Horticulture
- Field Crops
- Seafood
- Forestry, and
- Other industries such as bush foods, potential bioresources, food service, farmers markets, honey.

This report provides a methodological, high-level assessment of the value-adding opportunities identified through consultation and literature review, and recommended actions to realise these opportunities.

Value adding opportunities were broadly defined to include any steps likely to increase the gross value of agribusiness production (GVP), including a production improvement, an input or logistics improvement, a marketing activity or some form of processing. 'Value' may be an increase in production volume, an increase in unit value, a decrease in unit cost, an increase in enterprise return, an increase in Territory production or employment.

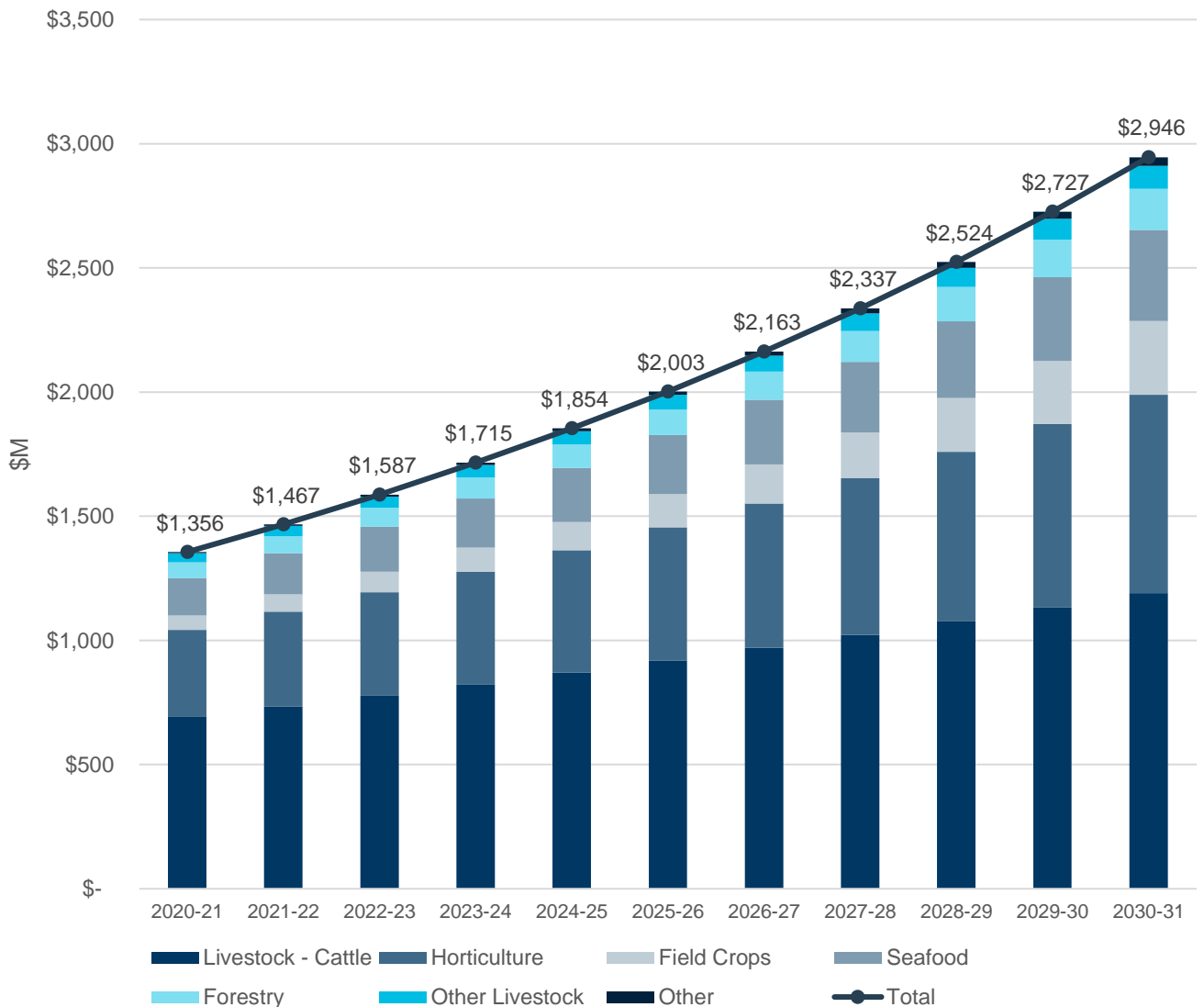
Methodology

The project was overseen by a Project Steering Committee including representatives from relevant industry organisations and government agencies. Analysis relied on a broad review of literature and consultation with relevant industry and government stakeholders (52 interviews).

In excess of 150 value adding ideas were identified through stakeholder engagement and literature reviews, sorted into a long-list of 110 opportunities and then shortlisted and aggregated to 52 distinct value-add opportunities. Modelling was then undertaken to quantify the additional value likely to be added to NT agribusiness by 2030-31 through these identified opportunities. GHD applied a bottom-up modelling approach which combined two parameters: (1) potential impact and (2) feasibility, the product of which – “feasibility weighted impact” – is an estimate of additional growth by 2030-31 above a defined baseline. A confidence rating (ranging from “Low” to “High”) was assigned to each opportunity to reflect the level of uncertainty in the assumptions applied.

Results

The study found there are opportunities for the sector to potentially double value by 2030-31 under a high growth scenario, incorporating both in-built productivity gains as well as identified opportunities to realise additional value through production and supply chain efficiencies, expansion and intensification opportunities, and access to higher value markets. The potential growth under this scenario is summarised below.



Potential agribusiness sector growth including value adding opportunities in NT (\$M GVP)

The analysis identified the opportunities that would have the highest overall impact on the value of NT agribusiness by 2030-31, and the recommended actions to progress them. This assessment aligns with the findings of a recently published report by Deloitte (2023) for DITT, which estimated that agribusiness under a high growth scenario could reach a GVP of \$3.1 billion by 2030-31, a slight difference compared to this assessment (\$2.9 billion).

Over the next 10 years, while there will be fluctuations from year to year, traditionally strong performers, such as the beef industry, should continue to perform well. Farmers will continue to diversify their cropping into newer high-valued commodities such as cotton, particularly where water is available. The sector will continue to benefit from rapid food demand growth as neighbouring economies (especially, Asia) become wealthier.

Opportunities also exist for greater value-adding to agricultural produce, particularly local meat processing. Furthermore, branding and marketing are enhancing opportunities for creating a market and price premium for NT agricultural products (especially Indigenous led economic development and aspirations).

Fully seizing opportunities in agriculture will require:

- ongoing investment by farmers in new technology to improve and optimise on-farm operations, particularly via the automatic collection and analysis of data, and in water-use efficiency solutions;
- addressing agricultural workforce issues and infrastructure challenges; and
- orchestrated approach in industry and government cooperation and investment.

Outlined below are the highest opportunities identified and the recommended actions to progress them.

Ten highest value-add opportunities and recommended actions

Rank	Opportunity (Report Section)	2030-31 Additional Value (\$M)	Recommended Actions
1	Expansion of cotton production and local ginning (E-6-1)	\$139	<ul style="list-style-type: none"> • Undertake the necessary planning for increased production, including attracting research and development (R&D), supporting services (machinery, chemicals, fertiliser, agronomy, irrigation, transport), and facilitating changes in land-use, transport demands and supply of water and utilities. • Continue to explore the feasibility of establishing a cotton spinning plant, including overcoming energy affordability challenges.
2	Streamlining and accelerating land development opportunities (A-1-1)	\$114	<ul style="list-style-type: none"> • Ongoing efforts to develop agricultural precincts, through identifying potential optimal land uses, undertaking necessary technical investigations, and obtaining the required approvals and infrastructure to attract investment. • Explore opportunities for a broad streamlining of processes for obtaining non-pastoral use permits, section 19 land use agreements, land clearing permits and water access licences. • Review the current process in conjunction with land councils to help ease pressure points for agriculture. Create support and education to growers for navigating potential land use changes. • Work with the Commonwealth and other stakeholders to provide clarity around the legal right and necessary approvals to conduct carbon industry activities, and/or generate biodiversity credits, across a range of land tenure arrangements (as recommended in the <i>Northern Territory Aboriginal Carbon Industry Strategy</i>).
3	Improved telecommunications (A-1-2)	\$69	<ul style="list-style-type: none"> • Continue to review telecommunication opportunities through emerging technology and prioritise infrastructure in higher production regions.
4	Adoption of intensive and high-density mango management systems (D-6-1)	\$49	<ul style="list-style-type: none"> • Targeted R&D and grower extension and promotion to support uptake. • The adoption of higher density planting requires a higher level of investment during establishment and the initial 10 years; the higher investment is rapidly recouped by the higher revenues achieved by increased yield per hectare.
5	Improved biosecurity protection (A-1-3)	\$46	<ul style="list-style-type: none"> • Ongoing updating and implementation of the <i>Northern Territory Biosecurity Strategy 2016-2026</i>. • Industry and government cooperation and investment to manage current and potential key biosecurity risks which threaten industry productivity and growth, including Foot and Mouth Disease, Lumpy Skin Disease, Banana Freckle Disease, Cucumber Green Mottle Mosaic Virus, Browsing Ant and Asian Honey Bee.

Rank	Opportunity (Report Section)	2030-31 Additional Value (\$M)	Recommended Actions
			<ul style="list-style-type: none"> Promote NT a natural quarantine region within Australia, thereby offering opportunities for biosecurity services.
6	Pursuing premium and niche markets including organic, indigenous, carbon neutral and wagyu-cross products (B-6-1)	\$46	<ul style="list-style-type: none"> Assessment of the most suitable and profitable premium and niche market opportunities for NT cattle. Continued investment into marketing, quality accreditations and grower education.
7	Project specific infrastructure and support to attract and retain aquaculture and fishery businesses (F-6-1)	\$39	<ul style="list-style-type: none"> Consideration of enabling infrastructure as a means of attracting and retaining project investors.
8	Increased energy affordability and security (A-1-4)	\$38	<ul style="list-style-type: none"> Ongoing exploration and development of energy supply options ensuring access and benefits for agribusiness.
9	Increased local meat processing capacity (B-6-2)	\$38	<ul style="list-style-type: none"> Continue to promote the opportunity to potential investors.
10	Improved finishing of cattle with higher value pasture, legume and grain production (B-6-3)	\$34	<ul style="list-style-type: none"> Promote and facilitate the increased establishment of cattle finishing and feedlotting facilities in higher rainfall areas. Identify and promote optimum feed production systems suited to local conditions and animal classes, including integrated cropping-livestock systems, mosaic farming and irrigation.

Discussion

The study found that growth is more likely to come from innovation and efficiencies within existing industries, more than the introduction of new crops or products to the Territory. The highest valued opportunities improve the viability of existing industries through unlocking lower input costs (transport, energy, fertiliser), higher production opportunities (improved practices) and capturing premium markets.

The study found opportunities to attract more investment to NT agribusiness through streamlined processes for accessing land and water resources, the ongoing establishment of development-ready precincts, and targeted infrastructure investments.

The analysis considered various opportunities to establish local processing and value-adding capacity within the Territory (cotton ginning, meat processing, seafood processing, horticultural waste, phytosanitary treatment facilities, biomass production), thereby providing higher value local markets and overcoming transport and logistical challenges. Such opportunities offer great potential but typically incur challenges in attracting the necessary skills, capital and throughput, and being market competitive.

This study identified the establishment of local cotton ginning capacity in the Territory as the highest value opportunity overall, and the establishment of improved phytosanitary treatment facilities likely to deliver value in facilitating fruit exports. Significant opportunities exist for the local processing of horticultural, meat, seafood and biomass, although the feasibility of these operations is unclear and may require more detailed analysis or changes to current operating or market conditions, in order to attract investment.

Overall, this assessment complements the findings and recommendations within the TERC Report and the subsequent Northern Territory Agribusiness Strategy 2030, and Evaluation of Northern Territory agriculture supply chains and export opportunities by quantifying and prioritising the potential value-add opportunities.

Priority Actions

From the identified list of value opportunities, this study recommends the following priority actions which are likely to be achievable and highly beneficial in the short-term:

Facilitate the expansion of cotton production and local ginning

- Undertake the necessary planning for increased production, including attracting R&D, supporting services (machinery, chemicals, fertiliser, agronomy, irrigation, transport), and facilitating changes in land-use, transport demands and supply of water and utilities.
- Continue to explore the feasibility of establishing a cotton spinning plant, including overcoming energy affordability challenges.

Streamlining and accelerating land development opportunities

- Review the current process in conjunction with land councils to help ease pressure points for agriculture
- Create support and education to growers for navigating potential land use changes.
- Work with the Commonwealth and other stakeholders to provide clarity around the legal right and necessary approvals to conduct carbon industry activities, and/or generate biodiversity credits, across a range of land tenure arrangements (as recommended in the *Northern Territory Aboriginal Carbon Industry Strategy*).

Improved biosecurity protection

- Ongoing updating and implementation of the Northern Territory Biosecurity Strategy 2016-2026.
- Industry and government cooperation and investment to manage current and potential key biosecurity risks which threaten industry productivity and growth, including Foot and Mouth Disease, Lumpy Skin Disease, Banana Freckle Disease, Cucumber Green Mottle Mosaic Virus, Browsing Ant and Asian Honey Bee.
- Promote NT as a natural quarantine region within Australia, thereby offering opportunities for biosecurity services (including pollination services).

Improved finishing of cattle with higher value pasture, legume and grain production

- Identify and promote optimum feed production systems suited to local conditions and animal classes, including integrated cropping-livestock systems, mosaic farming and irrigation.
- Promote and facilitate the increased establishment of cattle finishing and feedlotting facilities in higher rainfall areas.

Limitations

Assessment and comparison of opportunities of such scale is inherently challenging, given the uncertainty around the viability and feasibility of certain opportunities. As such this study should not be used as a replacement for detailed feasibility and due diligence required to progress any one of the individual opportunities.

The analysis relies on many informed assumptions to estimate the likely impact and feasibility of numerous industry opportunities. Assumptions were informed by stakeholder engagement, literature review and the consultant's own research, calculations, and judgement.

This report is subject to, and must be read in conjunction with, the limitations set out in section 1.2 and the assumptions and qualifications contained throughout the Report.

Contents

Executive Summary	i
1. Introduction and background	1
1.1 Purpose of this study	1
1.2 Scope and limitations	2
1.3 Assumptions	2
2. Data and methods	3
2.1 Conceptual framework	3
2.2 Empirical strategy	3
2.3 Stakeholder engagement	5
2.4 Modelling value-add opportunities	5
2.5 Enhanced growth modelling	6
3. Situation analysis	8
3.1 Overview of NT agribusiness sector	8
3.2 Production systems and supply chains	9
3.3 Policy and strategy alignment	12
3.4 Barriers and opportunities for growth	15
4. Value-add opportunities	18
5. Enhanced growth roadmap	20
6. Conclusion	24
6.1 A way forward	24
6.2 Priority actions	25
Acknowledgements	26
Acronyms and Abbreviations	27
Table index	28
Figure index	30
References	31
Appendices	36

1. Introduction and background

The NT Government aims to achieve a \$40 billion economy by 2030, leading to more jobs and higher living standards for all communities. To support this goal, the TERC outlined a strategy to grow Agribusiness in the Territory using a combination of Sustainable Development Precincts and a clear whole-of-sector strategic direction, co-designed by Territory Government and industry (TERC, 2020).

1.1 Purpose of this study

In response to a recommended action from TERC (2020), NT DITT engaged GHD to identify and evaluate opportunities to add value across the value chains of NT agribusiness sector by the following target industries:

- Livestock – Cattle
- Other Livestock
- Horticulture
- Field Crops
- Seafood
- Forestry, and
- Other industries such as bush foods, potential bioresources, food service, farmers markets, honey.

This report provides a methodological approach, situation analysis, overall assessment of the identified value-adding opportunities and the enhanced growth map, which are supported by separate sections evaluating opportunities within individual industries, as outlined in Table 1.

Table 1 *Structure of the report*

	Introduction & background	Data & methods	Situation analysis	Policy & strategy alignment	Value-add opportunities	Enhanced growth roadmap	Conclusion
Agribusiness	Section 1	Section 2	Section 3	Section 3	Section 4	Section 5	Section 6
Cross-Industry					Appendix A		
Livestock – Cattle			Appendix B		Appendix B	Appendix B	
Other Livestock			Appendix C		Appendix C	Appendix C	
Horticulture			Appendix D		Appendix D	Appendix D	
Field Crops			Appendix E		Appendix E	Appendix E	
Seafood			Appendix F		Appendix F	Appendix F	
Forestry			Appendix G		Appendix G	Appendix G	
Other Agribusiness			Appendix H		Appendix H	Appendix H	

1.2 Scope and limitations

This report has been prepared by GHD for DITT, NT Government and may only be used and relied on by DITT, NT Government for the purpose agreed between GHD and DITT, NT Government as set out in section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than DITT, NT Government arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section(s) 1.3 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

1.3 Assumptions

An assessment and comparison of opportunities of such heterogenous scale is inherently challenging, given the uncertainty around the viability and feasibility of certain opportunities. This study should not be used as a replacement for detailed feasibility and due diligence required to progress any one of the individual opportunities.

The analysis relies on informed assumptions to estimate the likely impact and feasibility of numerous industry opportunities. Assumptions were informed by stakeholder engagement, literature review and the consultant's own research, calculations, and judgement.

These assumptions are presented throughout this report and summarised below:

- Value-add is defined rather broadly and includes any steps likely to increase the gross value of agribusiness production (GVP).
- The analysis estimated the potential addressable opportunity, not its actual current value.
- Some opportunities may overlap.
- The expected value added to industry was modelled up to 2030-31, with additional value from opportunities added to a baseline growth estimate, reflecting both commodity price inflation and baseline productivity gains within industries.
- All figures are presented in nominal terms.
- Further analysis of feasibility will be required to scope individual opportunities, including quantifying costs, and determining the preferred investment or implementation options.

2. Data and methods

2.1 Conceptual framework

In order to carry out the feasibility assessment of the NT agribusiness sector, a conceptual framework has been developed which includes key steps and outcomes to address the objectives of this study (Figure 1).

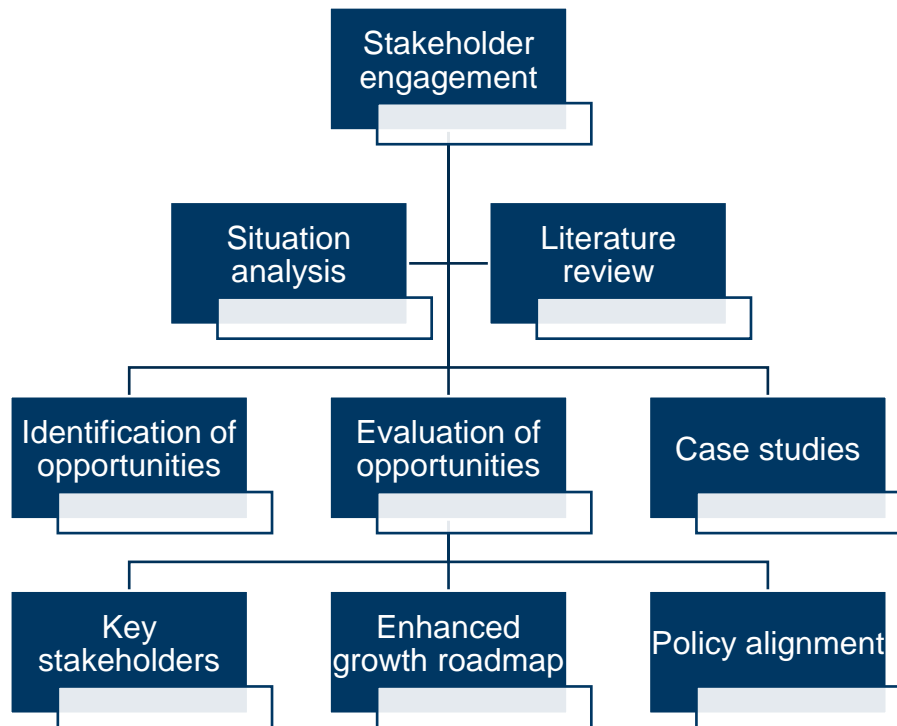


Figure 1 Conceptual framework

Source: GHD modelling approach.

GHD's approach has been primarily centred around the actual information and insights from the local industries which enabled practical assessment of the current challenges and opportunities firsthand.

In addition to the sector-wide analysis, each of the specified industries has been explored in detail to provide an understanding of the current and potential opportunities for these industries. In this process, GHD has undertaken a collaborative approach with DITT through each assessment stage. Ultimately, this work is expected to support the goal of a \$40 billion economy by 2030, as set as an objective by the NT Government.

2.2 Empirical strategy

Given the conceptual framework, GHD's empirical strategy included the following key steps which are discussed in detail in Table 2:

1. Identify potential value-add opportunities.
2. Short list the identified value-add opportunities.
3. Model the identified value-add opportunities.
4. Forecast the growth in value through implementing value-add opportunities.
5. Develop options (levers) to support the identified value-add opportunities.

Table 2 Empirical strategy

	Step 1	Step 2	Step 3	Step 4	Step 5
Description	Identify potential value-add opportunities	Short list the identified value-add opportunities	Model the identified value-add opportunities	Forecast the growth in value through implementing value-add opportunities	Develop options (levers) to support the identified value-add opportunities
Analytical method	<ul style="list-style-type: none"> – Stakeholder engagement – Literature review – Gap analysis 	<ul style="list-style-type: none"> – Internal and external consultation 	<ul style="list-style-type: none"> – Literature review and desktop research – Feasibility weighted impact modelling 	<ul style="list-style-type: none"> – Baseline assessment – Economic opportunity approach 	<ul style="list-style-type: none"> – Road mapping – Internal and external consultation
Data	<ul style="list-style-type: none"> – Interviews (Aug-Sep 2022) – CRCNA project reports – Other provided sources 	<ul style="list-style-type: none"> – FIAL (2020) – List of potential value-add opportunities (Step 1) 	<ul style="list-style-type: none"> – Short list of value-add opportunities (Step 2) 	<ul style="list-style-type: none"> – DITT Primary Industries and Fisheries Economic Overviews (2018-2022) – CSIRO (2019); FIAL (2020) – Modelling of value-add opportunities (Step 3) 	<ul style="list-style-type: none"> – State/territories and national strategies and programs – Previous feasibility assessments – Growth forecast through value-add opportunities (Step 4)
Expected results	<ul style="list-style-type: none"> – Long list of potential value-add opportunities – Potential actions identified – Potential stakeholders identified 	<ul style="list-style-type: none"> – Short-listing of potential opportunities 	<ul style="list-style-type: none"> – Modelling of short-listed opportunities 	<ul style="list-style-type: none"> – 2030 value forecast for each target industry – At each scale of analysis (where possible) 	<ul style="list-style-type: none"> – 2030 enhanced growth roadmap – Key stakeholders identified – Policy levers and actions identified

Source: GHD modelling approach.

In this process, a 'scale' of analysis has been identified (where possible) in terms of value, quantity and quality. Examples of scale include local, sector-wide, state, national or international levels (Figure 2). For example, development of production and supply chains of bush foods (H-5-1) is characterised by traditional hand-picking from naturally occurring trees by Indigenous people and overdoing the harvesting in wild settings should be avoided. Hence, this opportunity can be analysed at local scale. In contrast, in order to improve connection between Asian consumers and Territory growers (D-6-6), an international scale of analysis should be applied, since supply chains have already been established to high-value markets for premium products such as mangoes.

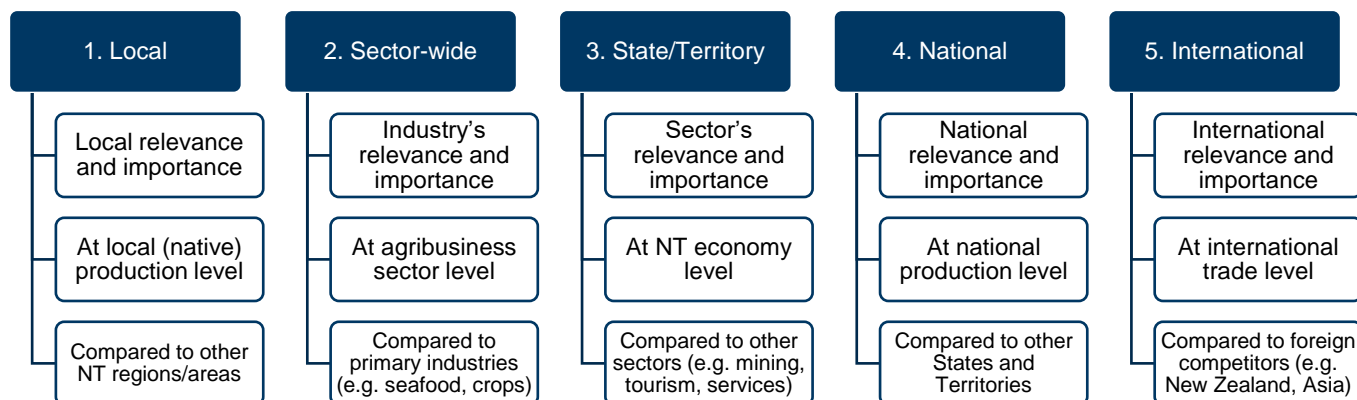


Figure 2 Scale of analysis

Source: GHD modelling approach.

2.3 Stakeholder engagement

The stakeholder engagement was conducted across a range of platforms, with the key one being interviews over the phone and/or Microsoft Teams with agricultural producers, industry representatives, applicable government departments, researchers, Aboriginal Land Councils and indigenous enterprises, and services along the supply chain. In total, 52 interviews were conducted which typically lasted from 30 minutes to one hour. Questions discussed included relevant context within industry, current or emerging opportunities and/or barriers, necessary next steps to reach greater growth and suitability of other ideas already identified. This process provided a long list of the opportunities based on the stakeholder perceptions as well as the barriers and extra sources of information.

Stakeholders were also given the opportunity to provide input to the study via email submissions or completing an online survey, which were promoted through industry publications.

Further, it was considered that other works that were ongoing/completed had already conducted stakeholder consultation, hence, the literature review became a key source of information.

The project benefitted from a steering committee of key personnel from each of the included agribusiness industries which provided feedback through workshop discussions.

2.4 Modelling value-add opportunities

As per DITT guidance, value-add is defined rather broadly and includes any steps that add value to a supply chain member. This may include a production improvement, an input or logistics improvement, a marketing activity or some form of processing. 'Value' may be an increase in production volume, an increase in unit value, a decrease in unit cost, an increase in enterprise return, an increase in Territory production or employment.

In this analysis, the total value of NT agribusiness has been estimated as a GVP¹ and defined as the gross value of agribusiness commodities produced. GVP is a measure of economic output, as opposed to gross value added, which is the value of the output produced minus the costs of the intermediate goods.

In excess of 150 value adding ideas were identified through stakeholder engagement and literature reviews, which were sorted into a long-list of 110 opportunities² and then shortlisted and aggregated to 52 distinct value-add opportunities. Whilst we have worked to our best effort to ensure all opportunities are mutually exclusive, a certain overlap may remain, as some opportunities focus on end markets, while others on production or supply chain elements, and therefore a full separation of value sources has proved impossible.

Modelling was then undertaken to quantify the additional value likely to be added to NT agribusiness by 2030-31 through these identified opportunities. Measuring the impact across many diverse opportunities is inherently challenging, particularly given the uncertainty around the viability and feasibility of certain opportunities. As such the modelling should not be used as a replacement for detailed feasibility and due diligence required to progress any one of the individual opportunities.

GHD has applied a bottom-up modelling approach which allowed for more detailed analysis of clearly defined and well documented opportunities and higher-level analysis of more general and less clearly defined opportunities.

The modelling approach was designed to be easily understood, combining two parameters: (1) potential impact and (2) feasibility, the product of which – “feasibility weighted impact” – is an estimate of additional growth by 2030 above a defined baseline. A confidence rating (ranging from “Low” to “High”) was assigned to each opportunity to reflect the level of uncertainty in the assumptions applied.

Table 3 below summarises the modelling method with a hypothetical example.

Table 3 Method for modelling value-adding opportunities

Potential Impact	Feasibility	Feasibility weighted impact	Confidence Rating
<p>Estimated potential growth in value from current levels by 2030-31 (%), based on literature review, stakeholder consultation and consultant’s judgement.</p> <p>Estimated growth in value was determined by considering the scale of the opportunity (e.g. uptake) and value generated through new markets, price premiums or reduced costs</p>	<p>Estimated chance of success (%) taking into consideration past experiences and studies, investment to date, required investment, market competitiveness and regulatory restrictions</p>	<p>(Impact x Feasibility)</p>	<p>Low: Broad opportunity, reliant on very high-level assumptions to assess impact and feasibility (+/- 50%)</p> <p>Medium: Moderately defined opportunity with some established assumptions of impact and feasibility (+/- 30%)</p> <p>High: Clearly defined opportunity with well-established assumptions of impact and feasibility (+/- 15%)</p>
<p>Example</p> <p>New downstream value-adding opportunity with potential to add 50% additional value to 20% of produce (50% x 20% = 10%)</p>	<p>Investor interest, however, some barriers to establishment and questions over competitiveness (50%)</p>	<p>(10% x 50% = 5%)</p>	<p>Medium: Parameters informed by relevant literature and stakeholders with some higher-level assumptions required.</p>

Note: The example is based on hypothetical values and is presented for demonstration purpose only.

2.5 Enhanced growth modelling

The expected value added to industry was modelled up to 2030-31, with additional value from opportunities added to a baseline growth estimate, reflecting both commodity price inflation and baseline productivity gains within industries. Modelling was completed for opportunities within individual industries (cattle, other livestock, horticulture, field crops, seafood, forestry, other agribusiness) as well as overall cross-industry opportunities which were assumed to benefit all industries.

¹ The gross value of production (GVP) is the value of recorded production at wholesale prices realised in the marketplace (e.g. cattle sold at saleyards or fruit and vegetables at the wholesale market).

² Provision of long list of value-add opportunities was beyond the scope of this engagement and therefore is not included in the Final Report. GHD Advisory | DITT, NT Government | 12588166 | NT Agribusiness

The contents, including any opinions, conclusions or recommendations contained in, or which may be implied from, this document must not be relied upon. GHD reserves the right, at any time, without notice, to modify or retract any part or all of the document. To the maximum extent permitted by law, GHD disclaims any responsibility or liability arising from or in connection with this document.

The table below outlines the assumed baseline compound annual growth rates (CAGR) within individual industries and the overall sector. GHD adopted baseline rates based on historical growth between 2013 and 2021 (Table 4). This is a more conservative approach compared to CRCNA (2022a)³, as the latter assumed the future growth rate based on the longer historical period (e.g., 2006-2021). GHD applied the 2020-21 baseline GVP values as per DITT Primary Industries and Fisheries Economic Overviews (DITT, 2022), with additional estimates of \$60M for forestry (pre-harvest value) and \$5M for other industries.

Table 4 Applied baseline growth assumptions

	2013-2021 average CAGR (DITT, 2022)	Modelled baseline CAGR (GHD)
Livestock – Cattle	2.2%	2.0%
Other Livestock	3.2%	5.0%
Horticulture	6.6%	5.0%
Field Crops	4.8%	5.0%
Seafood	4.0%	3.5%
Forestry	NA	5.0%
Other Agribusiness	NA	5.0%
Total	4.1%	3.2%

Given the large scope of value-add, we have followed the economic opportunity approach adopted by FIAL (2020) in growth forecasting. Under this approach, we estimated the value, benefit or income from providing a good or service that could be unlocked or tapped if businesses seized available opportunities. It can include the total cost savings and market revenues associated with the opportunities. Figure 3 below shows an example of how potential value-add from individual opportunities are presented over the predicted baseline growth.

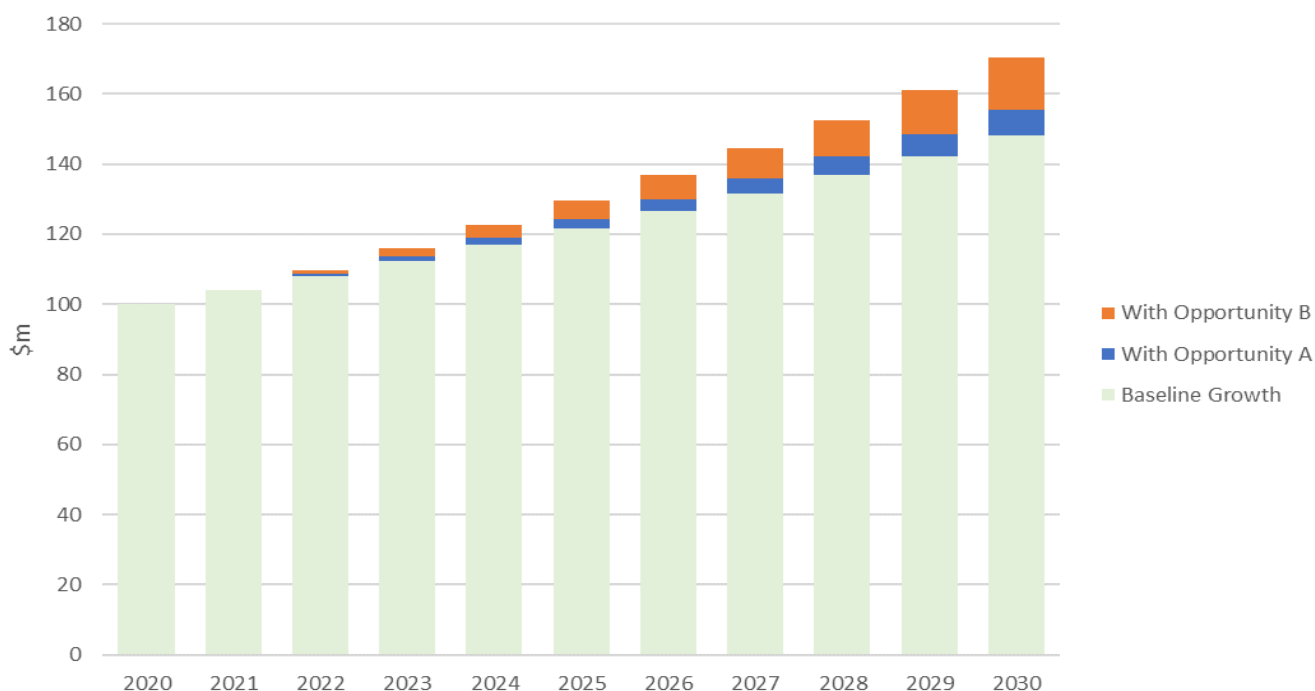


Figure 3 Example of value-add modelling

Note: The graph is based on hypothetical values and is presented for demonstration purpose only.

GHD estimates reflect the potential addressable opportunity, not its actual current value. The results of the analysis are estimates based on a variety of sources and assumptions. They measure how much value could be unlocked if NT businesses fully seized the available opportunities. Data challenges prevent us from calculating the actual amount of value that NT businesses may already be realising.

³ See CRCNA (2022a). *An evaluation of Northern Territory agriculture supply chains and export opportunities*, especially Section 8.1 Research Methodology. GHD Advisory | DITT, NT Government | 12588166 | NT Agribusiness

3. Situation analysis

3.1 Overview of NT agribusiness sector

Whilst total employment has been stable in NT with a marginal increasing trend in the last decade (reaching 145 thousand people in November 2022 quarter), Agriculture, Forestry and Fishing is characterised by high seasonal volatility, as demonstrated in Figure 4. According to the latest labour statistics, the sector employment was estimated at only 608 persons in November 2022 quarter, a significant drop from November 2019 quarter figure of 3,338 persons (ABS, 2023). Agriculture, Forestry and Fishing had a total of 931 businesses (or 6.2% of all registered businesses in NT) as at 30 June 2021, according to the last Census (ABS, 2022). The seasonal variation in total labour use reflects the timing of labour-intensive farm operations, such as planting and harvest of horticultural crops, and is driven by changes in the use of contract workers (often known as seasonal workers).

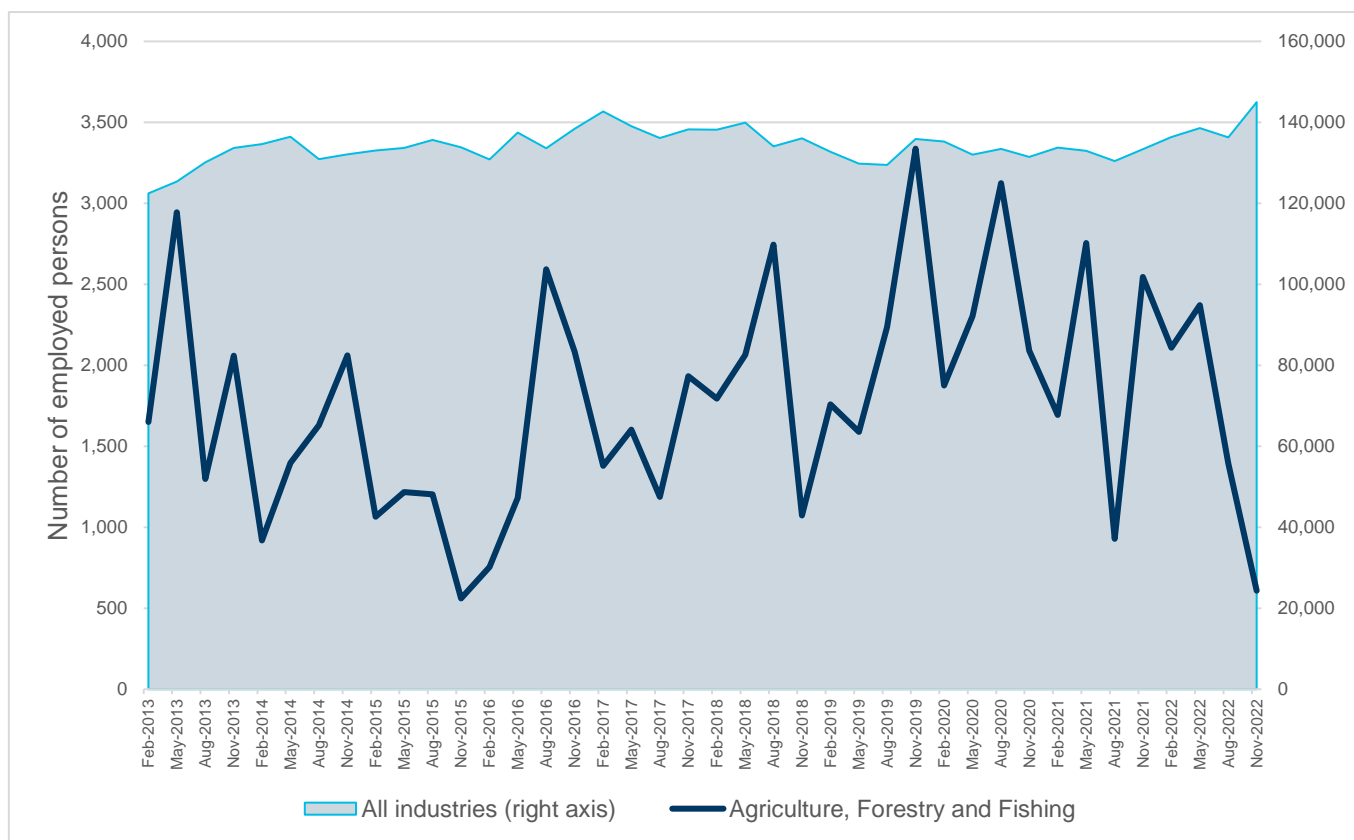


Figure 4 Employed persons (total) in NT, by quarter, 2013-2022

Source: GHD based on ABS (2023).

Agribusiness in the NT has enjoyed average year-on-year growth of 10.6% over the past 15 years (DITT, 2021) (Figure 5), largely driven by relatively high commodity prices and productivity gains in the cattle industry and expansion of horticultural production. Output from the forestry sector is expected to lift substantially when current plantations reach maturity in the coming 6-8 years, and cotton production has been increasing in anticipation of the establishment of local ginning facilities.

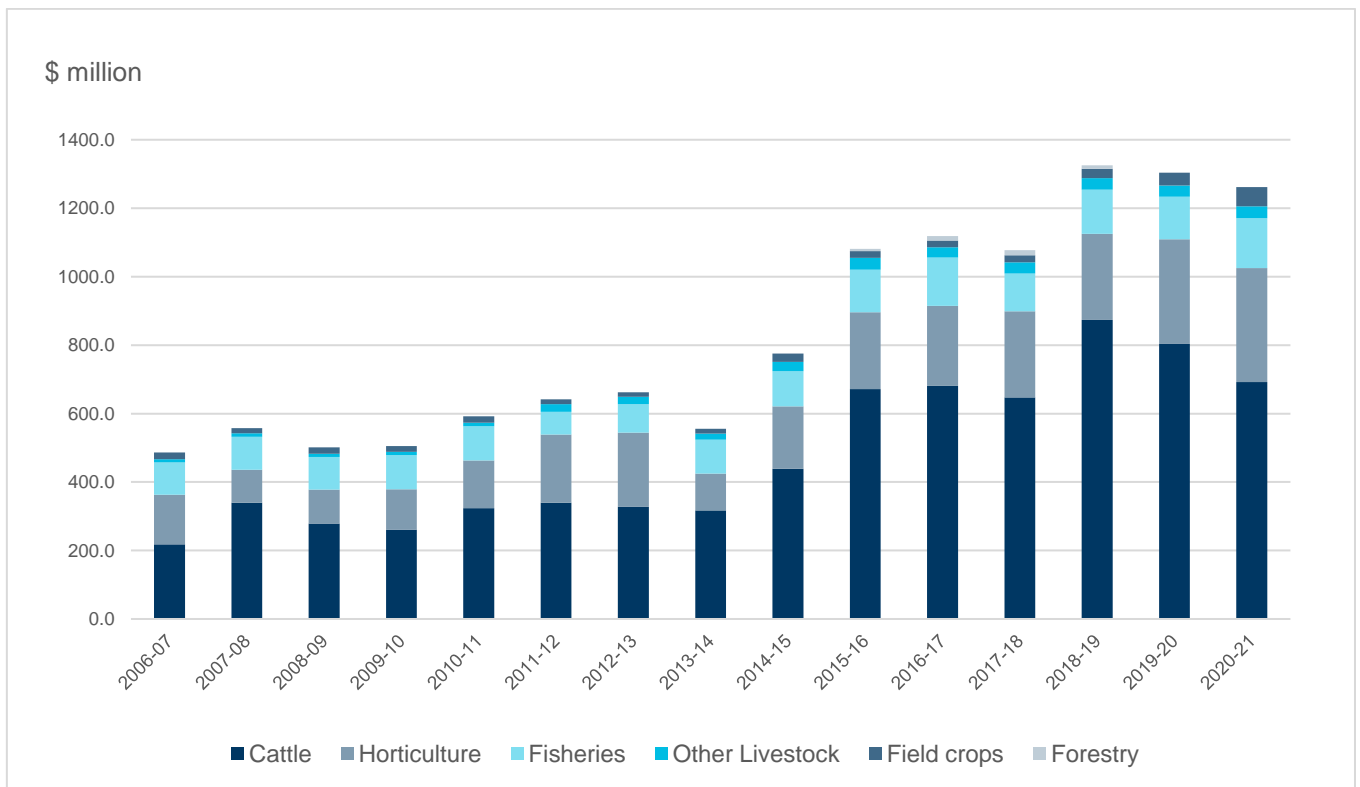


Figure 5 15-year growth in NT agribusiness sector

Source: GHD based on DITT (2022).

3.2 Production systems and supply chains

Agricultural production occurs on approximately 46% of the total land within the NT. Most of the agricultural land is held under pastoral lease (pursuant to the *Pastoral Lands Act 1992*) or Aboriginal land (pursuant to the *Aboriginal Land Rights (NT) Act 1976*). Whilst both forms of land tenure can potentially co-exist with more intensive farming practices, significant changes to land use require specific authorisation and approvals.

Table 5 below provides a summary of the various production systems and supply chains within NT agribusiness, and the identified gaps which may be containing growth (as identified by CRCNA, 2022a).

Table 5 Summary of NT agribusiness production systems and supply chains

Industry	Key inputs to production	Industry production	Transportation	Processing, packing and distribution	End users	Gaps in the NT supply chain
Livestock – Cattle	<ul style="list-style-type: none"> • Feed • Farming (breeding, fattening) • Labour • Energy and fuel • Accessories, equipment 	<ul style="list-style-type: none"> • Live cattle production 	<ul style="list-style-type: none"> • B-doubles road trains 	<ul style="list-style-type: none"> • Cattle transported to pre-export facility to quarantine • Cattle loaded for distribution to export markets from the Port of Darwin • Transport for domestic processing (Batchelor Abattoir or interstate) 	<ul style="list-style-type: none"> • Export destinations • Domestic markets 	<ul style="list-style-type: none"> • Limited local meat processing capacity • Restricted road access due to weather systems which limits cattle supply all year round
Field Crops (including Cotton)	<ul style="list-style-type: none"> • Seed growth and supply • Harvesting, processing & packaging equipment • Fertilisers, herbicides, 	<ul style="list-style-type: none"> • Field crop production 	<ul style="list-style-type: none"> • Road trains • Semi-trailers 	<ul style="list-style-type: none"> • Grain or fodder storage, processing or milling • Export distribution • Cotton ginning (interstate) 	<ul style="list-style-type: none"> • Export destinations • Domestic customers • Domestic retailers and wholesalers 	<ul style="list-style-type: none"> • Lack of local cotton ginning
Horticulture	<ul style="list-style-type: none"> • Seed growth and supply • Harvesting, processing & packaging equipment • Fertilisers, herbicides, pesticides • Irrigation and labour • Energy and fuel • Accessories, equipment 	<ul style="list-style-type: none"> • Horticulture crop production 	<ul style="list-style-type: none"> • Road trains • Semi-trailers 	<ul style="list-style-type: none"> • Processing and packaging • Phytosanitary treatment for export • Cold Storage • Export distribution 	<ul style="list-style-type: none"> • Export destinations • Domestic customers • Domestic retailers and wholesalers 	<ul style="list-style-type: none"> • Limited cold storage facility for transportation • Limited NT based freight forwarders • Canning and juicing facility • Controlled atmosphere container facility for shipment • National shortage and changing international standard size preference to Australia
Forestry	<ul style="list-style-type: none"> • Forestry plantation • Machinery • Labour • Energy and fuel • Accessories, equipment 	<ul style="list-style-type: none"> • Forestry production 	<ul style="list-style-type: none"> • Road trains • Vessel transportation 	<ul style="list-style-type: none"> • Saw milling • Export distribution 	<ul style="list-style-type: none"> • Export destinations • Domestic customers • Domestic retailers and wholesalers 	<ul style="list-style-type: none"> • The NT does not have a complete offering of mills that are required to produce a full range of forestry and paper products • Other processing facilities including ply, panel, pulp and paper mills

Industry	Key inputs to production	Industry production	Transportation	Processing, packing and distribution	End users	Gaps in the NT supply chain
Seafood	<ul style="list-style-type: none"> • Animal feed • Harvesting, processing & packaging equipment • Marine fishing equipment • Shipbuilding & repair services • Labour • Energy and fuel • Accessories, equipment 	<ul style="list-style-type: none"> • Aquaculture production • Seafood production 	<ul style="list-style-type: none"> • Semi-trailers • Refrigerated trucking • Vessel transportation 	<ul style="list-style-type: none"> • Processing, grading and packaging • Export distribution • Domestic distribution and supply 	<ul style="list-style-type: none"> • Export destinations • Domestic customers • Domestic wholesalers, retailers and food service 	<ul style="list-style-type: none"> • Major food retailers require testing of all fish products by the National Association Testing Authority (NATA) in an approved laboratory, and none are present in the NT • The absence of a frozen container facility in Darwin requires product to be transported interstate before shipment to export markets

Source: GHD based on CRCNA (2022a).

3.3 Policy and strategy alignment

The opportunities and challenges explored in this study are aligned to the broader policy and strategic agendas of the Commonwealth and Territory Governments, in areas of agricultural innovation, regional and indigenous economic development. Outlined below are the key policy and strategy documents which informed this study.

National Agricultural Policy Statement

The National Agricultural Policy Statement (2021) established four new innovation priorities that set challenges for Australia's agricultural innovation system. These priorities focus efforts and investments across Australia's agricultural innovation system and will help achieve greater returns on-farm and along the supply chain. By 2030, the National Agricultural Policy Statement aims to achieve the following four innovation priorities:

- Australia is a trusted exporter of premium food and agricultural products.
- Australia will champion climate resilience to increase the productivity, profitability and sustainability of the agricultural sector.
- Australia is a world leader in preventing and rapidly responding to significant incursions of pests and diseases through futureproofing our biosecurity system.
- Australia is a mature adopter, developer and exporter of digital agriculture.

Our North, Our Future: White Paper on Developing Northern Australia

The Our North, Our Future: White Paper on Developing Northern Australia (2015) is the Federal Government's 20-year framework to guide policy makers and investors in building a strong, prosperous, resilient northern economy. The White Paper outlines the Commonwealth Government's commitment to address challenges to development by:

- making it easier to use natural assets, in close consultation with, and the support of, Indigenous communities;
- providing a more welcoming investment environment;
- investing in infrastructure to lower business and household costs;
- reducing barriers to employing people improving governance.

Territory Economic Reconstruction Commission (TERC, 2020)

The TERC Report (2020) outlines suggested strategies to help the NT Government achieve its goal of a \$40 billion economy by 2030. Suggested actions are grouped into the following focus areas:

1. Establish a strong and strategic approach to winning investment.
2. Focus on the sectors that will drive growth.
3. Position the Territory for growth in the regions and with Aboriginal economic leadership.
4. Action the enablers that support investment
5. Increase the skilled population to accommodate industry growth.

In terms of agribusiness, TERC (2020) found the sector "needs a clear whole-of-sector strategic direction, co-designed by Territory Government and industry, that draws on synergies and reaches across related services, including new areas of value-add processing and manufacturing and prioritisation of biosecurity, including active promotion of provenance to underpin the sustainable growth of the sector from its current 2.5% of Gross State Product." The TERC made the following recommendations for growing NT Agribusiness which are being pursued by government and industry (Table 6).

Table 6 TERC recommendations for growing NT agribusiness

A1. Rapidly identify and develop key Sustainable Development Precincts
A2. Develop and implement an Agribusiness Strategy focusing on new integrated commercialisation opportunities across the supply chain Recommended key focus areas: <ul style="list-style-type: none"> • Enabling infrastructure requirements • Sector capability and capacity, including workforce and technology • Commercialisation opportunities through new products and emerging industries • Market access and supply chains • Value adding manufacturing and processing • Innovative and targeted research and development approaches • Mitigation of risks such as weeds, pests, diseases and a changing climate - prioritising biosecurity as a key market advantage • Opportunities for a "Territory Provenance" identity
A3. Support development of Aboriginal-led industry opportunities
A4. Facilitate sustainable development of the pastoral land estate and Aboriginal land

Source: TERC (2020).

Recognising Aboriginal aspirations to develop Aboriginal-led Agribusiness enterprises, support should be provided for Aboriginal groups to lead and develop sustainable ventures, including those that are culture-based, on land and sea, to create new sustainable industries and jobs on country.

Through increased industry engagement and collaboration with Traditional Owners, pastoralists, other land interests, and government there is opportunity to increase the productivity and sustainable development of Aboriginal land and the pastoral estate through a holistic, systems approach.

The TERC provided the following 10-year growth plan, as outlined in Figure 6.

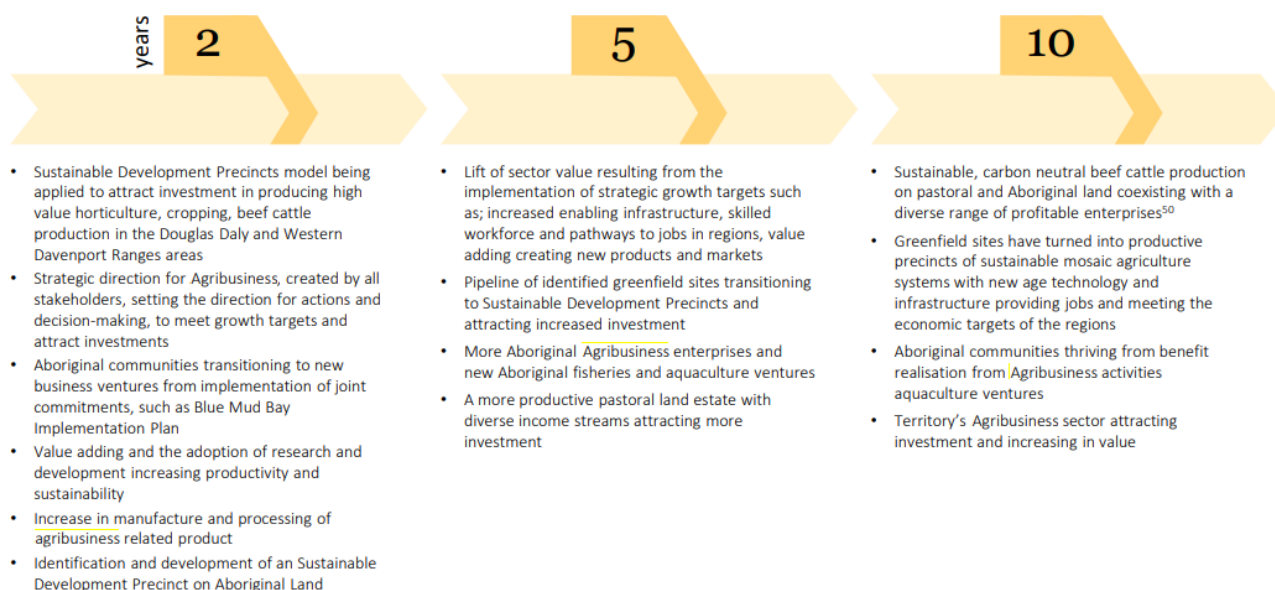


Figure 6 What does success look like?

Source: TERC (2020).

Northern Territory Agribusiness Strategy 2030

In response to recommendation A2 from the TERC, the NT Government and industry has been developing the *NT Agribusiness Strategy 2030*, with a goal of growing these industries from around \$1.3 billion to over \$2 billion by 2030.

Evaluation of Northern Territory agriculture supply chains and export opportunities (CRCNA, 2022a)

The Cooperative Research Centre for Developing Northern Australia (CRCNA) partnered with NT Farmers Association to conduct an evaluation of the NT agriculture supply chains and export opportunities. This project aimed to determine where to apportion effort to drive industry expansion and economic growth, and ultimately capitalise on the available opportunities.

The study consulted stakeholders to identify key constraints, trends, priorities, and opportunities within different agribusiness sectors. Options to address service needs were evaluated and prioritised using multi-criteria analysis. Table 7 below outlines the priority options identified in the study and the recommendations for further action.

Table 7 List of priority options and recommendations

Priority Options	Recommendations
1. Investigate the potential for a multi-user agricultural processing plant	1. Endorse the outcomes of the Project by confirming the prioritised options that address the service needs. Industry, government and relevant stakeholders to align and progress future planning activities based on the priorities identified in this report
2. Facilitate and accelerate 'development ready' land for agricultural precincts	
3. Reprioritise national road infrastructure upgrades to promote agribusiness development in the NT	2. Determine costs to undertake feasibility studies on the identified project options. Industry to partner with government to commission feasibility studies into the seven identified options, based on priority, identified through this report
4. Facilitate aggregation of agricultural products for export through the attraction of freight forwarders to the NT	
5. Develop a digital twin of the NT agricultural supply chain to assist with planning	3. Seek approval and funding from the relevant agencies to commence early work investigations and other activities. The NT Government is to nominate the key agencies with which industry will partner to develop and priorities funding for early work based on the priorities identified in this Project
6. Investigate volumes of agricultural waste and/or second/third grade product that can be used as inputs to shelf stable product manufacturing	
7. Conduct audit or stakeholder engagement to determine smaller, idle infrastructure that could be repurposed.	4. Continue to engage with stakeholders and industry to understand key constraints and opportunities

Source: CRCNA (2022a).

To avoid duplication, this project has drawn on the findings from a recently completed study by CRCNA, to inform the identification of constraints and opportunities. The intent is for this study to build on the findings through broader consultation, critical review and further modelling to quantify the benefits from individual opportunities.

The modelling by CRCNA (2022a) projected an increase in total agricultural value across six industries of 289% to \$3.96 billion in 2030, as shown in Figure 7.

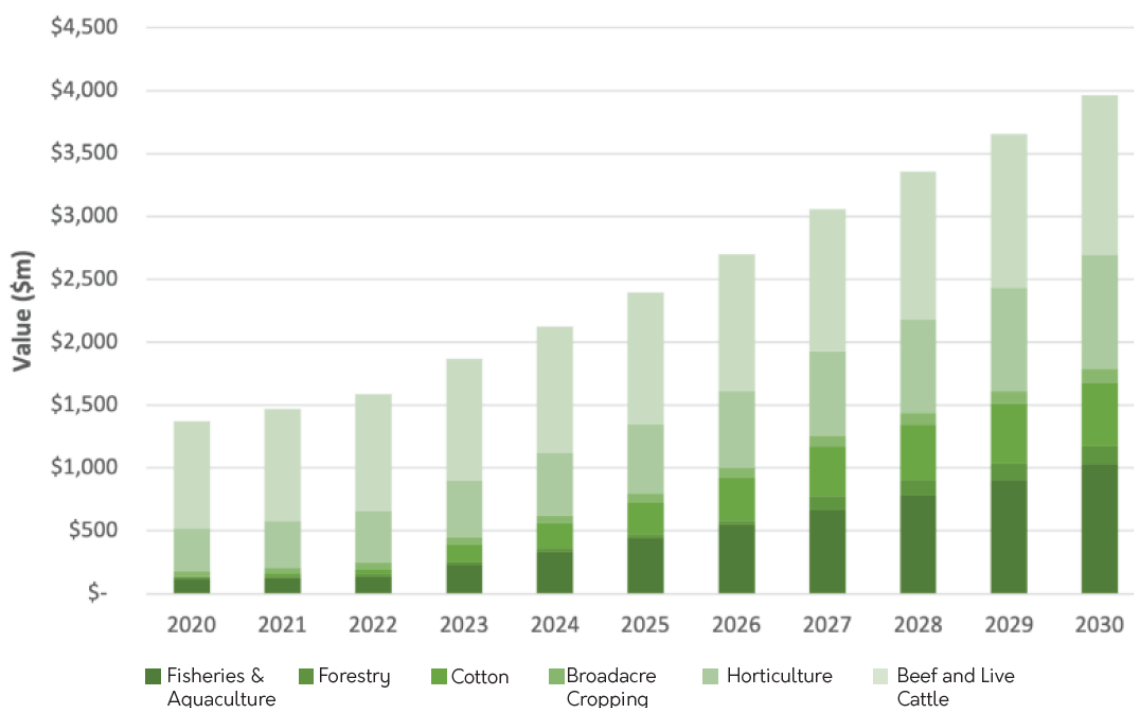


Figure 7 Current and projected future growth in NT agriculture value

Source: CRCNA (2022a).

3.4 Barriers and opportunities for growth

At high level, the GHD study resembled the key conditions identified in *Our North, Our Future: White Paper on Developing Northern Australia* by Australian Government (2015) for NT agribusiness:

- Complex land tenure arrangements
- Understanding of water availability and soil resources, secure water rights and water infrastructure
- Transport and communications infrastructure
- Skilled and flexible workforce, and
- Supportive regulatory and investment environment.

Some of these issues have been echoed in the recently completed evaluation by CRCNA (2022a).

As part of the current assessment of value-add opportunities, GHD has identified specific constraints based on stakeholder engagement and further literature review, with some examples as follows:

- **Integration of crop production with beef industry** has been limited due to large domestic transport distances required to fulfil this opportunity. Even if grains, pulses and high-quality fodders are available locally for beef finishing systems, the economics of feedlot fattening has not been thoroughly evaluated. In addition, for adoption of irrigation to occur by beef cattle producers there needs to be considerable capacity building at the level of communities of practice and individuals.
- While there has been some adoption of **improved feed base through introduction of legume species into pastures**, its application has not been widespread, largely due to issues of reliable and affordable aerial establishment, regulatory constraints, and a lack of confidence in first-time establishment.
- Whilst **cotton processing and local ginning** can be a profitable business, energy prices have been a key constraint and has been noted as the biggest disadvantage of this opportunity in NT.
- A number of issues may affect the profitability of **converting plantation African mahogany logs to high-value appearance grade timber**, such as wandering pith, the proportion of stem under heartwood at a young age (relative to native grown material), and the development of decay, and therefore stain – all of which are issues that could potentially be addressed through breeding and correct silviculture.

- **Development of the sandalwood industry** is still at the early rotation phase and the NT sandalwood plantations will not be harvested for more than a decade, where they then expect to go into the oils and pharmaceutical markets.
- The **mango genetic program** was stopped and the research into varieties such as Calypso has been complete, however, the licensing can be difficult to attain for growers, leaving them out of research adoption.
- **Value adding of Australian jackfruit in commercial quantities** has been limited due to a lack of consumer and market education, variable understanding of strategic value-added markets, limited quality assurance and training and international competition in exotic fruit markets.
- Although **organic fertiliser products from fish wastes** have been available in the market for a considerable time, long-term field evaluations of these products have been scarce. Such evaluations are essential to extend the current market availability further for fish-based fertiliser products.
- **Seafood processing facility in Darwin** has been characterised by weather implications for year-round use, its high complexity and associated costs as well as the lack of skilled labour to operate the facility.

Table 8 summarises the Strengths-Weaknesses-Opportunities-Threats (SWOT) analysis for NT agribusiness, whilst Table 9 identifies prevailing trends and sector priorities. GHD would like to emphasise that the workforce challenges (in terms of cost, quality and availability) as well as the lack of access to direct linkages with overseas markets (especially, Asia) remain a difficult reality in NT which restricts and undermines potential investments in the Territory. With migration to Australia rebounding post-pandemic, it is hoped backpackers and other migrants can again contribute to meeting the labour needs of the sector, particularly around planting and harvesting periods, when there are seasonal surges in labour requirements.

Table 8 SWOT analysis (NT agricultural supply chains)

Strengths	Weaknesses
<ul style="list-style-type: none"> • Abundant and valuable natural resources • The Port of Darwin is equipped with rail connections • NT Government focussed on improving critical inputs for agriculture including water, infrastructure, supply chains and increasing workforce • Advantageous environment for niche opportunities (e.g. aquaculture, bush foods, crocodiles and by-products) • Expected increase in global food prices • High-quality policy and regulatory systems driving the positive change 	<ul style="list-style-type: none"> • Limited information for governments and industries to drive decision making and implementation • Longstanding workforce/population attraction issues • High road and sea freight costs • Lack of scale in production • Limited port utilisation • Availability of data for production and costs • Land tenure challenges and barriers • Lack of regional and local infrastructure
Opportunities	Threats
<ul style="list-style-type: none"> • Growing consumption in neighbouring Asian countries • Utilising brand/reputation as safe and secure producer • Proximity to target new export markets • Coordinating supply to take advantage of shipping infrastructure • Improving road access 	<ul style="list-style-type: none"> • Foreign trade barriers and cheap imported products • Water availability • Increasing fuel prices and high cost of inputs • Increasing geopolitical risks of exporting NT products • Slow digital technology uptake • Lack of succession planning within the workforce • Climate change and extreme weather conditions • COVID-19 associated shortfalls in labour supply • Biosecurity incursions such as pests and diseases

Source: GHD based on CRCNA (2022a).

Climate change is a global challenge. NT agricultural producers are expecting to see increased volatility in weather patterns. Irrigators are expected to encounter challenges in the form of heightened uncertainty and variability around water supplies. Growers will need to continue to invest in water-use efficiency infrastructure such as more efficient irrigation equipment (e.g. centre pivot machines) or storage deepening. With regard to environmental challenges, the beef industry is one of the major sources of emissions of methane and the necessary support is required to technological initiatives which aim to reduce methane emissions in NT's beef industry.

Consequently, the agricultural sector will benefit from various policy measures consistent with the transition to net zero. For example, through enabling policy environment farmers can earn carbon credits by implementing sustainable farming practices such as increasing carbon content in their soil, planting and managing native vegetation and reducing methane and nitrous oxide emissions. The value of carbon credits is likely to increase significantly with expected changes to the Australian Government's Safeguard Mechanism which will require major polluters to reduce their emissions by 4.9 per cent per year and to obtain equivalent carbon credits where they fall short.

In terms of global market trends and priorities, the Australian Government has pursued an ambitious trade policy to improve market access for Australian products, particularly agricultural products, with 16 free trade agreements (FTAs) now in place. These FTAs help to promote the growth of NT's agricultural sector. Notably, in January 2022, Australia entered into the world's largest free trade agreement, the Regional Comprehensive Economic Partnership Agreement, comprising ten original parties, including China, Indonesia and Vietnam among others, reaching a potential market of two billion people. Another important agreement is the China–Australia FTA which outlines that almost 98 per cent of Australian products will enter the Chinese market with preferential treatment by 1 January 2029, providing an opportunity to boost NT's agricultural exports to China. While some agricultural exports to China, particularly beef, have been subject to trade restrictions in recent years, there is hope the restrictions will be relaxed in the future.

Over the next 10 years and beyond, the sector will continue to benefit from global population growth and more rapid food demand growth as emerging economies become wealthier. The growth in demand should yield strong growth opportunities for NT's agricultural sector into the future. The Territory's abundance of productive agricultural land will enable it to increase agricultural production to cater for the future growth in demand or increases in market share that it may experience.

Table 9 Trends and priorities in NT agribusiness sector

Trends	Priorities
<ul style="list-style-type: none"> • Global demand for food and fibre products is expected to increase into the future due to global population growth • Infrastructure needs to be regionally located for commercial production viability • Reducing environmental and market impacts including food fraud, increase in provenance and authenticity, high quality and consistent products, sustainability, and ethical sourcing • High value products in driving new supply chains • Australia leading the way in best practice management • Increased digital uptake for improved data driven decision making across the supply chain • Increasing automation • Acceleration of innovation • Emerging production methods and models that are understandable and relatable to communities 	<ul style="list-style-type: none"> • Future risk proofing and de-risking the industry against domestic, global, environmental, and geopolitical challenges • Focused regional research, development, and extension • Developing complimentary rotational cropping • Licensing and regulatory approval navigation pathways that create greater investment certainty • Improved efficiency in gaining access to land and water to build scale • Workforce development and local employment opportunities in forestry and horticulture across the supply chain • Targeting and opening new market access for export • Building capacity and knowledge in pastoral operations • Post farm gate processing linked to integrated farm enterprises

Source: CRCNA (2022a).

4. Value-add opportunities

Outlined below are the shortlisted opportunities which have been assessed as most likely to add value to the NT agribusiness sector, including cross-industry opportunities (helping to advance all industries) and industry specific opportunities. These opportunities were shortlisted following stakeholder consultation and literature review, before the likely impact and feasibility were estimated and modelled. Presented in Table 10 below are the results of the evaluation with more detail provided in the Appendices of this report.

Table 10 Identified value-add opportunities and estimated 2030-31 additional annual value

Opportunity	2030-31 Additional Value (\$M)
Cross-Industry	
Streamlining and accelerating land development opportunities	\$114
Improved telecommunications	\$69
Improved biosecurity protection	\$46
Increased energy affordability and security	\$38
Establishment of an industrial precinct for value-adding, as proposed through KLAH	\$34
Local fertiliser production	\$25
Road and infrastructure upgrade and development	\$24
Ease of access for migrant and seasonal workers	\$21
Improved air freight infrastructure	\$5.7
Establishment / extension of agricultural training courses	\$5.3
Extension of current port capacity and efficiency of the Port of Darwin	\$2.6
Development of branding and marketing for NT Indigenous produced products	\$2.5
Livestock – Cattle	
Pursuing premium and niche markets including organic, indigenous, carbon neutral and wagyu-cross products	\$46
Increased local meat processing capacity	\$38
Improved finishing of cattle with higher value pasture, legume and grain production	\$34
Increased uptake and adoption of lessons from the Indigenous Pastoral Program	\$30
Herd improvement programs based on genetic selection and genomic prediction	\$24
Improved water infrastructure on pastoral land	\$19
Other Livestock	
Commercialisation of crocodile by-products and further processing in NT	\$6.1
Multi-species processing	\$4.8
Increased harvest ceiling of crocodile eggs	\$4.4
Improved efficiency and market access for buffalo exports	\$3.2
Breeding and genetic improvement	\$1.7
Horticulture	
Adoption of intensive and high-density mango management systems	\$49
Access to superior genetics for commercial tropical fruit	\$23
Establishment of horticultural processing facility	\$22
Adoption of protective cropping technologies	\$12
Improved phytosanitary treatment facilities for fruit exports	\$10
Improved connection between Asian consumers and NT growers	\$7.7

Opportunity	2030-31 Additional Value (\$M)
Field Crops	
Expansion of cotton production and local ginning	\$139
Development of complementary crop rotations and production techniques	\$14
Establishment of producer owned processing and marketing co-operatives	\$4.7
Commercialisation and adoption of suitable wild rice varieties	\$2.8
Validation of research findings and updating crop and climate models with actual dryland crop production data in NT	\$2.0
Establishment of industrial hemp and processing facilities	\$0.3
Seafood	
Project specific infrastructure and support to attract and retain aquaculture and fishery businesses	\$39
Further production of black lipped oysters	\$19
Greater clarity of ongoing water access and resources	\$15
Project Sea Dragon or similar developments at the proposed site	\$15
Improved supply chain infrastructure including packing, chilling, storage and out-loading facilities	\$9.6
Seafood processing	\$5.8
Increased restocking of mud crabs	\$3.9
Forestry	
Increased participation in the Emissions Reduction Fund	\$19
Improved seed stock and management of plantation grown trees	\$5.2
Biomass and/or biochar production	\$4.7
Re-planting and extension of existing hardwood fibre pulp plantations with expected continuation of export market strength	\$4.6
Extension of Indigenous forestry management, wood products manufacturing and supply	\$3.5
Adoption of silvopastoral systems	\$3.5
Targeting higher value sandalwood markets	\$1.2
Other Agribusiness	
Further development of niche markets for bush foods and bioprospecting	\$11
Expansion of pollination industries	\$8.2
Development of a food incubator for entrepreneurial value adding	\$2.6

Source: GHD modelling results.

5. Enhanced growth roadmap

The study found there are opportunities for the sector to potentially double GVP by 2030-31 under a high growth scenario, incorporating both in-built productivity gains as well as identified opportunities to realise additional value through production and supply chain efficiencies, expansion and intensification opportunities, and access to higher value markets. The potential growth under this scenario is presented in Figure 8 below.

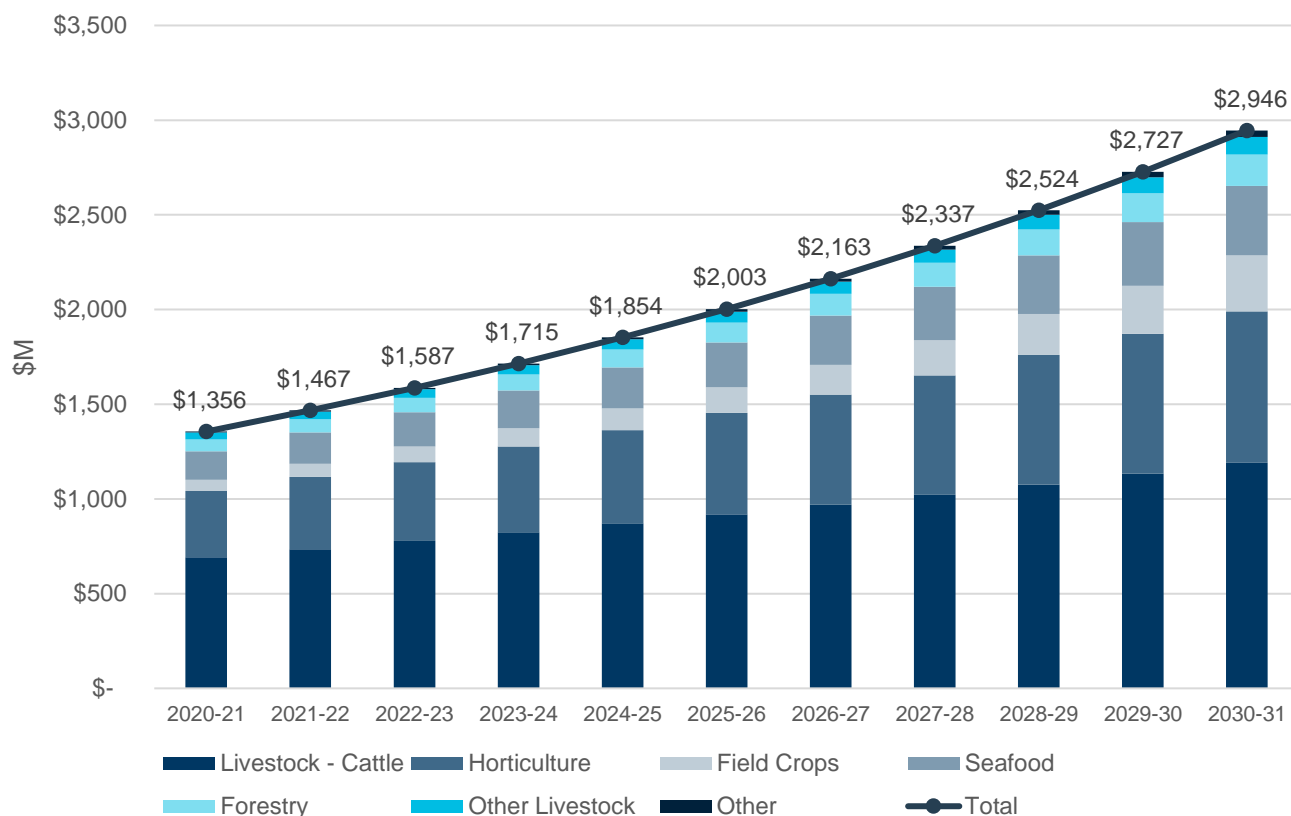


Figure 8 Potential agribusiness sector growth including value adding opportunities in NT (\$M GVP)

Source: GHD modelling results.

The analysis identified the following opportunities as having the highest overall impact on the value of NT agribusiness by 2030-31, presented in Table 11 with the recommended actions to progress them.

Over the next 10 years, while there will be fluctuations from year to year, traditionally strong performers such as beef industry should continue to perform well. Farmers will continue to diversify their cropping into newer high-valued commodities such as cotton, particularly where water is available. Over the next 10 years and beyond, the sector will continue to benefit from more rapid food demand growth as neighbouring economies (especially, Asia) become wealthier. Opportunities also exist for greater value-adding to agricultural produce, particularly local meat processing. Furthermore, branding and marketing are enhancing opportunities for creating a market and price premium for NT agricultural products (especially, Indigenous) whose provenance can be guaranteed.

Fully seizing opportunities in agriculture will require:

- ongoing investment by farmers in new technology to improve and optimise on-farm operations, particularly via the automatic collection and analysis of data, and in water-use efficiency solutions;
- addressing agricultural workforce issues and infrastructure challenges; and
- orchestrated approach in industry and government cooperation and investment.

Table 11 Highest value opportunities and recommended actions in NT agribusiness sector

Rank	Industry	Opportunity	Scale	2030-31 Additional Value (\$M)	Recommended Actions
1	Field Crops	Expansion of cotton production and local ginning	<ul style="list-style-type: none"> Sector-wide opportunity, as it will lead to cotton industry development as well as it will add value to total agribusiness by making available local cotton seed as a feed source for livestock industries. As an emerging industry in NT, the eventual scale of development remains unclear. 	\$139	<ul style="list-style-type: none"> Undertake the necessary planning for increased production, including attracting R&D, supporting services (machinery, chemicals, fertiliser, agronomy, irrigation, transport), and facilitating changes in land-use, transport demands and supply of water and utilities. Continue to explore the feasibility of establishing a cotton spinning plant, including overcoming energy affordability challenges.
2	Agribusiness	Streamlining and accelerating land development opportunities	<ul style="list-style-type: none"> Local (native), sector-wide and national opportunity, as it requires both Territory and Commonwealth-level policy review as well as it will enable traditional Aboriginal owners to make informed decisions. Whilst the number of micro-enterprise, private business, Government and community development activities occurring on Aboriginal land has increased over the last decade, a high-scale growth is still restricted due to lack of clarity over the legal rights and approval processes. 	\$114	<ul style="list-style-type: none"> Ongoing efforts to develop agricultural precincts, through identifying potential optimal land uses, undertaking necessary technical investigations, and obtaining the required approvals and infrastructure to attract investment. Explore opportunities for a broad streamlining of processes for obtaining non-pastoral use permits, section 19 land use agreements, land clearing permits and water access licences. Review the current process in conjunction with land councils to help ease pressure points for agriculture. Create support and education to growers for navigating potential land use changes. Work with the Commonwealth and other stakeholders to provide clarity around the legal right and necessary approvals to conduct carbon industry activities, and/or generate biodiversity credits, across a range of land tenure arrangements (as recommended in the <i>Northern Territory Aboriginal Carbon Industry Strategy</i>).

Rank	Industry	Opportunity	Scale	2030-31 Additional Value (\$M)	Recommended Actions
3	Agribusiness	Improved telecommunications	<ul style="list-style-type: none"> Local and sector-wide opportunity, as a broad adoption is constrained by expensive infrastructure and lack of density in most regions. Significant investment is required to achieve high scale and immediate efforts should be focussed on industry precincts. 	\$69	<ul style="list-style-type: none"> Continue to review telecommunication opportunities through emerging technology and prioritise infrastructure in higher production regions.
4	Horticulture	Adoption of intensive and high-density mango management systems	<ul style="list-style-type: none"> Sector-wide and inter-state opportunity, as a successful adoption in NT mango industry can achieve even higher input efficiencies and higher yields compared to other states (e.g. Queensland) NT mangoes proven to be competitive in domestic market with export opportunities also available. 	\$49	<ul style="list-style-type: none"> Targeted R&D and grower extension and promotion to support uptake. The adoption of higher density planting requires a higher level of investment during establishment and the initial 10 years; the higher investment is rapidly recouped by the higher revenues achieved by increased yield per hectare.
5	Agribusiness	Improved biosecurity protection	<ul style="list-style-type: none"> Sector-wide, state and national-level opportunity, as it addresses not only biosecurity challenges within NT agribusiness but also offers a national-scale solution. Full-scale implementation will depend on the readiness and incentives within NT biosecurity surveillance system. 	\$46	<ul style="list-style-type: none"> Ongoing updating and implementation of the <i>Northern Territory Biosecurity Strategy 2016-2026</i>. Industry and government cooperation and investment to manage current and potential key biosecurity risks which threaten industry productivity and growth, including Foot and Mouth Disease, Lumpy Skin Disease, Banana Freckle Disease, Cucumber Green Mottle Mosaic Virus, Browsing Ant and Asian Honey Bee. Promote NT a natural quarantine region within Australia, thereby offering opportunities for biosecurity services.
6	Livestock - Cattle	Pursuing premium and niche markets including organic, indigenous, carbon neutral and wagyu-cross products	<ul style="list-style-type: none"> International scale opportunity, as the premium market is expected to be in Asia. However, to become competitive NT should establish feedlot cattle production. 	\$46	<ul style="list-style-type: none"> Assessment of the most suitable and profitable premium and niche market opportunities for NT cattle. Continued investment into marketing, quality accreditations and grower education.

Rank	Industry	Opportunity	Scale	2030-31 Additional Value (\$M)	Recommended Actions
7	Seafood	Project specific infrastructure and support to attract and retain seafood businesses	<ul style="list-style-type: none"> Local-scale opportunity, as it would target project specific infrastructure. The eventual scale of this opportunity remains unclear, as no details were provided by stakeholders in terms of the specific projects and infrastructure requirements. 	\$39	<ul style="list-style-type: none"> Consideration of enabling infrastructure as a means of attracting and retaining project investors.
8	Agribusiness	Increased energy affordability and security	<ul style="list-style-type: none"> Sector-wide and Territory-level opportunity, as energy affordability and security has a broad impact across all industries in the supply chain. A further analysis is required to inform an actual scale of this opportunity with the options for agribusiness to participate in the energy market. 	\$38	<ul style="list-style-type: none"> Ongoing exploration and development of energy supply options ensuring access and benefits for agribusiness.
9	Livestock - Cattle	Increased local meat processing capacity	<ul style="list-style-type: none"> Local scale opportunity, as high-scale feasibility is challenging due to a range of factors such as seasonal supply, labour supply/costs, difficulty reaching slaughter weight. Potentially, this opportunity can bring a large amount of value back to NT as most is currently sent elsewhere for processing and value adding. 	\$38	<ul style="list-style-type: none"> Continue to promote the opportunity to potential investors.
10	Livestock - Cattle	Improved finishing of cattle with higher value pasture, legume and grain production	<ul style="list-style-type: none"> Sector-wide opportunity, as it requires an integration of cropping and livestock systems. Success of this opportunity will depend on the regional scale irrigation system and feed production, required by the live export trade. 	\$34	<ul style="list-style-type: none"> Promote and facilitate the increased establishment of cattle finishing and feedlotting facilities in higher rainfall areas. Identify and promote optimum feed production systems suited to local conditions and animal classes, including integrated cropping-livestock systems, mosaic farming and irrigation.

Source: GHD modelling results.

6. Conclusion

This study provides a high-level appraisal of the range of opportunities to grow the value of the NT agribusiness based on a review of literature, stakeholder input and independent analysis. The findings suggest there is a realistic path for the sector to double value by 2030, incorporating baseline growth and in-built productivity gains, as well as opportunities to realise additional value through production and supply chain efficiencies, expansion and intensification opportunities, and access to higher value markets.

The findings suggest that growth, within this timeframe, is more likely to come from innovation and efficiencies within existing industries, rather than from the introduction of new crops or products to the Territory. The highest valued opportunities improve the viability of existing industries through unlocking lower input costs (transport, energy, fertiliser), higher production opportunities (improved practices) and capturing premium markets.

The study found opportunities to attract more investment to NT agribusiness through more streamlined processes for accessing land and water resources, the ongoing establishment of development-ready precincts, and targeted infrastructure investments.

The study considered various opportunities to establish local processing and value-adding capacity within the Territory (cotton ginning, meat processing, seafood processing, horticultural waste, phytosanitary treatment facilities, biomass production), thereby providing higher value local markets and overcoming transport and logistical challenges. Such opportunities offer great potential, however, typically incur challenges in attracting the necessary skills, capital and throughput, and being market competitive. This study identified the establishment of local cotton ginning capacity in the Territory as the highest value opportunity overall, and the establishment of improved phytosanitary treatment facilities likely to deliver value in facilitating fruit exports. Significant opportunities exist for the local processing of horticultural, meat, seafood and biomass, however, the feasibility of these operations is unclear and may require more detailed analysis or changes to current operating or market conditions, in order to attract investment.

This study complements and extends the findings and recommendations within the TERC Report and the subsequent *Northern Territory Agribusiness Strategy 2030*, and *Evaluation of Northern Territory agriculture supply chains and export opportunities* by quantifying and prioritising the potential value-add opportunities.

6.1 A way forward

In order to reduce redundancy and target investment to options that maximise return, there is need to investigate each recommended opportunity in more detail. In particular, the report identified the next steps and recommendations for relevant stakeholders:

- The study would benefit from additional analysis of market distributions for existing production, including whether there is sufficient demand to take additional product or higher value product. A further supply chain assessment (including a gap analysis into infrastructure logistics) would also help identify where additional investment would produce the greatest impact.
- As total costs of initiatives to implement a particular opportunity might exceed the estimated value of such opportunity, there is a need to estimate costs and timing to implement them.
- Work collaboratively with industry peak bodies to develop an action plan including goals, leverages, priority activities and performance measures which would lead to fulfilling the value-add opportunities.
- Assign responsibilities at industry, sector, Territory/state and federal levels across the agreed actions and have a regular monitoring.
- Seek expert advice for certain technical and scientific requirements within the identified opportunities. For example, a fisheries scientist can advise on increased restocking of mud crabs (F-6-7) in terms of food source and survival conditions.

6.2 Priority actions

From the identified list of value opportunities, this study recommends the following priority actions which are likely to be achievable and highly beneficial in the short-term:

Facilitate the expansion of cotton production and local ginning

- Undertake the necessary planning for increased production, including attracting R&D, supporting services (machinery, chemicals, fertiliser, agronomy, irrigation, transport), and facilitating changes in land-use, transport demands and supply of water and utilities.
- Continue to explore the feasibility of establishing a cotton spinning plant, including overcoming energy affordability challenges.

Streamlining land development opportunities

- Ongoing efforts to develop agricultural precincts, through identifying potential optimal land uses, undertaking necessary technical investigations, and obtaining the required approvals and infrastructure to attract investment.
- Review the current process in conjunction with land councils to help ease pressure points for agriculture.
- Create support and education to growers for navigating potential land use changes.
- Work with the Commonwealth and other stakeholders to provide clarity around the legal right and necessary approvals to conduct carbon industry activities, and/or generate biodiversity credits, across a range of land tenure arrangements (as recommended in the *Northern Territory Aboriginal Carbon Industry Strategy*).

Improved biosecurity protection

- Ongoing updating and implementation of the Northern Territory Biosecurity Strategy 2016-2026.
- Industry and government cooperation and investment to manage current and potential key biosecurity risks which threaten industry productivity and growth, including Foot and Mouth Disease, Lumpy Skin Disease, Banana Freckle Disease, Cucumber Green Mottle Mosaic Virus, Browsing Ant and Asian Honey Bee.
- Promote NT a natural quarantine region within Australia, thereby offering opportunities for biosecurity services (including pollination services).

Improved finishing of cattle with higher value pasture, legume and grain production

- Identify and promote optimum feed production systems suited to local conditions and animal classes, including integrated cropping-livestock systems, mosaic farming and irrigation.
- Promote and facilitate the increased establishment of cattle finishing and feedlotting facilities in higher rainfall areas.

Acknowledgements

GHD acknowledges the guidance and feedback from the DITT and the project's Steering Committee, consisting of:

- Department of Industry, Tourism and Trade
- Department of the Chief Minister and Cabinet
- NT Cattlemen's Association
- NT Farmers Association
- NT Livestock Exporters Association
- NT Buffalo Industry Council
- NT Seafood Council.

GHD would specifically like to acknowledge all stakeholders that provided ideas and input to GHD's findings through giving time for interviews.

Acronyms and Abbreviations

AACO	Australian Agricultural Company
ASEAN	Association of Southeast Asian Nations
BCR	Benefit-cost ratio
CAGR	Compound annual growth rate
CDU	Charles Darwin University
CRCNA	Centre for Developing Northern Australia
DEPWS	Department of Environment, Parks and Water Security
DITT	Department of Industry, Tourism and Trade
DNA	Deoxyribonucleic acid
ERF	Emissions Reduction Fund
FIANT	Forest Industry Association Northern Territory
FTE	Full-time equivalent
FMD	Foot and Mouth Disease
FTA	Free trade agreement
GVP	Gross value of production
IPP	Indigenous Pastoral Program
KLAH	Katherine Logistic Agribusiness Hub
LSD	Lumpy Skin Disease
NAFTI	Northern Australia Food Technology Innovation
NATA	National Association Testing Authority
NPI	National Plantation Inventory
NT	Northern Territory
R&D	Research and development
R,D&E	Research, development and extension
SWOT	Strengths-Weaknesses-Opportunities-Threats
TERC	Territory Economic Reconstruction Commission
TESSFED	Top End Shelf-Stable Foods – Engineering and Design
VHT	Vapour Heat Treatment

Table index

Table 1	Structure of the report	1
Table 2	Empirical strategy	4
Table 3	Method for modelling value-adding opportunities	6
Table 4	Applied baseline growth assumptions	7
Table 5	Summary of NT agribusiness production systems and supply chains	10
Table 6	TERC recommendations for growing NT agribusiness	13
Table 7	List of priority options and recommendations	14
Table 8	SWOT analysis (NT agricultural supply chains)	16
Table 9	Trends and priorities in NT agribusiness sector	17
Table 10	Identified value-add opportunities and estimated 2030-31 additional annual value	18
Table 11	Highest value opportunities and recommended actions in NT agribusiness sector	21
Table 12	Streamlining and accelerating land development opportunities	38
Table 13	Improved telecommunications	39
Table 14	Improved biosecurity protection	40
Table 15	Increased energy affordability and security	41
Table 16	Establishment of an industrial precinct for value-adding, as proposed through KLAH	42
Table 17	Local fertiliser production	42
Table 18	Road and infrastructure upgrade and development	43
Table 19	Ease of access for migrant and seasonal workers	44
Table 20	Improved air freight infrastructure	45
Table 21	Establishment / extension of agricultural training courses	45
Table 22	Extension of current port capacity and efficiency of the Port of Darwin	46
Table 23	Development of branding and marketing for NT Indigenous produced products	47
Table 24	SWOT analysis (NT livestock cattle supply chain)	50
Table 25	Pursuing premium and niche markets including organic, indigenous, carbon neutral and wagyu-cross products	52
Table 26	Increased local meat processing capacity	52
Table 27	Improved finishing of cattle with higher value pasture, legume and grain production	53
Table 28	Increased uptake and adoption of lessons from the Indigenous Pastoral Program	54
Table 29	Herd improvement programs based on genetic selection and genomic production	54
Table 30	Improved water infrastructure on pastoral land	55
Table 31	Highest value opportunities and recommended actions in NT livestock cattle industry	56
Table 32	SWOT analysis (NT other livestock supply chain)	60
Table 33	Commercialisation of crocodile by-products and further processing in NT	61
Table 34	Multi-species processing	61
Table 35	Increased harvest ceiling of crocodile eggs	62
Table 36	Improved efficiency and market access for buffalo exports	63
Table 37	Breeding and genetic improvement	63
Table 38	Highest value opportunities and recommended actions in NT other livestock industry	65
Table 39	SWOT analysis (NT horticulture supply chain)	68
Table 40	Adoption of intensive and high-density mango management systems	70
Table 41	Access to superior genetics for commercial tropical fruit	71

Table 42	Establishment of horticultural processing facility	71
Table 43	Adoption of protective cropping technologies	72
Table 44	Improved phytosanitary treatment facilities for fruit exports	72
Table 45	Improved connection between Asian consumers and NT growers	73
Table 46	Highest value opportunities and recommended actions in NT horticulture industry	74
Table 47	SWOT analysis (NT broadacre and cotton supply chains)	78
Table 48	Expansion of cotton production and local ginning	80
Table 49	Development of complementary crop rotations and production techniques	80
Table 50	Establishment of producer owned processing and marketing co-operatives	81
Table 51	Commercialisation and adoption of suitable wild rice varieties	82
Table 52	Validation of research findings and updating crop and climate models with actual dryland crop production data	82
Table 53	Establishment of industrial hemp and processing facilities	83
Table 54	Highest value opportunities and recommended actions in NT field crop industry	84
Table 55	SWOT analysis (NT seafood supply chain)	88
Table 56	Past three years of recorded value; seafood	89
Table 57	Project specific infrastructure and support to attract and retain seafood businesses	90
Table 58	Further production of black lipped rock oysters	90
Table 59	Greater clarity of ongoing water access and resources	91
Table 60	Project Sea Dragon or similar developments at the proposed site	92
Table 61	Improved supply chain infrastructure including packing, chilling, storage and out-loading facilities	92
Table 62	Seafood processing	93
Table 63	Increased restocking of mud crabs	93
Table 64	Highest value opportunities and recommended actions in NT seafood industry	94
Table 65	NT forestry and forest products industry snapshot	97
Table 66	SWOT analysis (NT forestry supply chain)	98
Table 67	Increased participation in the Emissions Reduction Fund	99
Table 68	Improved seed stock and management of plantation grown trees	100
Table 69	Biomass and/or biochar production	100
Table 70	Re-planting and extension of existing hardwood fibre pulp plantations with expected continuation of export market strength	101
Table 71	Extension of Indigenous forestry management, wood products manufacturing and supply	101
Table 72	Adoption of silvopastoral systems	102
Table 73	Targeting higher value sandalwood markets	102
Table 74	Highest value opportunities and recommended actions in NT forestry industry	103
Table 75	SWOT analysis (other NT agribusiness supply chains)	106
Table 76	Further development of niche markets for bush foods and bioprospecting	107
Table 77	Expansion of pollination industries	108
Table 78	Development of a food incubator for entrepreneurial value adding	108
Table 79	Highest value opportunities and recommended actions in other NT agribusiness industries	109

Figure index

Figure 1	Conceptual framework	3
Figure 2	Scale of analysis	5
Figure 3	Example of value-add modelling	7
Figure 4	Employed persons (total) in NT, by quarter, 2013-2022	8
Figure 5	15-year growth in NT agribusiness sector	9
Figure 6	What does success look like?	13
Figure 7	Current and projected future growth in NT agriculture value	15
Figure 8	Potential agribusiness sector growth including value adding opportunities in NT (\$M GVP)	20
Figure 9	NT beef industry supply chain map	49
Figure 10	Breakdown of number of head of cattle	51
Figure 11	Value breakdown of cattle	51
Figure 12	Potential cattle industry growth including value adding opportunities	56
Figure 13	Total value of other livestock (\$million)	60
Figure 14	Potential other livestock industry growth including value adding opportunities	64
Figure 15	NT horticulture industry supply chain map	67
Figure 16	Distribution of value in horticulture sector	69
Figure 17	Growth in tonnes and price for horticultural produce	69
Figure 18	Potential horticulture industry growth including value adding opportunities	74
Figure 19	NT field crop industry supply chain map	77
Figure 20	Field crops; breakdown of growth in tonnes and price	79
Figure 21	Potential field crop industry growth including value adding opportunities	84
Figure 22	NT seafood industry supply chain map	87
Figure 23	Distribution of value within seafood sector, \$million	89
Figure 24	Potential seafood industry growth including value adding opportunities	94
Figure 25	NT forestry industry supply chain map	98
Figure 26	Potential forestry industry growth including value adding opportunities	103
Figure 27	Potential other NT agribusiness industry growth including value adding opportunities	109

References

- Austral Fisheries. (2022). *Austral Fisheries' Northern Finfish Expansion Project Awarded \$9.6m Grant*. Media release. Available at: <https://www.australfisheries.com.au/news/2022/austral-fisheries%e2%80%99-northern-finfish-expansion-proj>
- Australian Bureau of Agricultural and Resource Economics and Sciences [ABARES]. (2022). *Labour use in Australian agriculture: Analysis of survey results*. ABARES, Canberra. Available at: https://daff.ent.sirsidynix.net.au/client/en_AU/search/asset/1032783/0
- Australian Bureau of Statistics [ABS]. (2022). Region summary: Northern Territory. Available at: <https://dbr.abs.gov.au/region.html?lyr=ste&rgn=7>
- Australian Bureau of Statistics [ABS]. (2023). Cat. 6291.0.55.001 Labour Force, Australia, Detailed, Table 05. Available at: <https://www.abs.gov.au/statistics/labour/employment-and-unemployment/labour-force-australia-detailed/jan-2023>
- Australian Farmers' and Dealers' Journal [AFDJ]. (2021). *Horticulture is set for major upscale and expansion in far north*. Available at: <https://afdj.com.au/horticulture-is-set-for-major-upscale-and-expansion-in-the-far-north/#:~:text=Horticulture%20is%20set%20for%20major%20upscale%20and%20expansion,smart%2C%20sustainable%20options%20for%20northern%20Australia%20food%20production>
- Australian Farm Institute [AFI]. (2018). *The impacts of energy costs on the Australian agriculture sector*. Research report funded by Energy Consumers Australia. Available at: <https://www.farminstitute.org.au/product/the-impacts-of-energy-costs-on-the-australian-agriculture-sector/>
- Australian Meat Processor Corporation [AMPC]. (2022). *The future of hide processing in Australia*. Available at: <https://www.ampc.com.au/news-events/news/the-future-of-hide-processing-in-australia>
- Armstrong, M., Reilly, D, F., Lelievre, T., Hopewell, G., Redman, A., Francis, L., Robertson, R, M., (2007). *African Mahogany Grown in Australia – Wood quality and potential uses*. Rural Industries Research and Development Corporation (RIRDC). Available at: https://industry.nt.gov.au/_data/assets/pdf_file/0010/227728/07-107.pdf
- Ash, A., Gleeson, T., Hall, M., Higgins, A., Hopewood, G., MacLeoad, N., Paini, D., Poulton, P., Prestwidge, D., Webster, T., Wilson, P. (2017). Irrigated agricultural development in northern Australia: Value-chain challenges and opportunities. *Agricultural Systems*, 155, 116-125. Elsevier. <https://doi.org/10.1016/j.agsy.2017.04.010>
- Ash, A., & Watson, I. (2018). Developing the north: learning from the past to guide future plans and policies. *The Rangeland Journal*, 40, 301-314. <https://doi.org/10.1071/RJ18034>
- Australian Government. (2015). *Our North, Our Future: White Paper on Developing Northern Australia*. Available at: https://apo.org.au/sites/default/files/resource-files/2015-06/apo-nid55367_1.pdf
- Avenira. (n.d.). *Wonarah (Avenira – 100%)*. Avenira Limited. Available at: <https://avenira.com/other-projects/wonarah>
- Babacan, H., Tremblay, P., & McHugh, J. (2020). *Reframing Smart Supply Chains in Northern Australia*. The Cooperative Research Centre for Developing Northern Australia (CRCNA). Available at: <https://crcna.com.au/research/projects/reframing-smart-supply-chains-northern-australia>
- Barramundi Group. (2022). *Strategic Partnership For Australia Business*. Media Release. Available at: <https://barramundi.com/strategic-partnership-for-australia-business/>
- Bennett, D., & Dickinson, G. (2021). Economic Case Study of Intensive Mango Systems. A comparison of the profitability of conventional (low, medium & high density) and trellis (high density) mango canopy systems in north Queensland based on early trial results. Queensland Department of Agriculture and Fisheries (DAF) & Cooperative Research Centre for Developing Northern Australia (CRCNA). Available at: <https://crcna.com.au/resources/publications/economic-case-study-intensive-mango-systems>
- Best, A. (2015). *Value-adding options for tropical fruit using jackfruit as a case study*. Rural Industries Research and Development Corporation (RIRDC). Available at: <https://hortintl.cals.ncsu.edu/sites/default/files/documents/value-addingoptionsfortropicalfruitusingjackfruitasacasestudy.pdf>

- Brann, M. (2013). *Forestry and weeds the key to biochar's future up North*. ABC Rural. Available at: <https://www.abc.net.au/news/rural/2013-11-06/turning-weeds-into-biochar/5071570>
- Bryceson, K. (2008). *Value chain analysis of bush tomato and wattle seed products*. DKCRC Research Report 40. Desert Knowledge Cooperative Research Centre, Alice Springs. Available at: https://www.researchgate.net/publication/43495149_Value_chain_analysis_of_bush_tomato_and_wattle_seed_products
- Burton, L., & Brann, M. (2018). *Australia's largest cattle company AACo mothballs Darwin abattoir*. ABC News. Available at: <https://www.abc.net.au/news/rural/2018-05-23/aaco-closes-livingstone-beef-abattoir-near-darwin/9790454>
- Cao, S., Hine, D., Henry, R., Shaw, L., Mitter, N. (2020). *Evaluation of the potential to expand horticultural industries in Northern Australia*. The Cooperative Research Centre for Developing Northern Australia (CRCNA). Available at: <https://www.crcna.com.au/resources/publications/evaluation-potential-expand-horticultural-industries-northern-australia>
- Crocodile Farmers Association of the Northern Territory [CFANT]. (2015). *Northern Territory Crocodile Farming Industry | Strategic Plan 2015-2021*. Available at: https://industry.nt.gov.au/data/assets/pdf_file/0008/239039/crocodile-strategic-plan.pdf
- Chapman, B., Henry, R., Wurm, P., Bellairs, S., Crayn, D., Smyth, H., Furtado, A., Sivapalan, S., Ford, R., Matchett, T. (2020). *A situational analysis for developing a rice industry in Northern Australia – Final Report*. The Cooperative Research Centre for Developing Northern Australia (CRCNA). Available at: <https://crcna.com.au/resources/publications/situational-analysis-developing-rice-industry-northern-australia-final-report>
- Cobcroft, J., Bell, R., Fitzgerald, J., Diedric, A., Jerry, D. (2020). *Northern Australia aquaculture situational analysis*. Cooperative Research Centre for Developing Northern Australia (CRCNA). Available at: <https://crcna.com.au/resources/publications/northern-australia-aquaculture-situational-analysis>
- Cranney, K. (2021). *Upscaling and expanding horticulture in northern Australia*. The Commonwealth Scientific and Industrial Research Organisation (CSIRO) | Science for Sustainability (ECOS). Available at: <https://ecos.csiro.au/upscaling-and-expanding-horticulture-in-northern-australia/>
- Chilcott, C., Ash A., Lehnert, S., Stokes, C., Charmley, E., Collins, K., Pavey, C., Macintosh, A., Simpson, A., Berglas, R., White, E., & Amity, M. (2020). *Northern Australia beef situational analysis*. Cooperative Research Centre for Developing Northern Australia (CRCNA). Available at: <https://crcna.com.au/resources/publications/northern-australia-beef-situation-analysis-report-cooperative-research-centre-developing-northern-australia>
- Cooperative Research Centre for Developing Northern Australia [CRCNA]. (2019a). *Capturing the ASEAN Agricultural Opportunity for Northern Australia*. Available at: <https://www.crcna.com.au/resources/publications/capturing-asean-agricultural-opportunity-northern-australia#:~:text=Capturing%20the%20ASEAN%20Agricultural%20Opportunity%20for%20Northern%20Australia,agri-food%20products%20with%20the%20highest%20future%20export%20potential.>
- Cooperative Research Centre for Developing Northern Australia [CRCNA]. (2019b). *High-density mango orchards: understanding the basics*. Available at: <https://www.crcna.com.au/resources/publications/high-density-mango-orchards-understanding-basics>
- Cooperative Research Centre for Developing Northern Australia [CRCNA]. (2020). *Northern Australian broadacre cropping situational analysis*. Available at: <https://www.crcna.com.au/resources/publications/northern-australian-broadacre-cropping-situational-analysis>
- Cooperative Research Centre for Developing Northern Australia [CRCNA]. (2021). *Transforming Mango Futures*. Available at: <https://www.crcna.com.au/research/projects/transforming-mango-futures>
- Cooperative Research Centre for Developing Northern Australia [CRCNA]. (2022a). *An evaluation of Northern Territory agriculture supply chains and export opportunities*. Unpublished report by PwC for NT Farmers and CRCNA.
- Cooperative Research Centre for Developing Northern Australia [CRCNA]. (2022b). *Spicing up Northern Australia with high-value condiment crops*. [Unpublished].
- Cooperative Research Centre for Developing Northern Australia [CRCNA]. (2022c). *Strengthening Northern Australia's horticultural sector through assessing protected cropping value chain linkages and pathways*

- for adoption. Available at: <https://www.crcna.com.au/research/projects/strengthening-northern-australias-horticultural-sector-through-assessing-protected-cropping-value-chain-linkages-and-pathways-adoption>
- Commonwealth Scientific and Industrial Research Organisation [CSIRO]. (2012). *Strategic directions for the Northern Australia beef industry*. Available at: <https://doczz.net/doc/7681263/strategic-directions-for-the-northern-australia-beef-indu>
- Commonwealth Scientific and Industrial Research Organisation [CSIRO]. (2016). Transport Network Strategic Investment Tool (TraNSIT) – Application to Northern Australia Beef Roads Submissions. <https://doi.org/10.4225/08/591211c8d825e>
- Commonwealth Scientific and Industrial Research Organisation [CSIRO]. (2019). Growth opportunities for Australian food and agribusiness. Economic analysis and market sizing. Available at: <https://research.csiro.au/foodag/>
- Commonwealth Scientific and Industrial Research Organisation [CSIRO]. (2021). *Horticulture and grains: value-added opportunities for industry*. Available at: <https://www.csiro.au/en/work-with-us/industries/food/Horticulture-sub>
- Commonwealth Scientific and Industrial Research Organisation [CSIRO]. (n.d.). *Livestock logistics: The challenge Transporting livestock in northern Australia*. Available at: <https://www.csiro.au/en/research/animals/livestock/Livestock-logistics>
- Deloitte. (2023). Economic Valuation of the Maritime, Agribusiness, Minerals, and Oil and Gas Industries. Report for DITT. Available at: <https://www2.deloitte.com/au/en/pages/economics/articles/economic-valuation.html>
- Department of Environment, Parks and Water Security [DEPWS]. (2022). *Non-pastoral use application and permits*. Northern Territory Government. Available at: <https://nt.gov.au/industry/agriculture/farm-management/non-pastoral-use-applications-and-permits>
- Department of Infrastructure, Planning and Logistics [DIPL]. (2018). *Katherine Logistics and Agribusiness Hub*. Northern Territory Government. Available at: <https://dipl.nt.gov.au/projects/katherine-logistics-and-agribusiness-hub>
- Department of Infrastructure, Planning and Logistics [DIPL]. (2023). *Frances Bay Mooring Basin lock upgrade*. Northern Territory Government. Available at: https://dipl.nt.gov.au/__data/assets/pdf_file/0009/1202688/fbmb-lock-upgrade-project-page-updates-february-2023.pdf
- Department of Industry, Tourism and Trade [DITT]. (2020). *Northern Territory Primary Industries and Fisheries Economic Overview*. Northern Territory Government. Available at: https://industry.nt.gov.au/__data/assets/pdf_file/0006/1078854/economic-overview-2019-2020.pdf
- Department of Industry, Tourism and Trade [DITT]. (2022). *Unpublished raw data on Northern Territory Primary Industries and Fisheries for Economic Review*. Northern Territory Government.
- Department of Primary Industry and Resources [DPIR]. (2016). *Donkey Business: Potential of the donkey industry in the Northern Territory*. Northern Territory Government. Available at: https://dpiir.nt.gov.au/__data/assets/pdf_file/0007/373642/donkey-business-discussion-paper.pdf
- Department of Primary Industries and Regional Development [DPIRD]. (2022). *Biomass in Western Australia*. Government of Western Australia. Available at: <https://www.agric.wa.gov.au/climate-land-water/biomass-western-australia>
- Department of Regional Development, Primary Industry, Fisheries and Resources [DRDPIFR]. (2008). *Annual Report 2008-2009*. Northern Territory Government. Available at: <https://hdl.handle.net/10070/670434>
- Drucker, A. G. (2008). Economics of camel control in the central region of the Northern Territory. *Desert Knowledge CRC*.
- Ernst & Young [EY]. (2017). *Economic Value of the Crocodile Farming Industry to the Northern Territory*. Report prepared for the Department of Trade, Business and Innovation. Available at: https://industry.nt.gov.au/__data/assets/pdf_file/0009/438921/nt-crocodile-industry-eca-final.pdf
- Ernst & Young [EY]. (2018). *Determining the economic potential of bush foods and medicine industry in Central Australia*. Report prepared for the Department of Primary Industry and Resources. Available at: https://industry.nt.gov.au/__data/assets/pdf_file/0012/889437/bush-food-project.pdf

- Food Innovation Australia Limited [FIAL]. (2020). *Capturing the prize: The A\$200 billion opportunity in 2030 for the Australian food and agribusiness sector*. Report prepared by AlphaBeta for The Food & Agribusiness Growth Centre. Available at: <https://workdrive.zohopublic.com.au/file/qx5769e1e310483ee4389b5d9f6cc55e768fe>
- Forestry Industry Association Northern Territory [FIANT]. (2022). *Forestry Industry Association Northern Territory*. Available at: <https://fiant.org.au/>
- FNQ Food Incubator. (2022). *Home Page FNQ Food Incubator*. Available at: <https://www.fnqfoodincubator.com.au/>
- Gorman, J., Cunningham, A. B., Wei, S., Marcsik, D., Hoult, M., (2015). Factors Influencing the Growth of the Floriculture Industry in the Monsoonal Tropics of the Northern Territory, Australia. *Acta Horticulturae*, 1104(62), 421-427. 10.17660/ActaHortic.2015.1104.62
- Gorman, J., Pearson, D., Wurm, P. (2020). Old Ways, New Ways – Scaling Up from Customary Use of Plant Products to Commercial Harvest Taking a Multifunctional, Landscape Approach. *Land*, 9(5), 171. MDPI AG. <https://doi.org/10.3390/land9050171>
- Honan, K., & McCarthy, M. (2017). *Native bush food demand outstripping supply says industry as more growers encouraged*. ABC News. Available at: <https://www.abc.net.au/news/rural/2017-08-30/native-bush-food-demand-outstripping-supply-says-industry/8855058>
- Invest NT. (2022). Local Jobs Fund - Headland Food Group Pty Ltd. Northern Territory Government. Available at: <https://invest.nt.gov.au/funding/projects/headland-food-group-pty-ltd>
- KPMG. (2020a). *Darwin Seafood Processing Facility Scoping Study*. Report prepared for Northern Territory Government. Available at: https://industry.nt.gov.au/_data/assets/pdf_file/0006/977307/darwin-seafood-processing-facility-scoping-study.pdf
- KPMG. (2020b). *Northern Territory Seafood Council Export Strategy*. Report prepared for Northern Territory Seafood Council. Available at: https://www.ntsc.com.au/sb_cache/associationnews/id/55/f/NT%20Seafood%20Export%20Strategy%20-%20%20Full%20Report.pdf
- Kumar, I, V., & Telfer, D. (2022). *Developing a northern Australia industrial hemp industry value chain*. AgriFutures Emerging Industries. Available at: <https://agrifutures.com.au/wp-content/uploads/2022/11/22-109.pdf>
- MacDonald, N., Lemcke, B., Bilato L., Jans, B., and Bristow, M. (2021) AgriFutures Buffalo Program Strategic RD&E Plan (2021-2025). AgriFutures Australia. Available at: <https://agrifutures.com.au/wp-content/uploads/2021/03/21-004.pdf>
- Miller, F. (2020). *Adding Value and Attracting Investment to Northern Territory Timberlands*, Nuffield Australia Farming Scholar. Available at: https://www.nuffieldscholar.org/sites/default/files/reports/2019_AU_Frank-Miller_Adding-Value-And-Attracting-Investment-To-Northern-Territory-Timberlands.pdf
- Nankervis, L., Barbero, G., Irving, A., Joyce, M., Pizzutto, M., Diedrich, A., and Condon, K. (2022). *Future-proofing the NA aquaculture industry need for skilled staff to 2050*. Report. CRCNA. Available at: <https://researchonline.jcu.edu.au/76293/1/Future%20proofing%20the%20Northern%20Australia%20aquaculture%20industry.pdf>
- National Broadband Network [NBN]. (2021). *Connecting Australian Agriculture*. Report prepared for National Farmers Federation. Available at: <https://www2.nbnco.com.au/content/dam/nbn/documents/about-nbn/reports/reports-and-publications/connecting-australian-agriculture-report.pdf>
- Nichols, P, D., Elliott, N, G., Bakes, M, J., Mooney B, D. (1997). *Marine oils from Australian fish: characterization and value-added products*. Commonwealth Scientific and Industrial Research Organisation (CSIRO) Division of Marine Research. Available at: <http://hdl.handle.net/102.100.100/224309?index=1>
- Nichols, P., Rayner, M., Stevens, J. (2001). *A Pilot Investigation of Northern Australian Shark Liver Oils: Characterization and Value-adding*. Commonwealth Scientific and Industrial Research Organisation (CSIRO) Division of Marine Research. Available at: <https://www.frdc.com.au/sites/default/files/products/1999-369-DLD.pdf>
- Northern Land Council [NLC] (n.d.). *Section 19 Land Use Agreements*. Available at: <https://www.nlc.org.au/our-land-sea/aboriginal-land-legislation>
- NT Buffalo Industry Council. (n.d.). *Home Page – The Northern Territory Buffalo Industry Council, Inc | Setting Standards through collaboration and communication*. Available at: <https://ntbuffalo.com/>

- NT Farmers. (2020). *Northern Territory Plant Industries Economic Impact Analysis*. Northern Territory Farmers' Association. Available at: https://ntrebound.nt.gov.au/_data/assets/pdf_file/0017/930023/1.-NT-Plant-Industries-Economic-Impact-Analysis-Advocacy-document_final-2020-compressed.pdf#:~:text=NORTHERN%20TERRITORY%20PLANT%20INDUSTRIES%20ECONOMIC%20IMPACT%20ANALYSIS%202, and%20horticultural%20precincts%20in%20the%20NT%20by%202030.
- NT Farmers. (2021). *Workforce Development Plan 2020-2025*. NT Plant Industries. Available at: <https://ntfarmers.org.au/workforce-development-plan-2020/>
- NT Government (2022). *Resourcing the Territory: NT Geological Survey: Northern Territory major mines and developing projects*. https://resourcingtheterritory.nt.gov.au/_data/assets/pdf_file/0010/756559/A22-333d_RTT_MajorMinesDevProjects_withInsets_Oct2022.pdf
- O'Gara, F, P. (1998). *Striking the balance: conservation farming and grazing systems for the semi-arid tropics of the Northern Territory*. Department of Primary Industry and Fisheries. Northern Territory Government.
- PwC. (2019). *Business Case for the Construction of a Cotton Gin in the Northern Territory*. Report commissioned by the NT Farmers Association and funded by the NT Government. Available at: <https://az659834.vo.msecnd.net/eventsairaeu/production-aapevents-public/60321b63d7bd4778a95579680cac25f2>
- Revell, G., Welsh, J., Powell, J. (2022). *Cotton Industry Gross Margins | Gross Margin Budget: Northern Australian Raingrown Cotton*. CottonInfo. AgEcon. Available at: <https://www.cottoninfo.com.au/sites/default/files/2021-08/Northern%20Australia%20raingrown.pdf>
- Rouda, R. (2010). *Feasibility of Establishing a Northern Western Australian Beef Abattoir*. Rural Industries Research and Development Corporation (RIRDC). Strategic Design and Development. Meateng Pty. Ltd. Department of Food and Agriculture Western Australia. Available at: <https://agrifutures.com.au/product/feasibility-of-establishing-a-northern-western-australian-beef-abattoir/>
- Ruello, N, V. (1997). *The Handling and Value Adding of Farmed Barramundi*. Ruello & Associates Fisheries Consultants | Fisheries Research and Development Corporation (FRDC).
- Saalfeld, K., Fukuda, Y., Duldig T., and Fisher, A. (2016). *Management Program for the Saltwater Crocodile (Crocodylus porosus) in the Northern Territory of Australia, 2016-2020*. Northern Territory Department of Environment and Natural Resources, Darwin.
- Sangha, K. K., Ahammad, R., Mazahar, M. S., Hall, M., Owens, G., Kruss, L., ... & Dickinson, G. (2022). An Integrated Assessment of the Horticulture Sector in Northern Australia to Inform Future Development. *Sustainability*, 14(18), 11647.
- Saunders, A. (2019). *NT Fisheries Infrastructure: Identifying infrastructure needs that underpin growth of the NT seafood industry in the next 10 years*. Oceanomics. Available at: https://ntrebound.nt.gov.au/_data/assets/pdf_file/0005/945212/Infrastructure-report-20190418_FINAL.pdf
- Seafarms (n.d.) *About Project Sea Dragon*. Available at: <https://seafarms.com.au/about-project-sea-dragon/#about>
- Simpson, B. K., Aryee, A. N., & Toldrá, F. (Eds.). (2019). *Byproducts from agriculture and fisheries: Adding value for food, feed, pharma and fuels*. John Wiley & Sons.
- Stephens, M., Woods, T., Brandt, C., Bristow, M., Annandale, M. (2020). *Northern forestry and forest products industry situational analysis*. CRCNA. Available at: https://www.crcna.com.au/sites/default/files/2020-04/FINAL_CRCNA%20NA%20Forestry%20SA_April%202020-%20amended.pdf
- Surapaneni, A. (2007). *Agricultural trials of a fish-based fertilizer (BioPhos) produced from Australian seafood processing wastes*. Fisheries Research and Development Corporation (FRDC) | Australian Government. Available at: <https://www.frdc.com.au/sites/default/files/products/2002-250-DLD.PDF>
- Territory Economic Reconstruction Commission [TERC]. (2020). *A Step Change to Win Investment and Create Jobs: Territory Economic Reconstruction Commission Final Report*. Available at: https://ntrebound.nt.gov.au/_data/assets/pdf_file/0020/952301/terc-final-report.pdf
- Tremblay, P., Babacan, H., & McHugh, J. (2020). *Northern Australia agribusiness supply chains*. CRCNA. Available at: <https://www.crcna.com.au/resources/publications/northern-australia-agribusiness-supply-chains-review-literature>
- Verdant Minerals. (2022). *Home page: Verdant Minerals*. Available at: <https://www.verdantminerals.com.au/>
- Wondu Business and Technology Services. (2004). *Adding Value to New Animal Product Supply Chains*, prepared for the Rural Industries Research and Development Corporation.

Appendices

Appendix A	Cross-industry value-add opportunities
Appendix B	Livestock - Cattle value-add opportunities
Appendix C	Other Livestock value-add opportunities
Appendix D	Horticulture value-add opportunities
Appendix E	Field Crop value-add opportunities
Appendix F	Seafood value-add opportunities
Appendix G	Forestry value-add opportunities
Appendix H	Other Agribusiness value-add opportunities

Appendix A

Cross-industry value-add opportunities

A-1 Value-add opportunities

Outlined below are the shortlisted opportunities which were assessed as most likely to add value to the overall NT agribusiness sector. These opportunities were shortlisted following stakeholder consultation and literature review before the likely impact and feasibility were estimated and modelled. Opportunities are presented in descending order based on the modelled impact on the value of NT agribusiness by 2030-31.

A-1-1 Streamlining and accelerating land development opportunities

Stakeholders cited several opportunities to streamline and accelerate agricultural developments creating opportunities for higher valued production. The NT Government has been actively involved in planning the development of agricultural precincts, through identifying potential optimal land uses, undertaking necessary technical investigations, and obtaining the required approvals to attract increased agricultural investment to the NT. This preliminary development work helps to de-risk the investment environment (CRCNA, 2022a). The Northern Territory Land Corporation has released three agricultural precincts (Larrimah, Wildman, and Weaber Plains) with a combined area of almost 100,000ha. Developments are also being promoted in Douglas Daly and other precincts.

Separately, The *Pastoral Lands Act 1992* restricts leaseholders from undertaking more intensive production, unless they can obtain a Non-Pastoral Use Permit, which can be a lengthy process. In recent years, on average only two permits have been issued each year. Stakeholders also raised delays and challenges in obtaining Water Extraction Licences, and Pastoral Land Clearing Permits. The *Land Rights (Northern Territory) Act 1976* provides the legal framework for progressing economic development activities on Aboriginal land on behalf of traditional Aboriginal owners. To create or change a section 19 Land Use Agreement, land councils must consult traditional Aboriginal owners to give opportunity to consider, develop terms, conditions, and the right to consent or reject proposals. Consultations suggests that land tenure impacts most new developments and/or land use changes and deters new investors. It is reported to be a lengthy, uncertain, and expensive process.

Land tenure was also cited as an impediment to participation in carbon-farming and other biodiversity credit schemes. Under the Emissions Reduction Fund (ERF), Savannah Burning and Herd Management are the only methods which have been adopted on NT pastoral lease and Aboriginal land, while methodologies which sequester carbon to soil or vegetation have not been adopted to date. The *Northern Territory Aboriginal Carbon Industry Strategy* (Department of Environment and Natural Resources) found there is a need to clarify the right to conduct an emissions abatement project across the various land tenure and native title arrangements that apply on land in the Territory.

Table 12 Streamlining and accelerating land development opportunities

Opportunity	Streamlining and accelerating land development opportunities
Impact	9.0% Assume improved opportunities for higher value production via development of precincts, as well as general streamlining of processes for obtaining non-pastoral use permits, section 19 land use agreements, land clearing permits and water access licences, as well as increased ability to participate in carbon and biodiversity schemes, The analysis assumes that by 2031 an additional 58,000 ha of land could be transitioned to support higher value production, including 10% horticultural production (5,800ha) and 90% field cropping (52,200ha), conservatively generating gross values of \$15,000/ha and \$2,000 per ha respectively.
Feasibility	60% Precinct developments are underway and ongoing government efforts to streamline complex development process.
Feasibility weighted impact	5.4%
Modelled growth by 2030-31	\$114M
Confidence rating	Medium The complexities surrounding this opportunity meant high level assumptions were used to assess the benefit from streamlined processes resulting in higher value land uses.

Opportunity	Streamlining and accelerating land development opportunities
Recommended actions	<ul style="list-style-type: none"> • Ongoing efforts to develop agricultural precincts, through identifying potential optimal land uses, undertaking necessary technical investigations, and obtaining the required approvals and infrastructure to attract investment. • Explore opportunities for a broad streamlining of processes for obtaining non-pastoral use permits, section 19 land use agreements, land clearing permits and water access licences. • Review the current process in conjunction with land councils to help ease pressure points for agriculture. Create support and education to growers for navigating potential land use changes. • Work with the Commonwealth and other stakeholders to provide clarity around the legal right and necessary approvals to conduct carbon industry activities, and/or generate biodiversity credits, across a range of land tenure arrangements (as recommended in the <i>Northern Territory Aboriginal Carbon Industry Strategy</i>).
Sources	CRCNA (2022a); NLC (n.d.); DEPWS (2022); GHD (2022)

A-1-2 Improved telecommunications

Currently a large number of agricultural production facilities do not have access to internet/phone reception. For example, Douglas Daly region is a 'black spot' for phone reception, limiting the amount of tech that can be adopted by farmers in the region. The advantages of these technologies in production are great in other areas but inaccessible currently for the NT's agricultural sector. There would also be large benefits to community, social, safety etc.

Table 13 Improved telecommunications

Opportunity	Improved telecommunications
Impact	6.5% Research undertaken by the National Broadband Network in 2020 estimated that improved connectivity, combined with digital technologies, could increase the NT agricultural sector's gross value of production by \$120 million per year by 2030. With the main benefits being through improved decision support, sensors and monitoring, robotics and automation.
Feasibility	50% The impact analysis relies on broad improvements in connectivity as well as broad uptake of technology. Ongoing government efforts, however, largely dependent of private investment and technology advances making the return on investment achievable. To achieve a significant scale is also unlikely – considering the expensive infrastructure necessary and lack of density in most regions. Efforts may be focussed on production precincts.
Feasibility weighted impact	3.3%
Modelled growth by 2030-31	\$69M
Confidence rating	Low High level assumptions of improved coverage and associated benefits.
Recommended actions	<ul style="list-style-type: none"> • Continue to review telecommunication opportunities through emerging technology and prioritise infrastructure in higher production regions.
Sources	Cobcroft et al. (2020); NBN (2021); CRCNA (2022a); GHD (2022)

A-1-3 Improved biosecurity protection

Australia has a strong biosecurity system underpinned by product traceability, surveillance, education and awareness. However, Government (Federal and Territory) and agrifood industries aim to continually improve protection. Improved biosecurity was raised by stakeholders across various industries as a broad value-add opportunity, reducing the downside risk of production losses, trade disruption and control costs. This is especially relevant with the current threat of Foot and Mouth Disease (FMD) and Lumpy Skin Disease (LSD) incursions. In other industries the importance of biosecurity is highlighted by recent incursions from Banana Freckle Disease, Cucumber Green Mottle Mosaic Virus, Browsing Ant and Asian Honey Bee. Maintaining strong biosecurity

protections and disease free-status can provide the Territory with a valuable competitive advantage over other Australian and international growing regions, helping to attract new investment. For many pathogens the NT is considered natural quarantine region within Australia, thereby offering opportunities for biosecurity services.

Table 14 Improved biosecurity protection

Opportunity	Improved biosecurity protection		
Impact	2.7%		
	No specific biosecurity improvements were cited, other than general improvements to traceability, surveillance, awareness and education, with shared responsibility across government, industry and individual producers and the broader community.		
	Hafi et. Al. (2013) estimated the value of Australia’s biosecurity system at up to \$17,500 per year (2012-13 dollars) in terms of higher profits, for the average farm because of the on-farm costs and losses avoided due to the biosecurity system being in place. Applying Consumer Price Index increases to 2030 this estimate is projected to reach approximately \$28,000 per farm business. Extrapolated across the estimated 911 businesses operating in the agribusiness sector in the Territory, the annual value of on-farm biosecurity in the territory is in the order of \$26 million.		
	The above estimate may be considered conservative, given increased commodity prices as well as increased biosecurity threats, including: FMD and LSD. Current estimates suggest in the next 5 years there is an 11.6% likelihood of an FMD incursion and a 28% likelihood of an LSD incursion. The high-level analysis below suggests this equates to an annual risk weighted cost of \$40 million for Territory producers for these two threats alone.		
		FMD	LSD
	Likelihood of incursion within next 5 years (Centre of Excellence for Biosecurity Risk Analysis)	11.6%	28%
	Annual likelihood of incursion	2.3%	5.6%
	Estimated annual cost of incursion	\$8 billion (\$80 billion over 10 years)	\$7 billion (in first year)
	Annual Risk weighted cost (\$m)	185.6	392
	NT share of national beef herd	7%	7%
	13.0	27.4	
	NT annual risk weighted cost (\$m) \$40		
	With the above estimates in mind the analysis assumes improved biosecurity could deliver a 2.7% increase in cross industry value via avoided trade disruption, production losses and control costs.		
Feasibility	80%		
	Challenges in delivering biosecurity improvements beyond current measures.		
Feasibility weighted impact	2.2%		
Modelled growth by 2030-31	\$46M		
Confidence rating	Medium		
	It is difficult to estimate the effects of biosecurity investments, however with a range of ongoing threats, the large-scale potential savings mean the impact is still high.		
Recommended actions	<ul style="list-style-type: none"> • Ongoing updating and implementation of the <i>Northern Territory Biosecurity Strategy 2016-2026</i>. • Industry and government cooperation and investment to manage current and potential key biosecurity risks which threaten industry productivity and growth, including Foot and Mouth Disease, Lumpy Skin Disease, Banana Freckle Disease, Cucumber Green Mottle Mosaic Virus, Browsing Ant and Asian Honey Bee. • Promote NT a natural quarantine region within Australia, thereby offering opportunities for biosecurity services. 		
Sources	Cobcroft et al. (2020); CRCNA (2022a); GHD (2022)		

A-1-4 Increased energy affordability and security

The significance of energy costs to agriculture is being amplified by moves in many sectors to more energy-intensive practices to achieve efficiency gains in other areas such as water use (AFI, 2018). Energy affordability and security of supply was identified as a key challenge having a broad impact across all industries at all points in the supply chain. Opportunities to expand local energy generation and distribution could yield significant efficiency and attract additional investment to NT agribusiness.

Stakeholders cited opportunities for pastoralists and other landholders to diversify their income by participating in the energy market, hosting infrastructure (e.g. wind or solar) or potentially producing energy crops to power remote operations or where possible to feed back into the grid. Stakeholders also cited challenges for Territory agribusiness gaining access to affordable energy, due to high grid connection costs and export focussed developments. Some raised opportunities for intervention into the energy market via a gas reservation policy (similar to Western Australia) or local supply guarantees, as well as opportunities to increase support for off-grid production (e.g. solar) to reduce reliance on diesel generators in remote locations.

Table 15 Increased energy affordability and security

Opportunity	Increased energy affordability and security
Impact	3.6% Energy costs are estimated to represent 9% of the gross value of production for Australian farms, however with longer distances and reduced energy options in the NT this analysis has assumed energy costs for NT farms are double the Australian average (18%). The analysis assumes that regional energy investments could reduce farm energy costs by 20% compared to the base case (equating to a 3.6% reduction in total costs), which would have a direct 1:1 impact on the gross value of production.
Feasibility	50% Investments into energy security are being pursued, in particular solar and gas projects, however delivering significant improvement in energy supply costs will be challenging. Connecting remote locations to the grid is often considered cost prohibitive, however, opportunities exist to support increased off-grid production.
Feasibility weighted impact	1.8%
Modelled growth by 2030-31	\$38M
Confidence rating	Low Analysis relies on high level assumptions of potential energy use and savings generated from supply projects.
Recommended actions	<ul style="list-style-type: none"> Ongoing exploration and development of energy supply options, where possible ensuring grid access and for local agribusiness. Explore opportunities for agribusiness to participate in the energy market, including opportunities for increased off-grid production (e.g. solar) to reduce reliance on diesel generators in remote locations.
Sources	AFI (2018); GHD (2022)

A-1-5 Establishment of an industrial precinct for value-adding, as proposed through KLAH

The Katherine Logistic Agribusiness Hub (KLAH) project (currently awaiting final approval) aims to provide opportunities for packing and distribution, storage, food processing, communications tower, waste management, bushfoods, cold storage, fertiliser, pallet processing, feedlot, biofuel etc. (NT Department of Infrastructure Planning and Logistics). The establishment of this type of precinct aims to attract additional capital investment to the Territory and also create opportunities and synergies for co-located businesses (e.g. sharing of infrastructure and utilising production and waste streams). By grouping several manufacturing and other supply chain facilities in one place, there is potential to address some overarching issues such as labour, energy prices and logistics along with having collaborative qualities. Ultimately, this would increase the total volume of agribusiness production in NT.

Table 16 Establishment of an industrial precinct for value-adding, as proposed through KLAH

Opportunity	Establishment of an industrial precinct for value-adding, as proposed through KLAH
Impact	2.7%
	Assume precinct development would make value adding facilities 30% more likely to be developed in the NT. An additional 30% of NT product could undergo additional processing and value adding increasing value by 30%.
Feasibility	60%
	Feasibility and development is underway for the KLAH however significant private investment and uptake is still required.
Feasibility weighted impact	1.6%
Modelled growth by 2030-31	\$34M
Confidence rating	Low
	Uncertainty around the eventual feasibility, scale and uptake of businesses within the KLAH, therefore difficult to define benefits.
Recommended actions	<ul style="list-style-type: none"> Ongoing development and promotion of the KLAH and other precincts.
Sources	DIPL (2018); GHD (2022)

A-1-6 Local fertiliser production

NT has mineral deposits of phosphorous and potash which combined with a supply of natural gas could produce affordable fertiliser. NT soils are typically low in natural fertility, therefore production (particularly horticulture and field crops) is highly reliant on fertiliser imported from interstate or overseas, which incurs high freight and shipping costs. Local fertiliser production would lower input costs and make NT more competitive for higher intensity production. There are several challenges in establishing local fertiliser deposits and manufacturing. Phosphate deposits in the Georgina Basin are of relatively low solubility, potentially being suitable for slow-release direct application in broadacre, pasture and forestry, to support the poor soils in the NT, particularly the fast-leaching soils in the heavy rainfall zones. However, horticulture production generally requires highly soluble product. There are also challenges in storage of fertiliser in tropic zones.

Table 17 Local fertiliser production

Opportunity	Local fertiliser production
Impact	The analysis assumes that across the agribusiness sector fertiliser costs represents 10% of production costs (higher for broadacre cropping and horticulture industries but lower for pastoral and other industries), and local production could reduce this cost by 30% against current sources, due to reduced freight and shipping costs. The resulting 3% decline in input costs would have a direct 1:1 impact on the gross value of production.
	3.0%
Feasibility	40%
	Several companies are seeking to develop fertiliser deposits and potentially local manufacturing in the NT. Feasibility is likely to be limited by capital investment, infrastructure, skills and also the lack of local sulphur supply. The relatively small local fertiliser market is also a potential barrier to local manufacturing. Gas production is likely to be sold at global prices without the introduction of a gas reservation policy (as discussed in A-1-4). Phosphate deposits in the Georgina Basin are of relatively low solubility, potentially being suitable for slow-release direct application in broadacre, pasture and forestry, to support the poor soils in the NT, particularly the fast-leaching soils in the heavy rainfall zones. However, horticulture production generally requires highly soluble product. There are also challenges in storage fertiliser in tropic zones.
Feasibility weighted impact	1.2%
Modelled growth by 2030-31	\$25M
Confidence rating	Medium

Opportunity	Local fertiliser production
	The research completed confirmed this as having a high potential of impact with some key inputs available, however, the barriers are not well understood
Recommended actions	<ul style="list-style-type: none"> • Further development of projects prioritising local refinement and supply. • Consideration of a gas reservation policy or other mechanisms to encourage local fertiliser manufacturing.
Sources	Verdant Minerals (2022); NT Government (2022); Ag Econ (2022); Avenira (n.d.)

A-1-7 Road and infrastructure upgrade and development

The upgrading of roads and other transport infrastructure can yield significant benefits for producers through reduced travel time to market and increased wet-season access, as well as broader social and economic benefits to residents and other regional industries (e.g. mining and tourism). The Australian and NT Governments have made targeted investments into priority road projects through the Northern Australia Roads Program, Beef Roads and Mango Roads Programs. Currently committed or completed projects include:

- Barkly Stock Route: Upgrading a section of the Barkly Stock Route to a two-lane standard seal.
- Tablelands Highway: Upgrading selected sections of the Tablelands Highway to a two-lane sealed standard.
- Chibnall Road between Old Bynoe and Leonino Road
- Mocatto Road between Whitstone and Acacia Gap Road
- Horsnell Road between Elizabeth Valley Road and Alverly Road
- Kentish Road between Hopewell Road and the end of seal
- Plenty Highway: Progressive sealing and flood immunity improvements.
- Tjukaruru Road: Sealing and upgrades to an unsealed section of the road.
- Keep River Plains Road:
- Adelaide River Floodplain Upgrade Arnhem Highway: Upgrades to the Arnhem Highway, improving the flood immunity at the Adelaide River floodplain to provide all-weather access between the Stuart Highway and Mount Bundy.
- Buntine Highway Road Upgrading: Pavement strengthening, widening and sealing on priority sections.

The imminent harvesting of forestry plantations in the Douglas Daly, Katherine and east Arnhem Land regions make it important to develop roads to link the supply chain to these areas.

Table 18 Road and infrastructure upgrade and development

Opportunity	Road and infrastructure upgrade and development
Impact	<p>1.4%</p> <p>Between 2017 and 2022 the NT and Federal Governments invested around \$308m in road upgrades through the Northern Australia Roads Program, Beef Roads and Mango Roads Programs. Future investment into transport upgrades will be determined on a case-by-case basis and will generally need to deliver a net economic benefit (benefit-cost ratio (BCR) greater than 1) to industry and the broader community in order to justify investment ahead of competing projects. As an example, the \$21 million mango roads upgrade and seal project was projected to reduce fruit bruising and downgrades - increase revenue for the relevant producers by more than \$1 million each year, in addition to other social and economic benefits. In the absence of detailed analysis on specific project opportunities, this analysis assumes an indicative level of investment (\$120 million per annum), is sustained over the coming 5 years, delivering similar annual benefits to the mango roads project (equivalent to approximately 5% of the total investment returned in annual industry benefits). This equates to a benefit of around \$30 million per annum from the total investment of \$600 million. Modelled over a 25-year timeline and discounted at 5% this hypothetical investment returns a BCR of around 0.7 before taking into account additional economic benefits to residents and other industries. Note this is a high level analysis of potential benefits from undefined road improvement projects.</p>

Opportunity	Road and infrastructure upgrade and development
Feasibility	80% Previous road programs have already identified the most important roads to be targeted. The case will need to be made for additional investments returning sufficient benefits to justify investment. However, as agribusiness industries continue to grow the case for additional investment will become stronger.
Feasibility weighted impact	1.1%
Modelled growth by 2030-31	\$24M
Confidence rating	Low
	High level analysis which assumes that economically feasible road projects remain.
Recommended actions	<ul style="list-style-type: none"> Continued identification of priority road projects.
Sources	Ash & Watson (2018); CRCNA (2022a); GHD (2022)

A-1-8 Ease of access for migrant and seasonal workers

NT agribusiness is becoming increasingly reliant on overseas workers to fill labour shortages, restricting opportunities for the expansion and intensification of production and local processing or value adding. Access to labour is a key disadvantage in NT agribusiness' competitiveness. Since most agricultural produce is seasonal by nature, casual workforce, in high numbers, is required but only for short periods. Due to the COVID-19 pandemic, the labour shortage was exacerbated by visa changes, leading to limited migrant labour. According to Sangha et al. (2022), labour related issues include remoteness of the farms, inadequate accommodation and language barriers. Farm management within the agricultural sector is also not up to date to consider changing demand and strategies for workforce retention. NT Farmers Association recently developed a Workforce Development Plan 2020-2025 that covers, among others, gaps in skills and qualifications. In particular, a diverse range of people are required in the NT primary industries, such as unskilled, semi-skilled and skilled, from all over the world, including extended visa or pathways to permanent residency, new migrants, and seasonal workers from the South Pacific and Timor Leste, through the Seasonal Worker Program (NT Farmers, 2021).

Table 19 Ease of access for migrant and seasonal workers

Opportunity	Ease of access for migrant and seasonal workers
Impact	2.0% Hired labour typically accounts for around 20% of horticultural farm expenditure. During the peak mango harvest month of October, the NT horticultural industry typically employs an additional 1,000 overseas workers, mostly on short term contracts. In 2019-20, 51% of horticultural businesses reported increased difficulty in recruiting workers. Assuming 10% of demand for overseas workers is currently unmet, resulting in a proportionate constraint on productivity.
Feasibility	50% Recent outcomes of the job summit saw a positive sentiment towards allowing for greater seasonal worker options to be made available. However, further developments are difficult to achieve due to the complexities of issuing extra worker visas.
Feasibility weighted impact	1.0%
Modelled growth by 2030-31	\$21M
Confidence rating	Low
	Access to migrant and seasonal workers are influenced by complex Federal government policies and visa arrangements. The demand for migrant and seasonal workers is well understood however it is difficult to predict the impact and benefit of policy changes.
Recommended actions	<ul style="list-style-type: none"> NT Government to advocate for Federal government's review of policies and procedures impacting access to migrant and seasonal workers. Regular changes to visa legislation and policies make it difficult for farmers to keep up to date and comply with current regulations.
Sources	NT Farmers (2021); ABARES (2022); GHD (2022)

A-1-9 Improved air freight infrastructure

Northern Australian airports have limited refrigerated container capability; as a result substantial volumes of seafood, fruit and vegetables are trucked to Brisbane, Adelaide, and Melbourne before being airfreighting to Southeast Asia or distributed for domestic use (CRCNA, 2022a). A newly developed export facility opened at Darwin Airport is now providing freight handling and cold storage services. As a result, Cathay Pacific provided five weekly flights during the 2022 mango season, with a capacity to carry approximately 50 tonnes per flight. Further investment into air freight infrastructure, including cold storage, along with supporting services could create further export market opportunities, reducing reliance on road transport to domestic markets.

Table 20 Improved air freight infrastructure

Opportunity	Improved air freight infrastructure
Impact	0.5%
	Horticulture and seafood industries (representing around 30% of NT agribusiness output) are the most likely to utilise air freight. This analysis assumes that improved airfreight facilities could encourage these industries to direct an additional 30% of produce to higher value export markets, yielding a 5% premium compared to domestic markets.
Feasibility	60%
	The feasibility is dependent on export markets being more profitable than existing domestic markets. Existing investments may be sufficient to satisfy demand in the short term, however additional capacity will be required to support high levels of growth.
Feasibility weighted impact	0.3%
Modelled growth by 2030-31	\$5.7M
Confidence rating	Medium
	Discussions with key stakeholders gave GHD assumptions a reasonably solid basis along with supporting literature, however there is uncertainty around capacity constraints and future market opportunities.
Recommended actions	<ul style="list-style-type: none"> • Consideration of options to improve airfreight frequency of services, capacity and infrastructure. • A supply chain assessment (including a gap analysis into infrastructure logistics) would help identify where additional investment would produce the greatest impact.
Sources	CRCNA (2022a); GHD (2022)

A-1-10 Establishment / extension of agricultural training courses

A number of stakeholders interviewed raised the general lack of agricultural training courses in the NT as a longer-term constraint on growth. Charles Darwin University currently offers graduate certificate courses in Agriculture and Rural Operations, from its Katherine Campus and/or remotely, however there is option to obtain a Bachelor's Degree in Agricultural Science or similar within the Territory.

Table 21 Establishment / extension of agricultural training courses

Opportunity	Establishment / extension of agricultural training courses
Impact	5.0%
	There was an industry-identified need to produce more locally skilled people to create expertise in all the emerging industries. Improved agricultural education and training in the Territory would likely deliver significant industry benefits over the longer term (10+ years), encouraging more local students to pursue a career in agriculture and reducing the shortage of skilled labour and agricultural professionals. The short-term benefits (by 2030-31) may be less substantial.
Feasibility	5%
	The supply of local courses is likely to increase as the industry grows, creating additional demand for graduates and student interest. Government, industry, and education/training

Opportunity	Establishment / extension of agricultural training courses
	providers may be able to priorities the establishment of new courses and places, however, generally supply will match demand.
Feasibility weighted impact	0.3%
Modelled growth by 2030-31	\$5.3M
Confidence rating	Low
	Challenging to estimate and attribute industry growth to the provision of training.
Recommended actions	<ul style="list-style-type: none"> Industry, government, and education providers work together to identify skill gaps and training requirements.
Sources	Babacan et al. (2020); NT Farmers (2021); CRCNA (2022a); GHD (2022)

A-1-11 Extension of current port capacity and efficiency of the Port of Darwin

The Port of Darwin currently exports around 38% of Australia's live export cattle, however there are opportunities for greater exports of agricultural commodities via bulk or container transport. Specifically, stakeholders noted that current schedules of shipments are not well suited to some perishable agricultural products along with the port being expensive to use. Potentially a better suited schedule, supporting infrastructure and affordability of the port could create greater opportunity of exporting more agricultural products from the NT. The Port is equipped with rail connections from Katherine directly to the Port, which significantly reduces double handling. However, cattle exporters cite challenges and bottlenecks in trucking cattle from holding feedlots to loading facilities. As forestry begins greater harvesting in the years to come, the port will also have to accommodate extra exports. The planned development of Middle Arm Sustainable Development Precinct is expected to alleviate any capacity issues for the Port of Darwin, providing capacity for minerals, oil and gas and defence industries.

Table 22 Extension of current port capacity and efficiency of the Port of Darwin

Opportunity	Extension of current port capacity and efficiency of the Port of Darwin
Impact	0.5%
	More regular and efficient service at the Port of Darwin would reduce the transport and storage costs and potentially allow for greater market access.
Feasibility	25%
	The Port of Darwin is comfortable that it will be able to increase services as required to meet future demand from agribusiness industries, particularly given the planned development of the Middle Arm Sustainable Development Precinct. Services will likely increase, and costs decline as industries grow and reach a critical mass to justify additional investment.
Feasibility weighted impact	0.1%
Modelled growth by 2030-31	\$2.6M
Confidence rating	Low
	High level assumptions of benefits from improved capacity. Stakeholders had different views about the size of the problem.
Recommended actions	<ul style="list-style-type: none"> Assess current and future port capacity and efficiency considering the Middle Arm Sustainable Development Precinct.
Sources	Ash & Watson (2018); GHD (2022)

A-1-12 Development of branding and marketing for NT Indigenous produced products

Multiple sectors indicated that there was significant opportunity to build a reputation and associated branding of agricultural produce with indigenous involvement produced in the NT. The scale is limited due to this only applying to produce with indigenous involvement, however, the actual value-add to individual products could be high. There are additional opportunities promote carbon neutral or positive production.

Table 23 Development of branding and marketing for NT Indigenous produced products

Opportunity	Development of branding and marketing for NT Indigenous produced products
Impact	0.2%
	The analysis assumes that approximately 20% of produce in the NT might be eligible to be marketed under an indigenous brand (however this would depend on the criteria used), and there would be 75% uptake within this segment (15% overall). A successful marketing and branding exercise could expect to attract a 1% price premium.
Feasibility	80%
	Some companies and/or industries are already undertaking branding and marketing of indigenous produced products. Potential for a more coordinated approach.
Feasibility weighted impact	0.1%
Modelled growth by 2030-31	\$2.5M
Confidence rating	Medium
	Evidence of potential premiums for indigenous products, however difficult to estimate update and demand.
Recommended actions	<ul style="list-style-type: none"> Further encouragement of indigenous production and associated marketing.
Sources	GHD (2022)

Appendix B

Livestock – Cattle value-add opportunities

B-1 Industry overview

The cattle industry made up 55% of the overall primary industry and seafood production in the 2020-21 year, worth \$692.1 million. Most of this value is through transferring cattle interstate, \$368 million, with a substantial amount also exported overseas, \$320 million (DITT, 2022).

B-2 Production systems and supply chains

The production systems are generally extensive grazing of rangelands consisting of unimproved native and naturalised grasses, herb, forbs and shrubs. This marginal land and lack of access to water puts a constraint on the land use, making beef production one of the only viable options (Chilcott et al., 2020).

Post-farmgate value such as processing is generally captured external to the NT, with only \$4.7 million worth of cattle being slaughtered in the NT in 2020-21. Inter-state movements of cattle are generally sold for slaughter and distributed as boxed beef to domestic and international markets. Majority of live cattle are exported to Southeast Asia, specifically Indonesia which took 83.8% of NT's live exports in 2020-21. Other significant exporting locations of live cattle include Vietnam (6.7%), the Philippines (4.3%), Brunei (2.7%), and Malaysia (1.6%). It should be noted that live cattle exports are only counted as being from the NT if they are shipped from the Port of Darwin.

An abattoir in Livingstone that processed about 500 head of cattle a day was closed for operations in 2018 pending a better business environment (Burton & Brann, 2018).

Cattle from the NT travel an average of close to 1,000km and sometimes as much as 2,500km to east coast abattoirs (CSIRO, n.d.). CSIRO conducted a report which identified 'Beef Roads' which are the most economical to improve to reduce transportation costs (CSIRO, 2016). "Long travel distances raise costs and risks to production. Land transport costs compromise up to 35 per cent of the market price of livestock. For several months each year, floods and seasonal road closures can prevent stock reaching ports or abattoirs" (CSIRO, n.d.).

CRCNA (2022a) completed supply chain mapping for the NT beef industries and identified supply chain gaps which may be constraining industry development and exposure to a wider range of domestic and international markets.

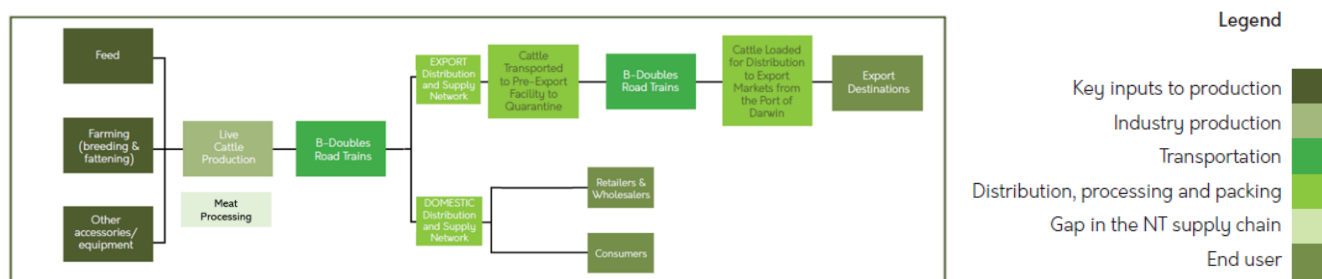


Figure 9 NT beef industry supply chain map

Source: GHD based on CRCNA (2022a).

B-3 Previous studies into value adding opportunities

Value-adding opportunities for the NT livestock industry have been previously explored in the following studies:

- Hide processing and tanning options for the NT: preliminary observations (NT Development Corporation, 1980)
- Value added study for the NT livestock industry (Resource Consulting Services, 1990)
- Conservation farming and grazing systems for the semi-arid tropics of the NT (O'Gara, 1998)
- Increasing the market share of NT Livestock Exports (DRDPFR, 2008)
- Feasibility of Establishing a Northern Western Australian Beef Abattoir (Rouda, 2010)
- Strategic directions for the Northern Australia beef industry (CSIRO, 2012)

- Irrigated agricultural development in northern Australia: value-chain challenges and opportunities (Ash et al., 2017)
- Capturing the agricultural opportunity of Association of Southeast Asian Nations (ASEAN) for Northern Australia (CRCNA, 2019a)
- Growth opportunity: traditional proteins, as part of FIAL (2020)
- Northern Australia Beef Situation Analysis (Chilcott et al., 2020)
- Northern Australia agribusiness supply chains: a review of the literature (Tremblay et al., 2020)
- The future of hide processing in Australia (AMPC, 2022).

B-4 Barriers and opportunities for growth

• The recently completed *Evaluation of Northern Territory agriculture supply chains and export opportunities* (CRCNA, 2022a), summarised the barriers and opportunities for NT beef industries in the following SWOT Analysis (Table 24) and the identified sector constraints, trends, priorities, and opportunities.

Table 24 SWOT analysis (NT livestock cattle supply chain)

Strengths	Weaknesses
<ul style="list-style-type: none"> – Northern Australia’s beef herd comprises 12.5 million cattle and contributes approximately 90% of Australia’s live cattle exports. – The Port of Darwin is ideally located to capitalise on growing demand for red meat in the Asian region. – Multi-generational knowledge and expertise throughout the cattle industry. 	<ul style="list-style-type: none"> – The cattle industry is particularly exposed to the costs of transport. – Climate conditions challenge road reliability (floods and annual monsoons). – It is currently very expensive to export via the Port of Darwin. – Underdevelopment of key elements in the beef value chain such as abattoirs.
Opportunities	Threats
<ul style="list-style-type: none"> – Significant opportunity to increase the volume of both live cattle and beef trade towards ASEAN nations. – Opportunity for the industry to utilise emissions reduction incentives. – Opportunities to integrate crop production with the beef industry to create a value-add in both sectors. 	<ul style="list-style-type: none"> – Northern Australia and the NT’s high capital costs and reliance on a small number of markets make it vulnerable to market shocks. – Increased community interest in the impact of red meat production on the environment, animal welfare and diet. – Lack of skilled abattoir workers. – Potential biosecurity incursions

Source: CRCNA (2022a).

B-5 Historical and projected growth in value

The total herd number for the NT has remained relatively stable, with no major increases driving increased production (Figure 10). However, it can be seen in Figure 11 that the total value has risen significantly due to an increase in commodity prices.

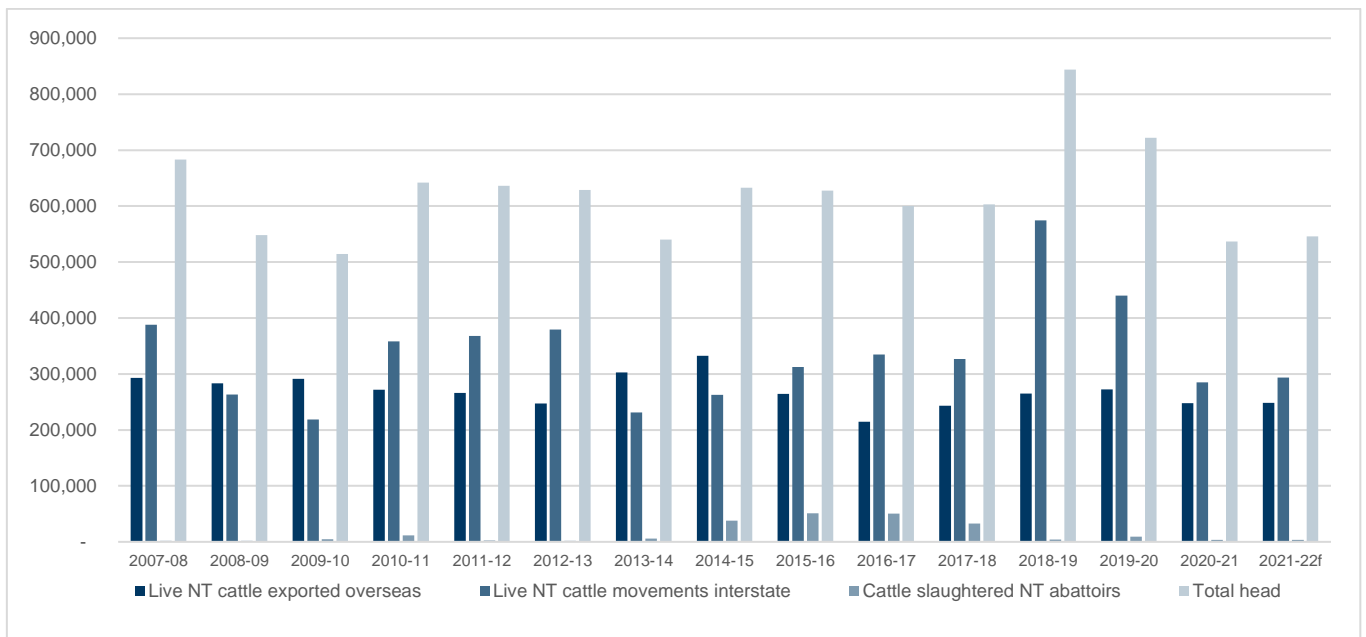


Figure 10 Breakdown of number of head of cattle

Source: GHD based on DITT (2022). (Note: 2021-22f: forecast).

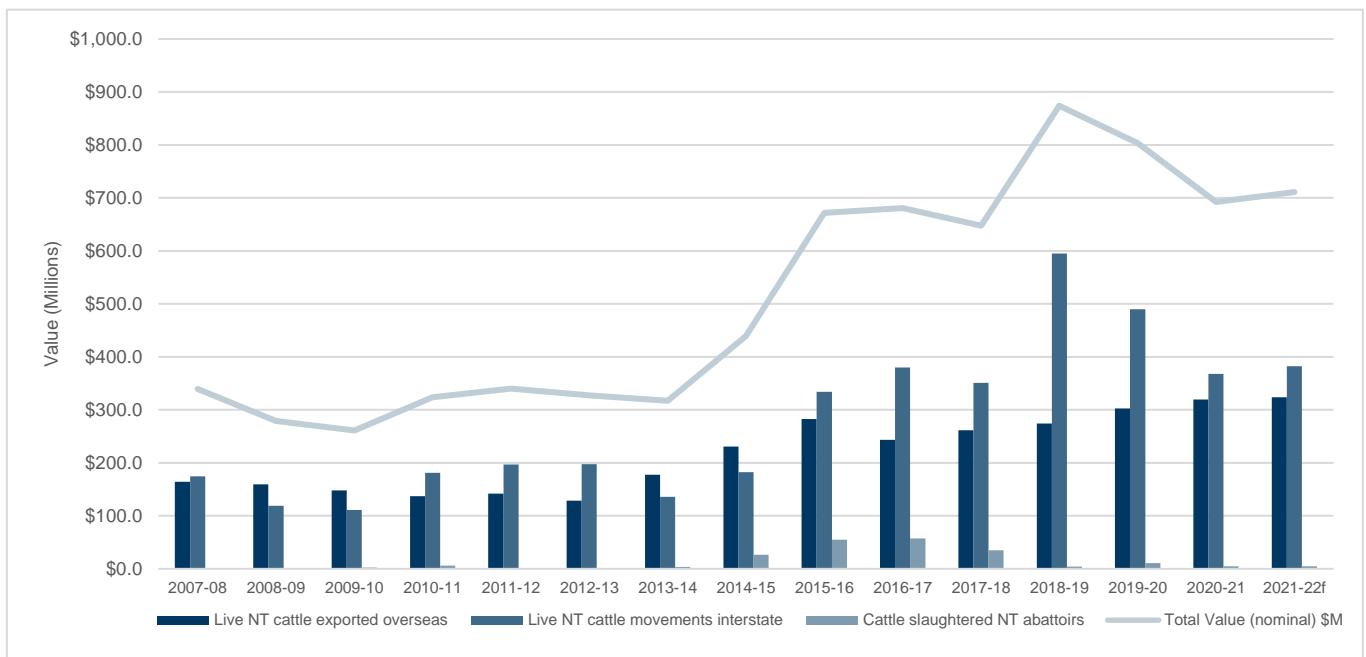


Figure 11 Value breakdown of cattle

Source: GHD based on DITT (2022). (Note: 2021-22f: forecast).

B-6 Value-add opportunities

Outlined below are the shortlisted opportunities which were assessed as most likely to add value to the NT cattle sector. These opportunities were shortlisted following stakeholder consultation and literature review, before the likely impact and feasibility were estimated and modelled. Opportunities are presented in descending order based on the modelled impact on the value of NT agribusiness by 2030-31.

B-6-1 Pursuing premium and niche markets including organic, indigenous, carbon neutral and wagyu-cross products

The Australian beef industry continues to grow in value by pursuing higher quality, premium, niche or differentiated markets. With relatively fixed costs of production, NT cattle producers are increasingly seeking to maximise value per animal. Stakeholders cited opportunities for wagyu-cross cattle, organic, carbon neutral and regenerative agricultural practices, underpinned by increased branding and quality certification.

The NT cattle industry is well equipped to access some of this value-add through areas such as its non-intensive nature of grazing, potential carbon neutrality and indigenous grown.

Table 25 Pursuing premium and niche markets including organic, indigenous, carbon neutral and wagyu-cross products

Opportunity	Pursuing premium and niche markets including organic, indigenous, carbon neutral, and wagyu-cross products
Impact	6.0%
	Assume opportunity to lift value of domestic cattle (approximately 50% of total) by 10% above baseline.
Feasibility	80%
	Continuing ongoing trend - targeted investment in this area could achieve even greater outcomes. This has typically been a focus of some key stakeholders in the NT (particularly outside of the live cattle trade).
Feasibility weighted impact	4.8%
Modelled growth by 2030-31	\$46M
Confidence rating	Medium
	Analysis relies on some established assumptions and higher level estimates of value gains.
Recommended actions	<ul style="list-style-type: none"> Assessment of the most suitable and profitable premium and niche market opportunities for NT cattle. Continued investment into marketing, quality accreditations and grower education.
Sources	CRCNA (2022a); GHD (2022)

B-6-2 Increased local meat processing capacity

Meat processing within the NT has been a key topic for the industry recently. The Australian Agricultural Company's (AACO) Livingstone abattoir was mothballed in 2018 although it is a fully functional facility with capacity to process over 500 head of cattle per day. Various factors appear to have contributed to the decision to mothball the facility, including cattle supply and market conditions, a high Australian Dollar, availability of labour and expertise and high energy costs.

Meanwhile the smaller scale Batchelor Meatworks (Rum Jungle Meat Exports) has been upgraded and re-opened. Stakeholder cited challenges including seasonal cattle supply, access to labour and energy costs, but referenced potential opportunities for the Territory to produce more finished, slaughter-ready cattle through increased field cropping (including cottonseed supply) and improved pasture/fodder production. If conditions changed to make meat processing viable, it would bring a large amount of value back to the NT as most is currently sent outside of the NT for further processing.

Table 26 Increased local meat processing capacity

Opportunity	Increased local meat processing capacity
Impact	20.0%
	Assume a potential market for 20% of turnoff could be processed locally, adding 200% to the local value of production.
Feasibility	20%

Opportunity	Increased local meat processing capacity
	The mothballing of the AACO facility shows that feasibility is challenging due to a range of factors such as seasonal supply, labour supply/costs, difficulty reaching slaughter weight.
Feasibility weighted impact	4.0%
Modelled growth by 2030-31	\$38M
Confidence rating	Medium
	Impact and feasibility informed by past experiences; however, markets and conditions can readily change.
Recommended actions	<ul style="list-style-type: none"> Continue to promote the opportunity to potential investors.
Sources	GHD (2022)

B-6-3 Improved finishing of cattle with higher value pasture, legume and grain production

Currently, the NT cattle sector is heavily reliant on breeding as a source of production, however, the lack of higher value pasture and fodder makes finishing cattle very difficult. The industry has built a successful trade in supplying lighter cattle to Indonesian feedlots, which are well placed to provide feed for finishing. However, there are potentially higher-value opportunities to supply finished cattle to local processors and other export markets.

There are significant opportunities to produce higher value feed, particularly in the semi-arid tropic regions using both irrigated and non-irrigated production (O’Gara, 1998). These opportunities have been steadily progressed for many years however there remains significant unrealised potential. Stakeholders cited opportunities for integration of crop-livestock systems at the regional scale through mosaic farming / irrigation, and also opportunities to produce feed (hay, silage, pellets) required by the live export trade.

Table 27 Improved finishing of cattle with higher value pasture, legume and grain production

Opportunity	Improved finishing of cattle with higher value pasture, legume and grain production
Impact	6.0%
	Opportunity limited to higher rainfall areas (assume 30% of value) with opportunity to lift production by 20%.
Feasibility	60%
	Ongoing priority particularly in higher rainfall areas and precincts, challenged by access to machinery, labour, fertiliser, irrigation and other inputs.
Feasibility weighted impact	3.6%
Modelled growth by 2030-31	\$34M
Confidence rating	Medium
	Benefits supported in literature and practical success, however difficult to quantify the scale of potential pasture improvement.
Recommended actions	<ul style="list-style-type: none"> Further research on tailored forage systems for a range of animal classes to determine which systems are most advantageous under different local conditions. Plan for and promote cattle feedlotting developments, taking advantage of increased feed output from field cropping industries, including cottonseed.
Sources	O’Gara (1998); Chilcott et al. (2020); GHD (2022)

B-6-4 Increased uptake and adoption of lessons from the Indigenous Pastoral Program

The Indigenous Pastoral Program (IPP) commenced in 2003 and supports best practice, culturally appropriate development and grazing management on Aboriginal lands. There is potential for greater utilisation of more land

that is already within the program and hence increase the total herd for cattle. There is also a scope to broaden the program to include additional Aboriginal land.

Table 28 Increased uptake and adoption of lessons from the Indigenous Pastoral Program

Opportunity	Increased uptake and adoption of lessons from the Indigenous Pastoral Program
Impact	4.0%
	Currently, the IPP has capacity of approximately 200,000 head (2% of total), with stated potential to double capacity on the operated land. The analysis assumes equal opportunities exist for production on additional Aboriginal land outside the IPP.
Feasibility	80%
	Plan underway to lift production within the IPP.
Feasibility weighted impact	3.2%
Modelled growth by 2030-31	\$30M
Confidence rating	High
	The opportunities within the IPP are well understood.
Action required	<ul style="list-style-type: none"> Continuation of current IPP collaborative project and assessment of the potential for incorporation of greater land areas.
Sources	GHD (2022)

B-6-5 Herd improvement programs based on genetic selection and genomic production

Herd improvement remains a challenge and significant opportunity NT cattle producers. Modern genomic deoxyribonucleic acid (DNA)-based methods can be used to help predict which bulls are most likely to produce resilient cross-bred offspring and to select the most suitable pure-bred sires for cross-breeding purposes. The DNA-based predictions for estimated breeding values for fertility allow selection decisions to be made on animals for which no phenotypic information is available.

Table 29 Herd improvement programs based on genetic selection and genomic production

Opportunity	Herd improvement programs based on genetic selection and genomic production
Impact	5.0%
	Potential to improve herd genetics and performance, with assumed productivity gains of 5% through weight gain, reproductive productivity etc.
Feasibility	50%
	Investments in herd genetics has typically led to overarching improvements for the cattle industry. Ongoing efforts to improve herd genetics however not prioritised by all business. Practical challenges in managing breeding in NT pastoral systems.
Feasibility weighted impact	2.5%
Modelled growth by 2030-31	\$24M
Confidence rating	Medium
	Reasonably well documented opportunities, however uncertainty in the rate and scale of improvements.
Recommended actions	<ul style="list-style-type: none"> Continued R&D investment to achieve higher accuracies and greater uptake and partnership between researchers, breed society, influential breeders and industries.
Sources	Chilcott et al. (2020); GHD (2022)

B-6-6 Improved water infrastructure on pastoral land

The number and reliability of stock water points is a key determinant of productivity on NT cattle stations. Overall carrying capacity can be increased by improving water supply where possible. Current efforts to improve understanding of both ground and surface water sources, and the current gaps in water supply will help industry increase production.

Table 30 Improved water infrastructure on pastoral land

Opportunity	Improved water infrastructure on pastoral land
Impact	4.0%
	Assume stock water access could be improved on 20% of pastoral land, improving carrying capacity by 20%.
Feasibility	50%
	Already a high priority for industry. Feasible in some areas and more challenging in others. The recent rise in cattle prices has shifted this back into being a large opportunity.
Feasibility weighted impact	2.0%
Modelled growth by 2030-31	\$19M
Confidence rating	Medium
	It is difficult to estimate based on sources the amount of potential impact. However, with it having large success in the past along with support by key stakeholders it should continue being investigated.
Recommended actions	<ul style="list-style-type: none"> • Further investment by stations and continued review of potentially underutilised land. • Progressing water resource planning and ensuring that it allows for dispersed small water licenses to be allocated.
Sources	GHD (2022)

B-7 Enhanced growth roadmap

The projected growth from industry-specific opportunities as well as cross-industry opportunities is summarised in Figure 12 below. Assuming the above value-add opportunities are implemented, the base case scenario would be a value of \$1,190 million realised by 2030-31.

Based on the confidence level applied to the value-add opportunities (as described in Table 3), the total upper limit is estimated to be \$1,243 million and the lower limit is \$1,138 million in 2030-31.

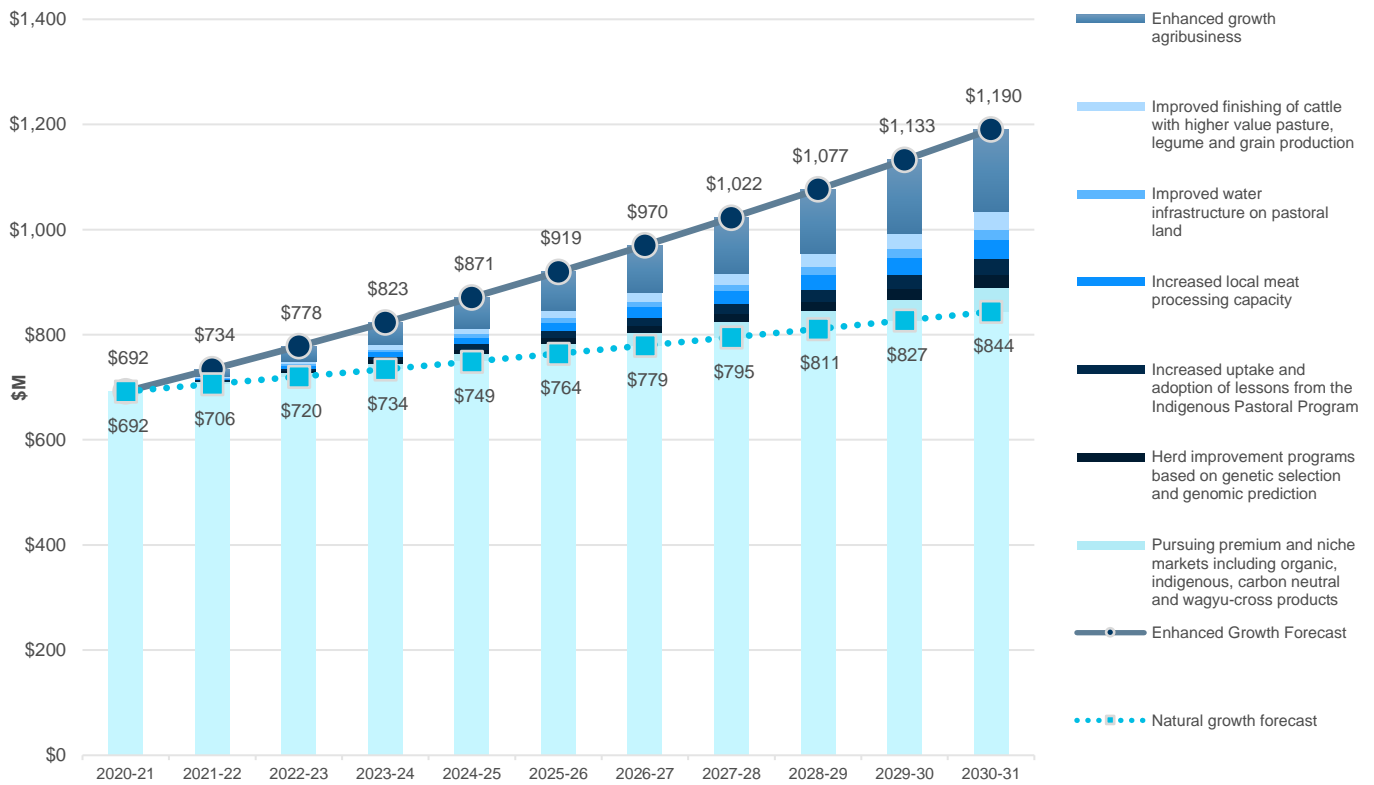


Figure 12 Potential cattle industry growth including value adding opportunities

Source: GHD modelling results.

The analysis identified the following opportunities as having the highest overall impact on the value of NT cattle industry by 2030-31, presented in Table 31 below with the actions required to progress them.

Table 31 Highest value opportunities and recommended actions in NT livestock cattle industry

Rank	Opportunity	2030-31 Additional Value (\$M)	Recommended actions
1	Pursuing premium and niche markets including organic, indigenous, carbon neutral and wagyu-cross products	\$46	Assessment of the most suitable and profitable premium and niche market opportunities for NT cattle. Continued investment into marketing, quality accreditations and grower education.
2	Increased local meat processing capacity	\$38	Continue to promote the opportunity to potential investors.
3	Improved finishing of cattle with higher value pasture, legume and grain production	\$34	Further research on tailored forage systems for a range of animal classes to determine which systems are most advantageous under different local conditions. Plan for and promote cattle feedlotting developments, taking advantage of increased feed output from field cropping industries, including cottonseed.

Rank	Opportunity	2030-31 Additional Value (\$M)	Recommended actions
4	Increased uptake and adoption of lessons from the Indigenous Pastoral Program	\$30	Continuation of current IPP collaborative project and assessment of the potential for incorporation of greater land areas.
5	Herd improvement programs based on genetic selection and genomic prediction	\$24	Continued R&D investment to achieve higher accuracies and greater uptake and partnership between researchers, breed society, influential breeders and industries.
6	Improved water infrastructure on pastoral land	\$19	Further investment by stations and continued review of potentially underutilised land. Progressing water resource planning and ensuring that it allows for dispersed small water licenses to be allocated.

Source: GHD modelling results.

Appendix C

Other Livestock value-add opportunities

C-1 Industry overview

In 2020-21, the other livestock industry is valued at \$34.9 million (2.8% of the NT's overall primary industries and seafood) broadly made up with the value of production of crocodiles (\$24.2 million), buffalo (\$10.4 million) and other livestock such as poultry, horses, camels, deer, pigs and goats amounting to \$0.28 million (DITT, 2022).

Australia accounts for 60% of the global saltwater crocodile skins and the NT makes up two thirds of Australia's output. There has been significant investment from some of the most prestigious fashion labels to ensure that their supply chains for crocodile products are safe and contain animal welfare standards.

C-2 Production systems and supply chains

The production system for crocodiles is a collaboration between farmers and regulators to balance the economic value with the environmental stability of the crocodile population. The system captures everything from egg collection/breeding through to slaughter and subsequent sales of skins and farm related tourism. Most value adding with skins and body parts occurs off-shore or interstate and is not captured in NT (EY, 2016).

The 2014 state of NT buffalo herd was estimated at 160 000 animals with a mix of managed wild/feral buffalo along with farmed animals. Almost 60% of buffalo exported between 2014 and 2018 were shipped to Vietnam, with 22.5% Malaysia, 11% Indonesia and 6.8% Brunei Darussalam. There is an identified \$20 million dollar demand from the European Union that is currently unfulfilled due to lack of suitable infrastructure (NT Buffalo Industry Council, n.d.).

As the prices of meat products have risen along with the feral goat population there has been instances where 'wild musters' have been commercially viable, whereby temporary yards are set up near a known wild population of goats which are then captured and sold.

C-3 Previous studies into value adding opportunities

Value-adding opportunities for the NT livestock (excluding beef) industries have been previously explored in the following studies:

- Adding Value to New Animal Product Supply Chains (Wondu Business and Technology Services, 2004)
- Economics of camel control in the central region of the NT (Drucker, 2008)
- The Northern Territory crocodile farming industry: strategic plan 2015-2021 (CFANT, 2015)
- Management Program for the Saltwater Crocodile in the NT 2015-2021 (Saalfeld et al., 2016)
- Donkey Business: Potential of the donkey industry in the NT (DPIR, 2016)
- Economic Value of the Crocodile Farming Industry to the NT (EY, 2017)
- AgriFutures Buffalo Program Strategic RD&E Plan (2021-2025) (MacDonald et al., 2021).

C-4 Barriers and opportunities for growth

The opportunities and barriers to growth in the NT (non-beef) livestock industries are summarised in the following SWOT Analysis (Table 32), adapted from analysis completed as part of *Evaluation of Northern Territory agriculture supply chains and export opportunities* (CRCNA, 2022a).

Table 32 SWOT analysis (NT other livestock supply chain)

Strengths	Weaknesses
<ul style="list-style-type: none"> – The Port of Darwin is ideally located to capitalise on growing demand for red meat in the Asian region. – Access to unique, pest or wild animals including buffalo, crocodile, goats, donkey etc. 	<ul style="list-style-type: none"> – Livestock industries are particularly exposed to the costs of transport. – Climate conditions challenge road reliability (floods and annual monsoons). – It is currently very expensive to export via the Port of Darwin. – Underdevelopment of key elements in livestock value chain such as abattoirs.
Opportunities	Threats
<ul style="list-style-type: none"> – Significant opportunity to increase the volume of trade towards ASEAN nations. – Opportunity for the industry to utilise emissions reduction incentives. – Opportunities to integrate crop production with the livestock industry to create a value-add in both sectors. 	<ul style="list-style-type: none"> – Northern Australia and the NT’s high capital costs and reliance on a small number of markets make it vulnerable to market shocks. – Increased community interest in the impact of red meat production on the environment, animal welfare and diet. – Lack of skilled abattoir workers. – Potential biosecurity incursions

Source: GHD based on CRCNA (2022a).

C-5 Historical and projected growth in value

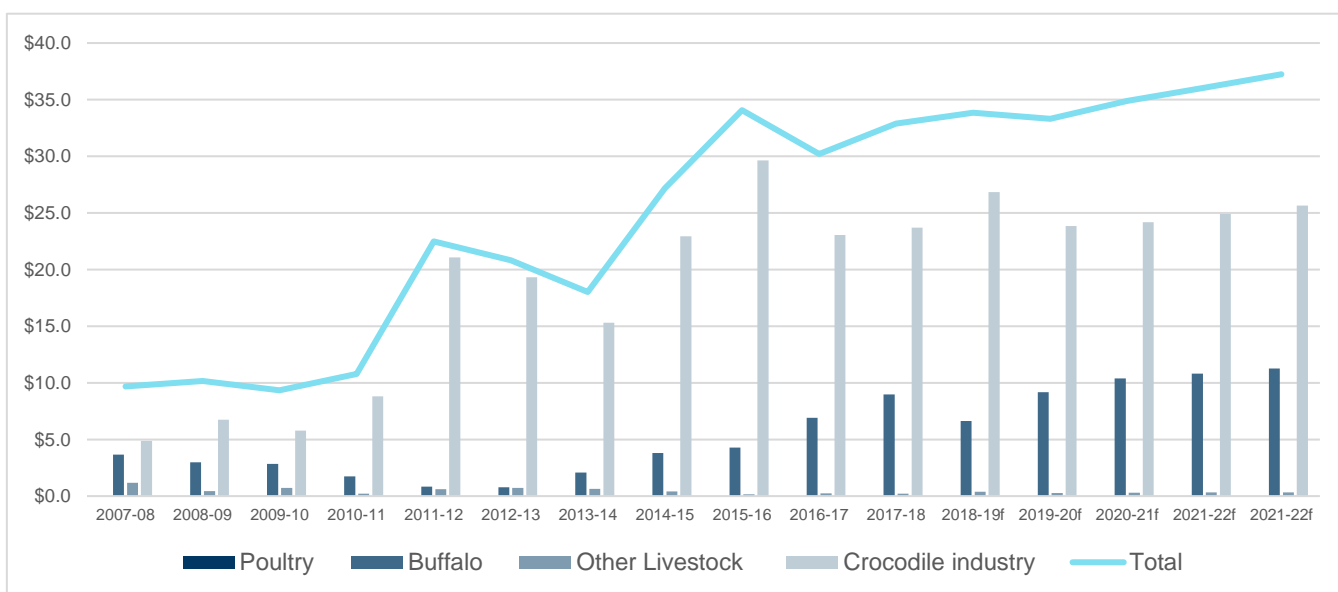


Figure 13 Total value of other livestock (\$million)

Source: GHD based on DITT (2022). (Note: 2021-22f: forecast).

C-6 Value-add opportunities

Outlined below are the shortlisted opportunities which were assessed as most likely to add value to the NT livestock sector. These opportunities were shortlisted following stakeholder consultation and literature review, before the likely impact and feasibility were estimated and modelled. Opportunities are presented in descending order based on the modelled impact on the value of NT agribusiness by 2030-31.

C-6-1 Commercialisation of crocodile by-products and further processing in NT

There is potential to increase the value of the crocodile farming industry through the commercialisation of by-products and by capturing more of the value chain through further processing, tanning and value adding in the NT. Except for some meat sold, many by-products from skin production are discarded due to a lack of established commercial markets or market access. Crocodile blood, oil, bile and gall bladder have been commercialised for medicinal uses in Asia and, to a lesser extent, in Mexico and South America and African countries (CFANT, 2015).

Table 33 Commercialisation of crocodile by-products and further processing in NT

Opportunity	Commercialisation of crocodile by-products and further processing in NT
Impact	18.0%
	Assume a possible 25% increase crocodile industry value, representing an 18% increase in the broader "other livestock" category.
Feasibility	50%
	Challenging to establish access to niche markets, however opportunities to market by-products through established channels, e.g. red meat by-products.
Feasibility weighted impact	9.0%
Modelled growth by 2030-31	\$6.1M
Confidence rating	Medium
	World markets for crocodile by-products are established however difficult to estimate value and feasibility.
Recommended actions	<ul style="list-style-type: none"> • Feasibility assessment to be carried out. • Stakeholder partners to be contacted and collaborated within the crocodile and process value adding industry.
Sources	CFANT (2015), EY (2017)

C-6-2 Multi-species processing

The upgraded and re-opened the Batchelor Meatworks (Rum Jungle Meat Exports) has provided an important outlet for female and heavier animals that do not meet live export specifications. Similar opportunities may exist for processing of camel, donkey and other wild or semi-farmed livestock for domestic and export markets. This would require the establishment of a Tier 2 multi-species abattoir, on-farm investment, and breeding (DPIR, 2016).

Table 34 Multi-species processing

Opportunity	Multi-species processing
Impact	24.0%
	DPIR (2016) found that it would likely be unsustainable to harvest the wild donkey population estimated at 50,000 head, however steady state farming of mammoth donkeys selected for meat and hide quality could be viable, particularly as a diversification option for pastoralists. Processed value (estimated at \$1,185 per head in 2016) is likely to be in the order of \$1,500 per head in 2022, with a potential turnoff of 5,000 head per annum in a fully developed industry. Across all potential species this analysis assumes a facility would have the capacity to process 5,000 buffalo at \$1,000 per head.
Feasibility	30%
	The establishment of a Tier 2 multi-species abattoir is unlikely by 2030-31. However, the current struggles of finding suitable supply for some abattoirs may create an opportunity to fill it with alternate species.
Feasibility weighted impact	7.2%
Modelled growth by 2030-31	\$4.8M

Opportunity	Multi-species processing
Confidence rating	Medium There has been a significant amount of research already put into this area.
Recommended actions	<ul style="list-style-type: none"> Explore opportunities with established abattoirs or greenfield developments.
Sources	DPIR (2016); GHD (2022)

C-6-3 Increased harvest ceiling of crocodile eggs

The Management Program for the Saltwater Crocodile in the NT 2015-2021 (Saalfeld et al., 2016) sets the current harvest ceiling at 90,000 viable eggs for each annual nesting season during the life of this program, however, currently only around half that number of viable eggs are being harvested annually. CFANT (2015) and interviewed stakeholders suggested that the harvest could potentially be increased without impacting the long-term sustainability of the industry or trade. Any increase in the harvest ceiling would need to be supported by robust modelling and approved by the NT Department of Environment, Parks and Water Security (DEPWS) from the Administrator and the Australian Government (noting DEPWS administers the *Territory Parks and Wildlife Conservation Act 1976*, under which the saltwater crocodile is classified as protected wildlife).

Table 35 Increased harvest ceiling of crocodile eggs

Opportunity	Increased harvest ceiling of crocodile eggs
Impact	11.0% Assume a possible 15% increase in harvestable crocodiles produced, which would lead to a comparable increase in the crocodile industry value, representing an 11% increase in the broader "other livestock" category.
Feasibility	60% If supported by modelling and evidence the harvest ceiling will be raised.
Feasibility weighted impact	6.6%
Modelled growth by 2030-31	\$4.4M
Confidence rating	Medium An increased harvest ceiling is almost guaranteed to translate into increased output. However, there is uncertainty around whether the ceiling can be sustainably raised.
Recommended actions	<ul style="list-style-type: none"> Regular modelling and review of the harvest ceiling.
Sources	Drucker (2008); CFANT (2015); Saalfeld et al. (2016)

C-6-4 Improved efficiency and market access for buffalo exports

The buffalo live export trade has gradually increased over the past 20 years, with annual numbers now exceeding 10,000 head and prices increasing to make the commercial harvest and production more profitable. The live trade to Vietnam, which started in 2014, takes mainly slaughter-weight bulls, while Indonesia takes younger males up to 350 kg to be finished in feedlots. Malaysia takes slaughter-weight buffalo opportunistically. Small shipments of breeders are also sold regularly, mainly to East Malaysia.

Rum Jungle abattoir processed 4,600 buffalo in 2022 and is looking to increase this production in years to come. However, industry has noted challenges in supplying Indonesia, which holds significant demand, due to requiring market access licenses which have not been successfully acquired yet.

Industry stakeholders and reports identify a range of opportunities to enhance the efficiency, sustainability, volume and value within the trade including:

- Improved licencing arrangements for boxed buffalo to enter some markets (in particular, Indonesia)
- Improved health and welfare outcomes along the supply chain, in particular reduced on-board mortality. This is a primary focus of the industry's Strategic Research, Development & Extension (R,D&E) Plan - 2021-2025 (MacDonald et al., 2021)

- Improved and expanded partnerships with Traditional Owners to sustainably manage country for the wild harvest of buffalo and share the economic dividends.

Table 36 Improved efficiency and market access for buffalo exports

Opportunity	Improved efficiency and market access for buffalo exports
Impact	6.0%
	The <i>Buffalo Program Strategic RD&E Plan</i> (MacDonald et. al. 2021) aims to significantly reduce on-board mortality rates by 2025, adding an estimated \$1.15 million per annum to the trade via reduced losses and risk of trade restrictions and uncertainty. Combined with improved access to animals and markets the analysis assume the buffalo industry (28% of other livestock sector) could see greater value and exports leading to a 20% increase in value.
Feasibility	80%
	Continuation of current industry priorities.
Feasibility weighted impact	4.8%
Modelled growth by 2030-31	\$3.2M
Confidence rating	Medium
	Opportunities are well documented and already being pursued.
Recommended actions	<ul style="list-style-type: none"> Continue to review and negotiate improved market access licencing agreements with Indonesia. Implementation of the <i>Buffalo Program Strategic RD&E Plan</i> with focus on reduced on-board mortality rates. Explore opportunities to improve partnerships with Traditional Owners to sustainably manage country and share the economic dividends.
Sources	MacDonald et al. (2021); GHD (2022)

C-6-5 Breeding and genetic improvement

Many livestock industries in the NT have not introduced extensive breeding programs and are still largely utilising the unimproved genetics of wild populations. Targeting genetic improvement in the breeding of animal species can lead to significant yield and quality increases. Implementing advanced breeding of niche species can be challenging and time consuming, however genetic improvement is increasingly occurring in the buffalo, crocodile and camel industries. Wondu Business and Technology Services (2004) found that genetic improvement combined with and implementing livestock identification and traceability systems can have a major impact on productivity and end-market product values, including in the crocodile, camel and buffalo industries. Separately DPIR (2016) found that the breeding and genetic improvement (rather than wild harvest) would be necessary to develop a viable donkey industry in the NT.

Table 37 Breeding and genetic improvement

Opportunity	Breeding and genetic improvement
Impact	5.0%
	Assume an increase in productivity/animal traits could lead to an average 5% increase in end value across the sector.
Feasibility	50%
	Scope for existing breeding programs to expand in the buffalo, crocodile, and camel industries, where market opportunities exist. Most benefits will be realised in the longer-term (beyond 2030).
Feasibility weighted impact	2.5%
Modelled growth by 2030	\$1.7M
Confidence rating	Medium

Opportunity	Breeding and genetic improvement
	Potential benefits are reasonably well documented, however, the level of uptake and realised benefits by 2030-31 is difficult to estimate.
Recommended actions	<ul style="list-style-type: none"> Further research and extension to encourage the introduction of superior genetics and advanced breeding.
Sources	Wonda Business and Technology Services (2004); DPIR (2016)

C-7 Enhanced growth roadmap

The projected growth from industry-specific opportunities as well as cross-industry opportunities is summarised in Figure 14 below. Assuming the above value-add opportunities are implemented, the base case scenario would be a value of \$92 million realised by 2030-31.

Based on the confidence level applied to the value-add opportunities (as described in Table 3), the total upper limit is estimated to be \$98 million and the lower limit is \$86 million in 2030-31.

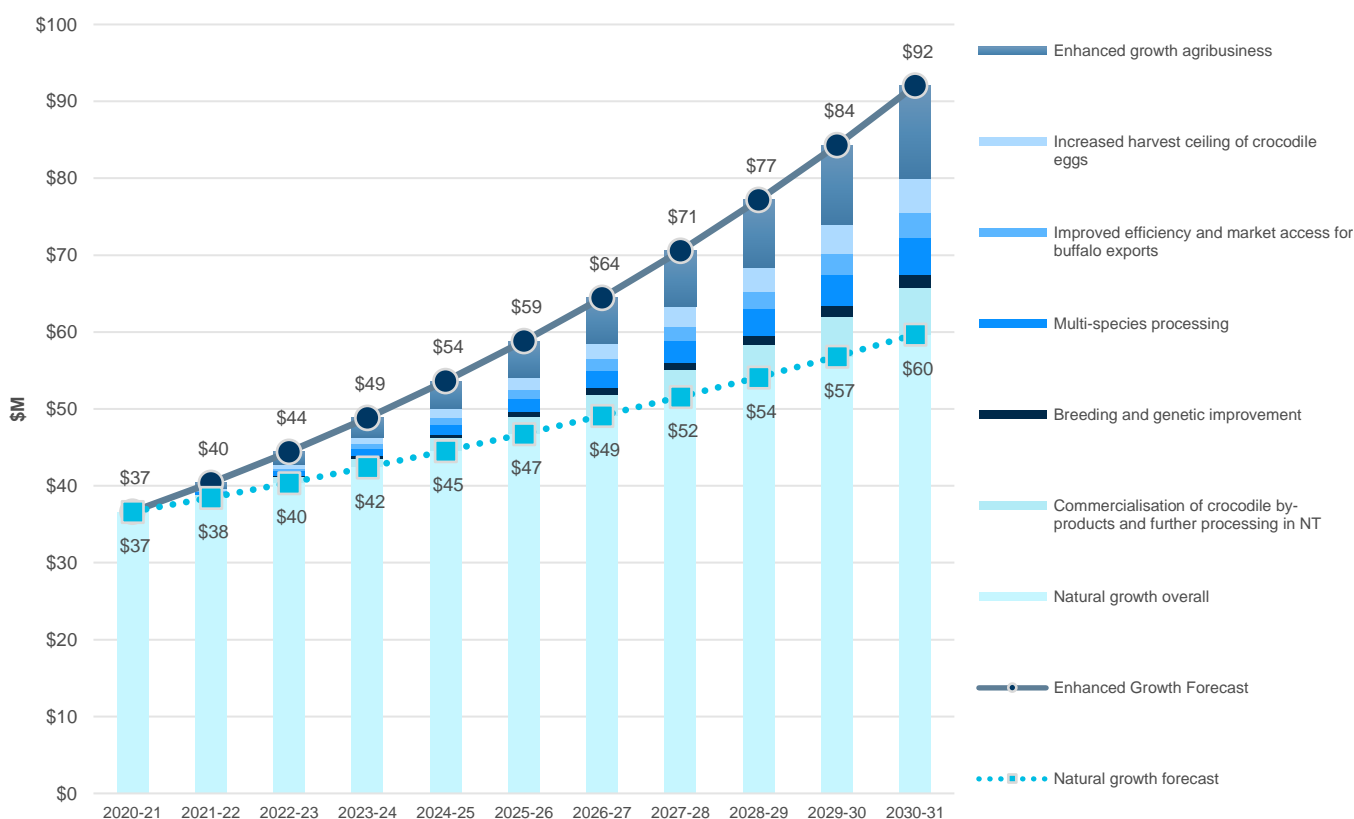


Figure 14 Potential other livestock industry growth including value adding opportunities

Source: GHD modelling results.

The analysis identified the following opportunities as having the highest overall impact on the value of NT livestock industry by 2030-31, presented in Table 38 below with the actions required to progress them.

Table 38 Highest value opportunities and recommended actions in NT other livestock industry

Rank	Opportunity	2030-31 Additional Value (\$M)	Recommended actions
1	Commercialisation of crocodile by-products and further processing in NT	\$6.1	Feasibility assessment to be carried out. Stakeholder partners to be contacted and collaborated within the crocodile and process value adding industry.
2	Multi-species processing	\$4.8	Explore opportunities with established abattoirs or greenfield developments.
3	Increased harvest ceiling of crocodile eggs	\$4.4	Regular modelling and review of the harvest ceiling.
4	Improved efficiency and market access for buffalo exports	\$3.2	Continue to review and negotiate improved market access licencing agreements with Indonesia. Implementation of <i>The Buffalo Program Strategic RD&E Plan</i> with focus on reduced on-board mortality rates. Explore opportunities to improve partnerships with Traditional Owners to sustainably manage country and share the economic dividends.
5	Breeding and genetic improvement	\$1.7	Further research and extension to encourage the introduction of superior genetics and advanced breeding.

Source: GHD modelling results.

Appendix D

Horticulture value-add opportunities

D-1 Industry overview

In 2020-21, the value of Territory Horticulture production was \$333.4 million and contributed an estimated 26.4% of the total value of Territory primary industry and seafood production (DITT, 2022). Mangoes (\$128 million), Melons (\$82 million) and Vegetables (\$80 million) are the highest value activities within Territory horticulture production. The Territory is well renowned for mango production and produces melons, vegetables, grapes, tropical fruit, ornamental plants, pastures and fodder crops. There are also value adding opportunities available on the back of increased investment and production in these sectors, which include food processing, livestock feed manufacturing, and transport and logistics.

Growth in demand for Australia’s horticultural produce is burgeoning in South-East Asia, China and the USA, presenting opportunities for future growers to enter the market.

D-2 Production systems and supply chains

Almost all production from Territory horticulture production is sent interstate for domestic consumption or to be exported.

Darwin is closely located to key supply chains and markets across Asia. As horticultural production increases, the cost of freight and transportation to these markets will likely reduce through economies of scale. For example, the Port of Darwin provides reduced transit times to key export nations across Southeast Asia, relative to that of Brisbane (it takes 10 days or more to travel from the Port of Brisbane to Singapore but only 4 to 7 days from the Port of Darwin (NT Farmers, 2020). This proximity to key markets, in conjunction with economies of scale, would enable Darwin to become a service hub for the NT and Australia.

CRCNA (2022a) completed supply chain mapping for the NT horticultural industries (Figure 15), and identified supply chain gaps which may be constraining industry development and exposure to a wider range of domestic and international markets. The analysis identified the following supply chain gaps (depending on the type of crops produced):

- Cold storage facility for transportation to domestic and international markets
- Canning and juicing facility, which are important products for international markets
- Controlled atmosphere container facility which is required to transport fresh product to international markets

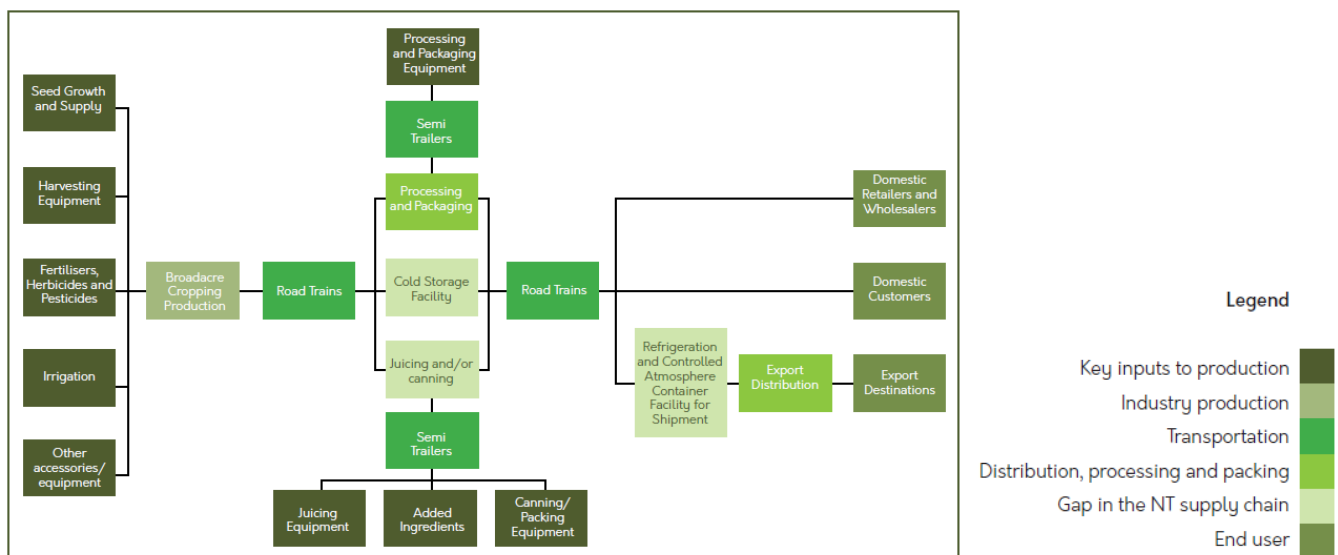


Figure 15 NT horticulture industry supply chain map

Source: CRCNA (2022a).

D-3 Previous studies into value adding opportunities

Value-adding opportunities for the horticultural industry applicable to the NT have been previously explored in the following studies:

- Value chain analysis of bush tomato and wattle seed production (Bryceson, 2008)
- Value adding options for tropical using jackfruit as a case study (Best, 2015)
- Factors influencing the growth of the floriculture industry in monsoonal tropics of NT (Gorman et al., 2015)
- Irrigated agricultural development in northern Australia: value-chain challenges (Ash et al., 2017)
- Capturing the ASEAN Agricultural Opportunity for Northern Australia (CRCNA, 2019a)
- High-density mango orchards: understanding the basics (CRCNA, 2019b)
- Evaluation of the potential to expand horticultural industries in Northern Australia (Cao et al., 2020)
- Old ways, new ways – scaling up from customary use of plant products to commercial harvest taking a multifunctional, landscape approach (Gorman, 2020)
- Northern Australia agribusiness supply chains: a review of the literature (Tremblay et al., 2020)
- Horticulture value-adding case study: (Peshafood, 2021)
- Transforming Mango futures (CRCNA, 2021)
- Upscaling and expanding horticulture in northern Australia (Cranney, 2021)
- Horticulture and grains: value-added opportunities for industry (CSIRO, 2021)
- Economic case study of intensive mango systems (Bennett & Dickinson, 2021)
- An Integrated Assessment of the Horticulture Sector in Northern Australia (Sangha et al., 2022)
- An evaluation of Northern Territory agriculture supply chains and export opportunities (CRCNA, 2022a)
- Strengthening Northern Australia’s horticultural sector through assessing protected cropping (CRCNA, 2022c).

D-4 Barriers and opportunities for growth

• The recently completed *Evaluation of Northern Territory agriculture supply chains and export opportunities* (CRCNA, 2022a), summarised the barriers and opportunities for NT horticultural industries in the following SWOT Analysis (Table 39) and the identified sector constraints, trends, priorities and opportunities.

Table 39 SWOT analysis (NT horticulture supply chain)

Strengths	Weaknesses
<ul style="list-style-type: none"> – Plant-based agricultural and horticultural crops in the NT have recently experienced high levels of growth. – Extensive commercial production already exists for a wide variety of crops. – Export market opportunities have increased in the last few years with Free Trade Agreements. 	<ul style="list-style-type: none"> – Intensive horticultural production involves high labour costs. – Transport costs per hectare of production are high for all crops. – Grading classes are developed to cater for domestic demand without considering international markets due to a lack of export standardisation within industries.
Opportunities	Threats
<ul style="list-style-type: none"> – A VHT treatment facility has been commissioned in Darwin and will facilitate the direct export of mangoes. – Development of irrigated agricultural land in the Western Davenport region. – Development of agricultural hubs/precincts with shared facilities to enable the growth of plant-based agriculture. 	<ul style="list-style-type: none"> – COVID-19 exacerbated the shortfalls in labour supply during peak production periods. – Bio-security incursions such as pests and pre-harvest and post-harvest diseases. – Increased geopolitical risks for exporting.

Source: CRCNA (2022a).

D-5 Historical and projected growth in value

In 2019-20, the value of production for the horticulture industry was \$306.1 million, which was a 21.8% increase from the 2018-19 value of production of \$251.2 million. Strong growth was also seen in the 2020-21 year to \$333.4 million. Considering less than 50% of farms in the NT are producing plant-based agricultural and horticultural crops, there is significant growth potential in the industry (NTFA, 2021).

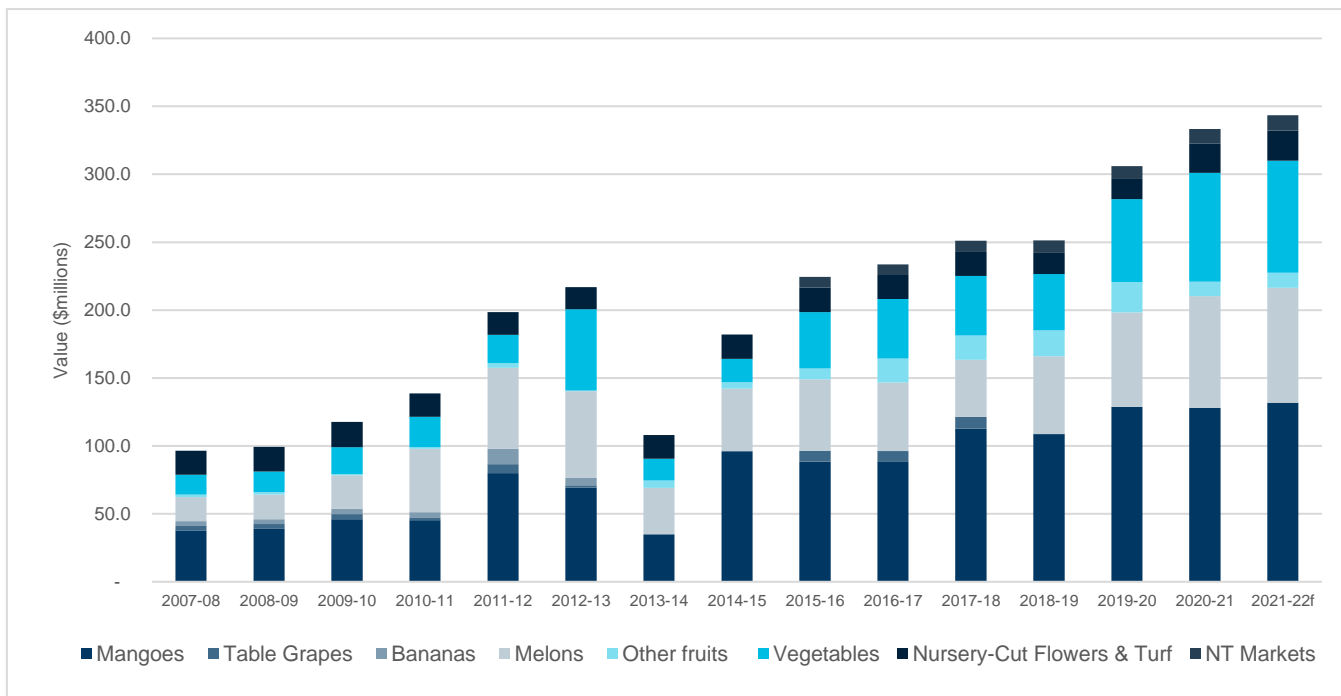


Figure 16 Distribution of value in horticulture sector

Source: GHD based on DITT (2022). (Note: 2021-22f: forecast).

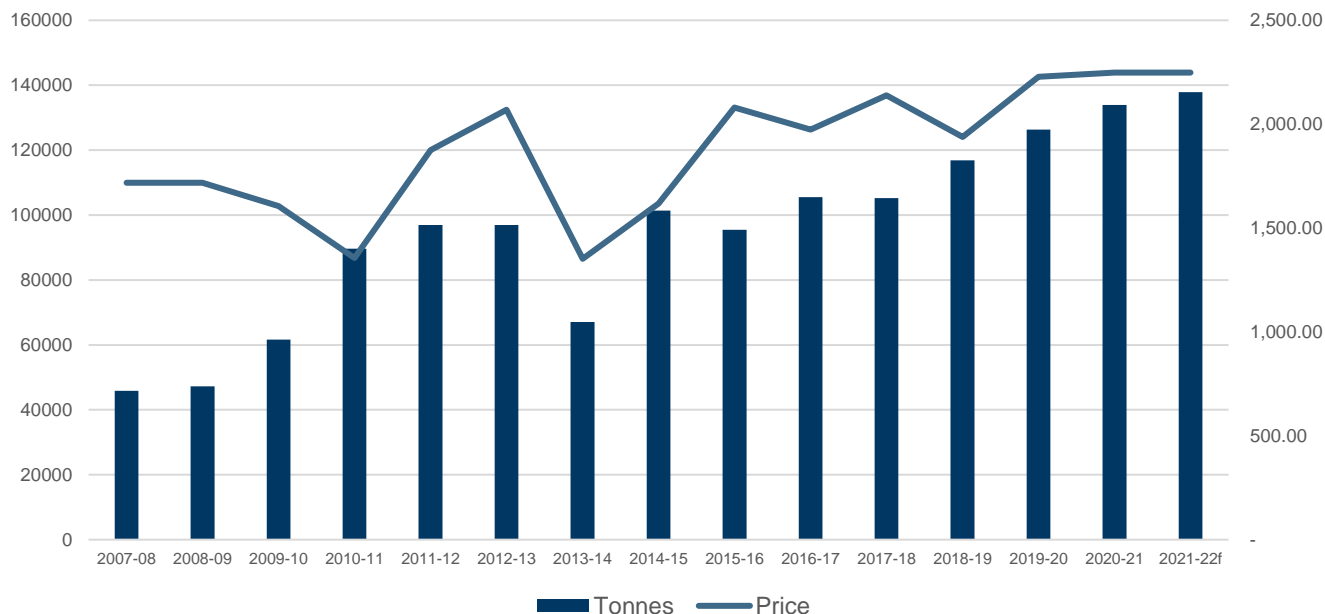


Figure 17 Growth in tonnes and price for horticultural produce

Source: GHD based on DITT (2022). (Note: 2021-22f: forecast).

NTFA (2020) forecast the NT plant-based agricultural and horticultural industry to surpass a GVP of \$1 billion per annum by 2030, assuming the industry's CAGR of 10.66% continues.

D-6 Value-add opportunities

Outlined below are the shortlisted opportunities which were assessed as most likely to add value to the NT horticulture sector. These opportunities were shortlisted following stakeholder consultation and literature review, before the likely impact and feasibility were estimated and modelled. Opportunities are presented in descending order based on the modelled impact on the value of NT agribusiness by 2030-31.

D-6-1 Adoption of intensive and high-density mango management systems

Bennett & Dickinson (2021) documented the economic benefits from the adoption of intensive and high-density mango management systems (e.g. trellised techniques). The potential advantages include yield increases, environmental suitability, efficient land use and better light utilisation. It is expected that new mango plantings and some existing plantings in the NT will likely adopt higher density systems with the opportunity to significantly lift production and margins.

Table 40 Adoption of intensive and high-density mango management systems

Opportunity	Adoption of intensive and high-density mango management systems
Impact	9.6% Mangoes represent approximately 40% of NT horticultural output and the NT accounts for around 55% of national mango production. A recent economic case study (CRCNA, 2021) suggests moving from conventional medium density production (408 trees per ha) to high density or trellis systems (1,188 – 1,242 trees per ha) can increase gross value of production per ha by 80-100% (and gross margins by 120-150%). This analysis assumes there is an opportunity to transition 30% of current mango production from medium to high density or trellis production within the next 10 years, lifting production on these areas by 80%.
Feasibility	80% Proven method and results for new plantings or replacing older plantings. NT mangoes proven to be competitive in domestic market with export opportunities also available.
Feasibility weighted impact	7.7%
Modelled growth by 2030-31	\$49M
Confidence rating	Medium Opportunity confirmed in literature and stakeholder engagement, however, some uncertainty around the level of uptake.
Recommended actions	<ul style="list-style-type: none"> Targeted R&D, grower extension and promotion to support uptake in new plantings. The adoption of higher density planting requires a higher level of investment during establishment and the initial 10 years; the higher investment is rapidly recouped by the higher revenues achieved by increased yield per hectare.
Sources	CRCNA (2019b); CRCNA (2021); Bennett & Dickinson (2021)

D-6-2 Access to superior genetics for commercial tropical fruit

The adoption of superior genetics is not widespread throughout NT horticulture produce due to licensing requirements, a lag period after planting and extension of completed research facing challenges. Many growers continue to produce from varieties which have been superseded and are therefore failing to capitalise on potential yield and quality benefits. It is expected that new plantings and some existing plantings in the NT will likely adopt superior genetics helping to generate additional value in the coming years.

Table 41 Access to superior genetics for commercial tropical fruit

Opportunity	Access to superior genetics for commercial tropical fruit
Impact	4.0%
	Tropical fruit represent approximately 40-45% of horticultural output, assumed opportunity to increase productivity by up to 10% with superior genetics.
Feasibility	90%
	Improved genetics method for lifting productivity and remaining competitive. Suitable for new plantings or replacing older plantings
Feasibility weighted impact	3.6%
Modelled growth by 2030-31	\$23M
Confidence rating	High
	Shown through trial programs to be an effective method to produce productivity gains
Recommended actions	<ul style="list-style-type: none"> Targeted R&D and grower extension and promotion to support uptake.
Sources	GHD (2022)

D-6-3 Establishment of horticultural processing facility

Currently, there is a significant amount of waste or downgraded products (2nd or 3rd grade produce) that is either wasted or underutilised. Opportunities exist to add value to this portion of production through processing. A processing facility has been proposed for the NT, with the opportunity to transform downgraded horticultural produce (and other produce) into juices, purees, dried fruit or other shelf stable products. The concept is currently being investigated by the Northern Australia Food Technology Innovation (NAFTI) and Top End Shelf-Stable Foods – Engineering and Design (TESSFED) projects being delivered by Charles Darwin University (CDU).

Table 42 Establishment of horticultural processing facility

Opportunity	Establishment of horticultural processing facility
Impact	7.0%
	Assume 70% of produce suitable for processing of which 20% is waste or downgraded. The processing of this waste would lead to a 50% of full value being realised.
Feasibility	50%
	There are significant challenges apparent to successful creation of a processing facility, however, the NAFTI and TESSFED projects are seeking to address some of these. This has been unsuccessfully trialled previously in the NT and northern Australia, through freezing and juicing processing plants. There is also concern that as genetics and plantation management improve across the NT, there will no longer be the supply of waste produce. However, the growing horticulture volume along with technology gains in processing could make it feasible.
Feasibility weighted impact	3.5%
Modelled growth by 2030-31	\$22M
Confidence rating	Medium
	The concept was discussed with multiple stakeholders identifying the key reasons why/why not it would be possible. A clearer understanding of the opportunities will be provided following the CDU/NAFTI Project is complete.
Recommended actions	<ul style="list-style-type: none"> R&D spending on innovative technologies and market research. Research into value adding and product development for jackfruit and other tropical fruits. Process engineering designs and costs required to develop an investment package. Development of a sustainable grower business model and strategic marketing plan. Education of food manufacturers, food services and consumers.
Sources	Best (2015); AFDJ (2021); CSIRO (2021); Cranney (2021); GHD (2022)

D-6-4 Adoption of protective cropping technologies

The use of shade and bird cloth protection for orchard crops has been successful in higher production (year-round cropping in some cases) and reduced losses. Strengthening horticultural sector through assessing protected cropping value chain linkages and pathways for adoption would require a development of a road map of potential technologies and associated agronomic practices to securely produce a wider range of 'demand-led' fresh produce, over a longer period and with greater efficiency in the management of resources.

Table 43 Adoption of protective cropping technologies

Opportunity	Adoption of protective cropping technologies
Impact	3.0%
	Currently vegetable production is 24% of total horticulture production. Assume 25% additional uptake in vegetable growers by 2030-31 lifting production by 50%.
Feasibility	60%
	Proven technology however some technical and practical challenges to overcome in NT environment. Outside investors will likely prioritise other locations for protective cropping developments.
Feasibility weighted impact	1.8%
Modelled growth by 2030-31	\$12M
Confidence rating	Low
	Techniques and benefits have not been widely tested in NT. There were varying stakeholder views on the feasibility.
Recommended actions	<ul style="list-style-type: none"> Further exploration of benefits and applicable uses within the NT horticultural industry.
Sources	CRCNA (2021); GHD (2022)

D-6-5 Improved phytosanitary treatment facilities for fruit exports

The lack of local phytosanitary facilities has been a major barrier to the expansion of export orientated horticultural industries in the NT. The recent development of a Vapour Heat Treatment (VHT) plant at the Pakfresh facility at Darwin Airport has provided direct access of produce (particularly mangoes) to the Asian markets. This facility increases the shelf life of products along with being necessary for export requirements. Additional, higher capacity facilities will likely need to be established to facilitate industry expansion.

Table 44 Improved phytosanitary treatment facilities for fruit exports

Opportunity	Improved phytosanitary treatment facilities for fruit exports
Impact	2.0%
	Potential to divert more produce to higher value export markets (e.g., direct exports to China, South Korea, Japan, Indonesia and the European Union), assume adding 10% premium to 20% of produce.
Feasibility	80%
	Existing VHT facility operational, with additional opportunities for extension or irradiation.
Feasibility weighted impact	1.6%
Modelled growth by 2030-31	\$10M
Confidence rating	Medium
	The key stakeholders, growers, and logistics, are already collaborating to produce this outcome
Recommended actions	<ul style="list-style-type: none"> Assessment of barriers to foreign markets and the role of treatment facilities.
Sources	GHD (2022)

D-6-6 Improved connection between Asian consumers and NT growers

Cao (2020) explored various opportunities to achieve better supply chain visibility, data sharing and decision making within high value horticultural trade between Northern Australian growers and Asian customers. The study identified a range of measures which could add value to the trade, including:

- Establishing a digital market and supply chain intelligence platform for small to medium growers
- Establishing an Export Development Decision Support System including knowledge hub
- Improved collaboration and planning of R&D to better meet market requirements.

Improvements in this area will allow local producers to access higher value export markets, better meet customers' needs, and avoid waste and supply chain oversupply and congestion.

Table 45 Improved connection between Asian consumers and NT growers

Opportunity	Improved connection between Asian consumers and NT growers
Impact	2.0%
	Opportunity for local horticultural production to better meet export customer requirements, assume 10% premium for 20% of produce.
Feasibility	60%
	Cao et al. (2020) provide specific recommendations and a pathway to delivery. However, the digital platforms remain a concept at this stage.
Feasibility weighted impact	1.2%
Modelled growth by 2030-31	\$7.7M
Confidence rating	Medium
	Documented benefits however uncertainty around the concept.
Recommended actions	<ul style="list-style-type: none"> • Establish a digital market and supply chain intelligence platform that is accessible to small and medium growers. • Establish an Export Development Decision Support System and Digital Export and Knowledge Hub. • Improved collaboration and planning of R&D to better meet market requirements.
Sources	CRCNA (2019a); Cao et al. (2020); CRCNA (2022a); Sangha et al. (2022)

D-7 Enhanced growth roadmap

The projected growth from industry-specific opportunities as well as cross-industry opportunities is summarised in Figure 18 below. Assuming the above value-add opportunities are implemented, the base case scenario would be a value of \$799 million realised by 2030-31.

Based on the confidence level applied to the value-add opportunities (as described in Table 3), the total upper limit is estimated to be \$835 million and the lower limit is \$763 million in 2030-31.

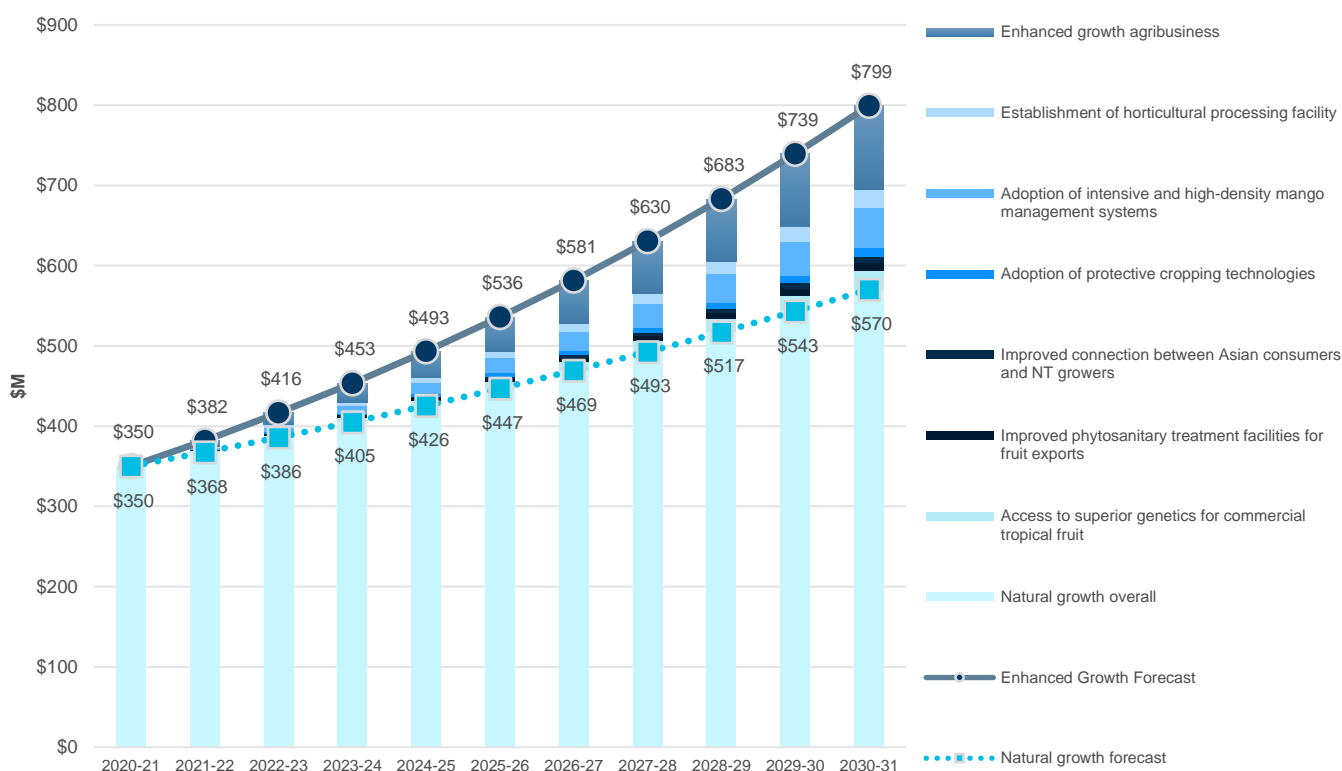


Figure 18 Potential horticulture industry growth including value adding opportunities

Source: GHD modelling results.

The analysis identified the following opportunities as having the highest overall impact on the value of NT horticultural industry by 2030-31, presented in Table 46 below with the actions required to progress them.

Table 46 Highest value opportunities and recommended actions in NT horticulture industry

Rank	Opportunity	2030-31 Additional Value (\$M)	Recommended actions
1	Adoption of intensive and high-density mango management systems	\$49	Targeted R&D, grower extension and promotion to support uptake in new plantings. The adoption of higher density planting densities requires a higher level of investment during establishment and the first 10 years; however, these are rapidly recouped by the higher revenues achieved by increased yield per hectare.
2	Access to superior genetics for commercial tropical fruit	\$23	Targeted R&D and grower extension and promotion to support uptake.
3	Establishment of horticultural processing facility	\$22	R&D spending on innovative technologies and market research. Research into value adding and product development for jackfruit and other tropical fruits. Process engineering designs and costs required to develop an investment package. Development of a sustainable grower business model and strategic marketing plan. Education of food manufacturers, food services and consumers.
4	Adoption of protective cropping technologies	\$12	Further exploration of benefits and applicable uses within the NT horticultural industry.

Rank	Opportunity	2030-31 Additional Value (\$M)	Recommended actions
5	Improved phytosanitary treatment facilities for fruit exports	\$10	Assessment of barriers to foreign markets and the role of treatment facilities
6	Improved connection between Asian consumers and NT growers	\$7.7	Establish a digital market and supply chain intelligence platform that is accessible to small and medium growers. Establish an Export Development Decision Support System and Digital Export and Knowledge Hub. Improved collaboration and planning of R&D to better meet market requirements.

Source: GHD modelling results.

Appendix E

Field Crop value-add opportunities

E-1 Industry overview

Historically, Territory mixed farming has included seed production, sorghum, maize and other crops, such as sesame and soybeans. The value of field crop production in 2020-21 was \$55.9 million, recording fast growth over the past three years from \$20.5 million in 2017-18.

The local hay industry plays an important role in supporting the pastoral industry and provides feed for the live export supply chain. In recent years, the industry has diversified its production to include sorghum, rice, maize, peanuts and pulses.

With the emergence of the cotton industry in the NT, field crops will play an essential role as a rotational crop in the industry. The sector is expected to continue to grow as land availability and regular seasonal rainfall attracts further investment and development to the Territory. Growers have reported significant yield increases thanks to local industry innovations and research.

E-2 Production systems and supply chains

Darwin is closely located to key supply chains and markets across Asia. As plant-based agricultural production increases, the cost of freight and transportation to these markets will likely reduce through economies of scale. For example, the Port of Darwin provides reduced transit times to key export nations across Southeast Asia, relative to that of Brisbane (it takes 10 days or more to travel from the Port of Brisbane to Singapore but only 4 to 7 days from the Port of Darwin (NTFA, 2020). This proximity to key markets, in conjunction with economies of scale, would enable Darwin to become a service hub for the NT and Australia.

The development of agricultural precincts will provide extensive cost savings to plant-based agricultural and horticultural producers. These cost savings are borne from the proximity to key markets and reduced logistics expenses. For example, cotton growers will no longer be required to send their agricultural product to the Queensland based cotton gin, ultimately increasing their farm gate returns.

CRCNA (2022a) completed supply chain mapping for the NT broadacre and cotton industries (respectively) and identified supply chain gaps which may be constraining industry development and exposure to a wider range of domestic and international markets (Figure 19). The analysis did not identify any gaps in the broadacre cropping supply chain, however for cotton, the lack of a local cotton gin was identified as a key gap requiring product to be transported interstate for ginning and distribution to end users.

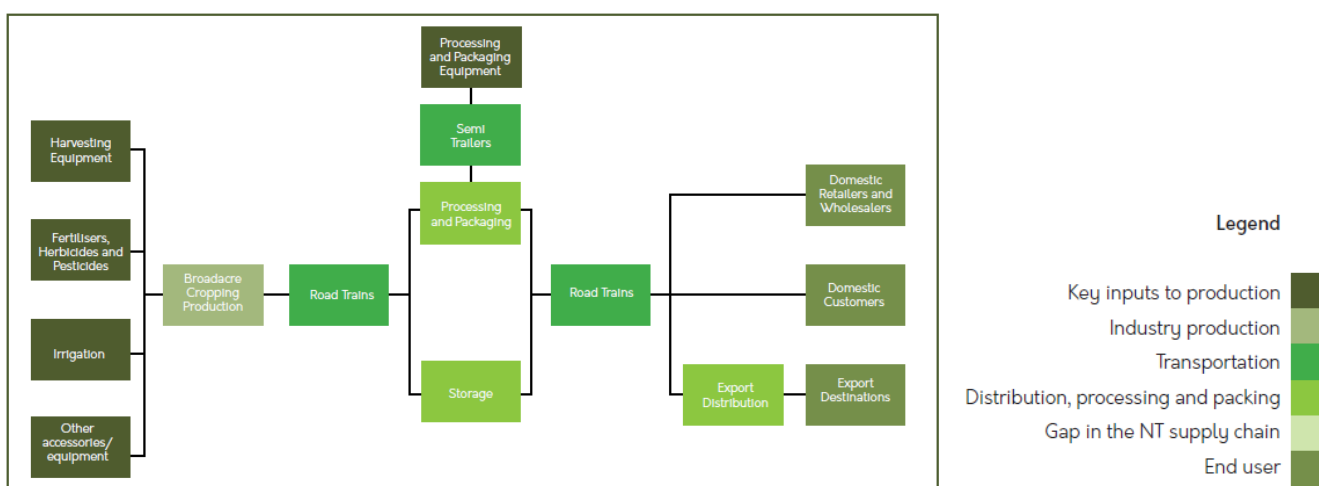


Figure 19 NT field crop industry supply chain map

Source: CRCNA (2022a).

E-3 Previous studies into value adding opportunities

Value-adding opportunities for the NT field cropping industries have been previously explored in the following studies:

- Irrigated agricultural development in northern Australia: value-chain challenges (Ash et al., 2017)
- Business Case for the Construction of a Cotton Gin in NT (PwC, 2019)
- Northern Australian broadacre cropping situational analysis (CRCNA, 2020)
- NT Plant Industries Economic Impact Analysis (NT Farmers, 2020)
- A situational analysis for developing a rice industry in Northern Australia (Chapman et al., 2020)
- An evaluation of NT agriculture supply chains and export opportunities (CRCNA, 2022a)
- Spicing up Northern Australia with high value condiment crops (CRCNA, 2022b).
- Developing a northern Australia industrial hemp industry value chain (Kumar & Telfer, 2022).

E-4 Barriers and opportunities for growth

- The recently completed *Evaluation of Northern Territory agriculture supply chains and export opportunities* (CRCNA, 2022a), summarised the barriers and opportunities for NT broadacre and cropping industries in the following SWOT Analysis (Table 47) and the identified sector constraints, trends, priorities and opportunities.

Table 47 SWOT analysis (NT broadacre and cotton supply chains)

Strengths	Weaknesses
<p>Broadacre</p> <ul style="list-style-type: none"> – Broadacre agricultural production in the NT since the 1820s. – Global demand for food and fibre products is expected to increase significantly in the future. – Expected increase in global grain prices. – Australia is leading the way in best practice management of broadacre crops. <p>Cotton</p> <ul style="list-style-type: none"> – Successful cotton trials have resulted in growers expanding in the NT. – Australian cotton has a global reputation as an industry leader. – Well established Australian irrigated cotton production and emerging dryland production. – 90% of the cotton produced in Australia is exported. 	<p>Broadacre</p> <ul style="list-style-type: none"> – NT broadacre cropping is currently very limited. – Limitations of food grade transport containers for sea freight. – Lack of processing and storage facilities. – Limited water access and supply. – Tropical climate provides challenges for some crops. <p>Cotton</p> <ul style="list-style-type: none"> – Remote geographical locations of cotton farms. – High freight costs. – Lack of water for farming expansions. – High capital requirements for investment in the cotton industry. – Cotton gins must be regionally located for commercial production viability.
Opportunities	Threats
<p>Broadacre</p> <ul style="list-style-type: none"> – Potential for increased Australian production to replace imports. – Expansion in the Western Davenport region. – Potential of niche products cropped for the domestic market. – Opportunities to grow summer field crops during mild tropical winters of the NT. – Development of rotational cropping. <p>Cotton</p> <ul style="list-style-type: none"> – Development of new processing facilities. – Production of cottonseed as a feed source for cattle. – Export out of the Port of Darwin could significantly reduce road freight costs. – Opportunity to develop rotational crops to boost productivity and longevity. 	<p>Broadacre</p> <ul style="list-style-type: none"> – Lack of the sufficient processing facilities that are needed to encourage investment. – Biosecurity and diseases. – Social licence to operate is required to successfully implement large-scale production. <p>Cotton</p> <ul style="list-style-type: none"> – Difficulties in finding and maintaining qualified workforce. – Must ensure water and land development are synchronised. – Must ensure enabling infrastructure is able to support development. – Storage is a key issue for setting up cotton exports out of the Port of Darwin.

Source: CRCNA (2022a).

E-5 Historical and projected growth in value

The development and expansion of the NT plant-based agricultural and horticultural industry will provide many downstream benefits. The NT plant-based agricultural and horticultural industry is forecast to surpass a GVP of \$1 billion per annum by 2030, assuming the industry’s CAGR of 10.66% continues. This direct GVP of the industry will initiate a downstream and flow-on economic effect in the NT, injecting an additional \$530 million into the region’s economy each year. As a result, the total economic benefit derived from the NT plant-based agricultural and horticultural industry is forecast to surpass \$1.5 billion by 2030 (NT Farmers, 2020).

The NT plant based agricultural and horticultural industry will also catalyse full-time equivalent (FTE) employment across the region. By 2030, the industry is forecast to employ over 3,500 FTEs. This employment is forecast to facilitate the creation of an additional 1,803 FTE roles in the NT. The number of FTE roles supported by the horticultural industry, both directly and indirectly, will exceed 5,300 by 2030. This, coupled with the forecast economic contribution of \$1.5 billion p.a., confirms the vast potential associated with the NT plant-based agricultural and horticultural industry (NT Farmers, 2020).

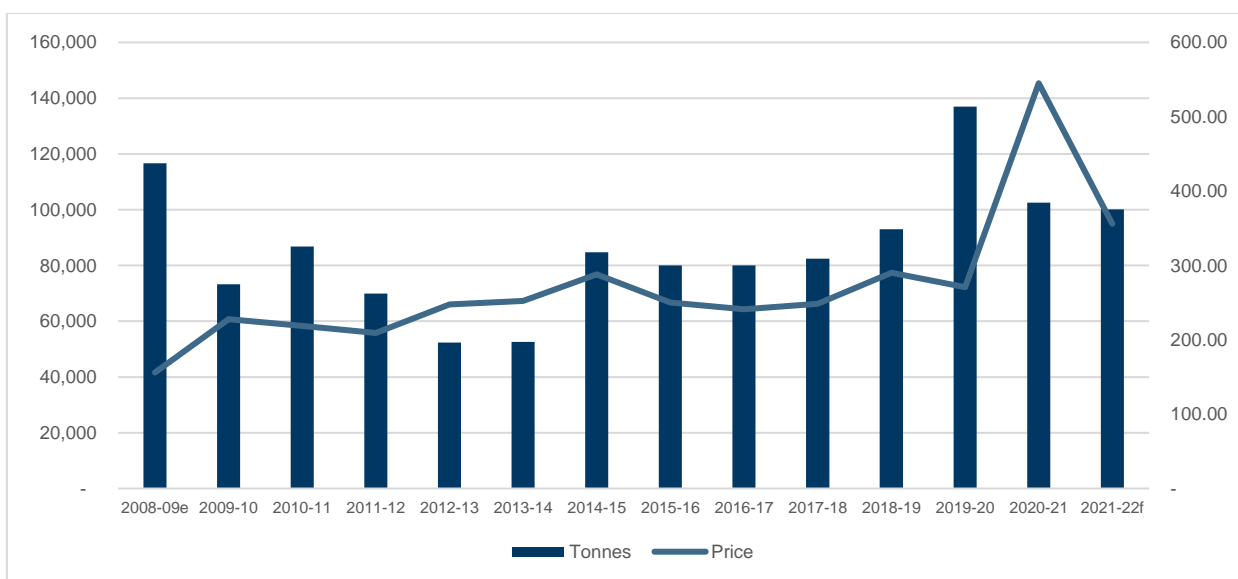


Figure 20 Field crops; breakdown of growth in tonnes and price

Source: GHD based on DITT (2022). (Note: 2021-22f: forecast).

E-6 Value-add opportunities

Outlined below are the shortlisted opportunities which were assessed as most likely to add value to the NT field cropping sector. These opportunities were shortlisted following stakeholder consultation and literature review, before the likely impact and feasibility were estimated and modelled. Opportunities are presented in descending order based on the modelled impact on the value of NT agribusiness by 2030-31.

E-6-1 Expansion of cotton production and local ginning

The viability of cotton production in the NT has been well demonstrated with regular seasonal rainfall allowing for the production of predominately rain-fed cotton. However, the development of the industry has been constrained by the lack of local ginning capacity, requiring harvested cotton to be transported to Queensland facilities at a cost between \$100 and \$200 per bale, which significantly cuts into profitability and sustainability (PwC, 2019). Interstate ginning not only imposes costs on local producers but also prevents local livestock producers from accessing cottonseed as a valuable stock feed. A new gin in Katherine is currently nearing completion with initial capacity of 140,000 bales per annum, and ability to increase to 190,000 bales per annum. There is also investor interest in developing a nearby cotton spinning mill, which could potentially add additional value to cotton output from the gin. Energy affordability is considered the main barrier to this development.

Table 48 Expansion of cotton production and local ginning

Opportunity	Expansion of cotton production and local ginning
Impact	130.0%
	The analysis assumes the new gin in Katherine will reach full capacity (190,000 bales) by 2030, purchasing locally produced cotton for \$627/bale (Revell et al. 2022), generating around \$119 million in annual value. At this capacity the gin will produce around 60,000 tonnes of cottonseed suitable for supplementary feeding of cattle (1-2 kg/head/day). This analysis has considered the value of cottonseed supplied to NT cattle producers to be included in the price per bale paid at the gin, which includes approximately \$70/bale for cottonseed content.
Feasibility	95%
	The new gin in Katherine is nearing completion and considered likely to reach full capacity by 2030.
Feasibility weighted impact	123.5%
Modelled growth by 2030-31	\$139
Confidence rating	Medium
	The opportunity and benefits are well documented.
Recommended actions	<ul style="list-style-type: none"> Undertake the necessary planning for increased production, including attracting R&D, supporting services (machinery, chemicals, fertiliser, agronomy, irrigation, transport), and facilitating changes in land-use, transport demands and supply of water and utilities. Continue to explore the feasibility of establishing a cotton spinning plant, including overcoming energy affordability challenges.
Sources	Ash et al. (2017); PwC (2019); CRCNA (2020); CRCNA (2022a); GHD (2022); (Revell et al., 2022)

E-6-2 Development of complementary crop rotations and production techniques

Broadacre farmers can significantly increase the value of production from their land by adopting the optimal rotation for their local conditions. The right rotation will maximise yields, while conserving moisture, fixing nitrogen and suppressing weeds and pathogens. The NT field cropping sector is in its relative infancy and many growers are still experimenting with different crop rotations, timings of activities and inputs. NT Farmers (2020) cited opportunities for rotational cropping of sorghum, rice, legumes, maize, and other high value crops, while CRCNA (2022a) cited opportunities for producers to potentially grow crops in both the wet and dry seasons under irrigation, significantly increasing returns. There are also emerging opportunities for carbon neutral/positive crop production techniques, attracting price premiums, incentives and investment.

Table 49 Development of complementary crop rotations and production techniques

Opportunity	Development of complementary crop rotations and production techniques
Impact	20.0%
	Assume more optimal crop rotation and production techniques could yield 20% increase in value through higher production and more optimal inputs and techniques, including year wet and dry season production in some irrigated areas.
Feasibility	60%
	Realisation of benefits will require research, development and extension (R,D&E) and grower uptake.
Feasibility weighted impact	12.0%
Modelled growth by 2030-31	\$14M

Opportunity	Development of complementary crop rotations and production techniques
Confidence rating	Medium
	The success in other parts of Australia along with stakeholder engagement support the potential for this value-add.
Recommended actions	<ul style="list-style-type: none"> Further R,D&E to define optimal crop rotations and techniques for irrigated and dryland conditions.
Sources	NT Farmers (2020); CRCNA (2020); CRCNA (2022a)

E-6-3 Establishment of producer owned processing and marketing co-operatives

Forming a co-operative can be an effective way for a group of producers to establish market power and build industry capacity and supply chains. Cooperatives can be most effective for producers in smaller industries or more isolated growing regions which would otherwise have difficulty attracting outside private investment into supply chains and services. Producer co-operatives may become involved in supplying inputs.

Table 50 Establishment of producer owned processing and marketing co-operatives

Opportunity	Establishment of producer owned processing and marketing co-operatives
Impact	7.0%
	Assume 5% profit margin on chemical and fertiliser inputs is returned to members and 5% premium on price paid. These assumptions applied to Northern Australia rainfed cotton gross margins (Revell et. al., 2022) increase gross margins by 7%.
Feasibility	60%
	Producer owned cooperatives often fail and they can be challenging to establish without guaranteed benefits to members.
Feasibility weighted impact	4.2%
Modelled growth by 2030-31	\$4.7M
Confidence rating	Medium
	The case studies show potential however it was not flagged as an opportunity by stakeholders. It would require focus by a producer group to be successful.
Recommended actions	<ul style="list-style-type: none"> R&D funding to understand the key markets, supply/value chains, storage and handling capacities and requirements in NT.
Sources	CRCNA (2020); Revell et al. (2022)

E-6-4 Commercialisation and adoption of suitable wild rice varieties

Northern Australia has several advantages for rice production, including suitable production temperature, water and land availability, and suitability for growing higher-value aromatic varieties as well as access to various native rice species. The NT presents several locations with promise for commercial rice growing (Tortilla Flats on the Adelaide River, Katherine and the coastal plains) with the major markets being export market for Papua New Guinea. Fogg Dam on the Adelaide River flood path in the NT could present a suitable site for wild harvest rice which grows in abundance and can meet increasing demand. However, there are also a number of challenges which to date have restricted the development of a rice industry in Northern Australia, including difficulty negotiating approval processes, development of appropriate varieties, and market access. Past efforts at growing rice in the NT have failed due to a lack of established markets, resulting in product being supplied as lower value livestock feed. Wild rice offers potential economic opportunities for Aboriginal communities, supplying niche, high value markets. However, care needs to be taken when commercialising wild rice varieties to ensure provenance is protected and traditional owners are able to control their IP and share in the economic opportunities.

Table 51 Commercialisation and adoption of suitable wild rice varieties

Opportunity	Commercialisation of adoption and suitable wild rice varieties
Impact	50.0%
	Chapman et al. (2020) suggest opportunity for annual production of 100,000 tonnes with conservative value of \$750 per tonne.
Feasibility	5%
	Several past efforts to develop a northern Australian rice industry have failed, and a range of challenges would need to overcome (including approvals, supply chain infrastructure, and variety development).
Feasibility weighted impact	2.5%
Modelled growth by 2030-31	\$2.8M
Confidence rating	Medium
	Strong literature research showing potential, however stakeholders raised a range of challenges to development.
Recommended actions	<ul style="list-style-type: none"> Chapman et al. (2020) outlined 10 recommendations to develop the industry including developing a tropical rice breeding and varietal development program as well as communication, education and outreach.
Sources	Chapman et al. (2020)

E-6-5 Validation of research findings and updating crop and climate models with actual dryland crop production data in NT

Comparison of actual data with modelled expectations and adjustment of the underlying assumptions is important to accurately determine the actual potential of broadacre cropping. There is potential to increase the understanding of broadacre cropping opportunities through further modelling and validation of dryland crop production data. This greater understanding could lead to a change of use in land from low value activities (grazing) to high value (cropping). This opportunity was highlighted in CRCNA (2020).

Table 52 Validation of research findings and updating crop and climate models with actual dryland crop production data

Opportunity	Validation of research findings and updating crop and climate models with actual dryland crop production data in NT
Impact	3.0%
	Minor improvement in production value through better understanding of broadacre cropping opportunities in the NT, more optimal crop choices and reduced risks.
Feasibility	60%
	Research and models relatively easy to validate and update, however more challenging to achieve producer uptake.
Feasibility weighted impact	1.8%
Modelled growth by 2030-31	\$2.0M
Confidence rating	Medium
	Well defined opportunity and benefits, however difficult to estimate the scale of land use change that would be triggered.
Recommended actions	<ul style="list-style-type: none"> Validation of dryland crop production and small-scale trials in commercial settings (rotation options in various farming systems). Commercial production data needs to be generated and accessed to validate and update previous modelling predictions as well as providing feedback on how current, small-scale trial results are best implemented into commercial farming business operations to maximise profit and sustainability.
Sources	CRCNA (2020)

E-6-6 Establishment of industrial hemp and processing facilities

A recent study into the potential for hemp production in Northern Australia (Kumar & Telfer, 2022) found potential for the development of multiple value chains for industrial hemp products including seeds/grain, fibre, hempcrete and livestock forage. The study estimated a theoretical gross margin of between \$7,049 and \$3,869 per ha depending on the value chain. It is also suggested that cotton-hemp rotation may be beneficial in northern Australia, helping to suppress weeds and disease, conserve moisture and lower soil temperatures particularly when cotton is sown into hemp stubble. Industrial hemp production also provides opportunities for carbon neutral/positive farming, with carbon sequestration during plant growth, and carbon storage in the form of durable products.

Constraints and challenges to industry growth include:

- A limited number of certified quality varieties specially selected and bred for Australia's tropical north growing conditions
- Lack of documented best practice for production and post-harvest handling
- Lack of local supply chain infrastructure (e.g. driers, cleaners and cool rooms).

Table 53 Establishment of industrial hemp and processing facilities

Opportunity	Establishment of industrial hemp and processing facilities
Impact	2.5%
	Assume the introduction of hemp production and processing could replace lower value fodder crops, adding 25% value to 10% of crop area.
Feasibility	10%
	Requires feasibility analysis and capital investment to succeed.
Feasibility weighted impact	0.3%
Modelled growth by 2030-31	\$0.3M
Confidence rating	Medium
	Opportunities are documented and quantified, however uncertainty around the feasibility and likelihood of success.
Recommended actions	<ul style="list-style-type: none"> • Development of a best practice material. • Promotion of investment opportunities, in particular for post-harvest supply chain. • Market research into local opportunities for novel products.
Sources	Kumar & Telfer (2022); GHD (2022)

E-7 Enhanced growth roadmap

The projected growth from industry-specific opportunities as well as cross-industry opportunities is summarised in Figure 21 below. Assuming the above value-add opportunities are implemented, the base case scenario would be a value of \$297 million realised by 2030-31.

Based on the confidence level applied to the value-add opportunities (as described in Table 3), the total upper limit is estimated to be \$346 million and the lower limit is \$248 million in 2030-31.

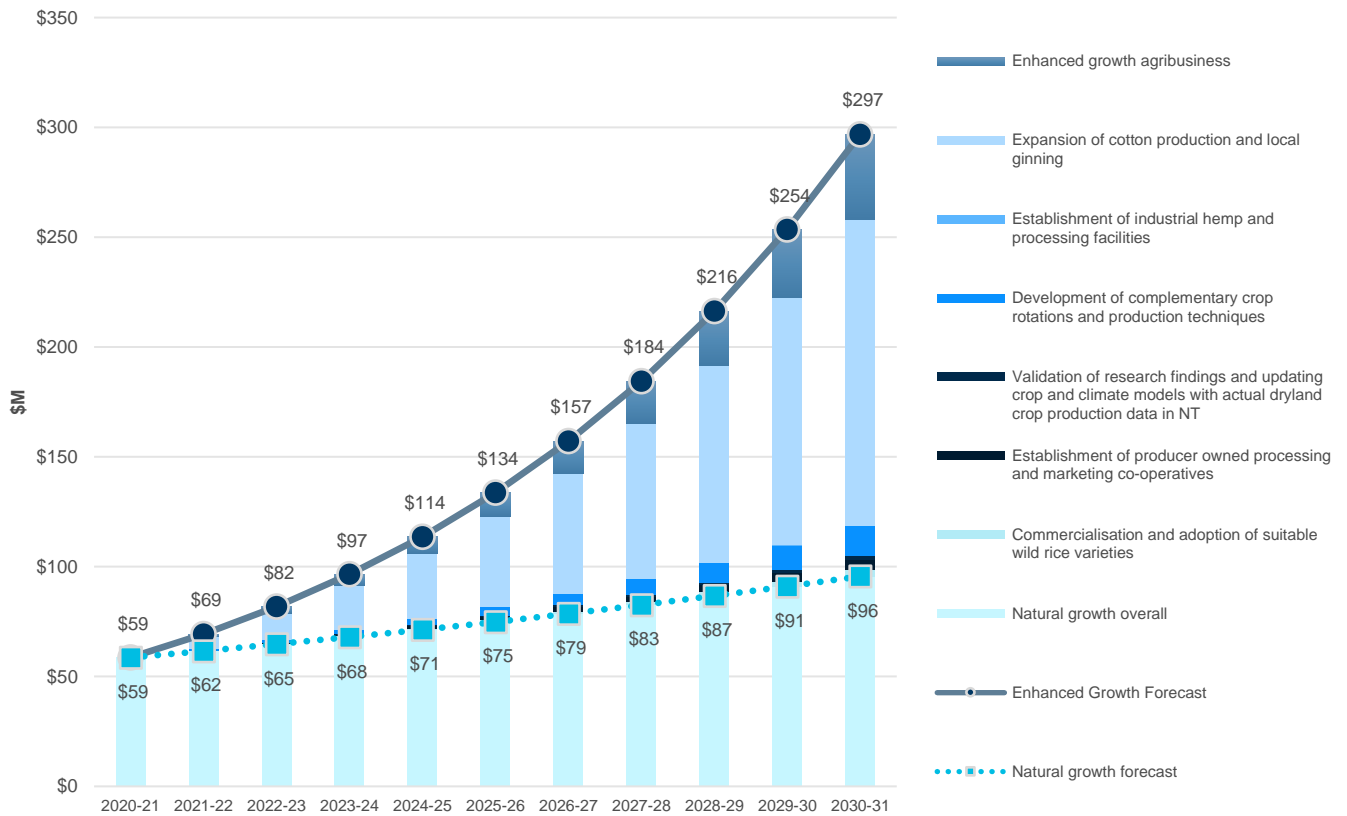


Figure 21 Potential field crop industry growth including value adding opportunities

Source: GHD modelling results.

The analysis identified the following opportunities as having the highest overall impact on the value of NT field cropping industry by 2030-31, presented in Table 54 below with the actions required to progress them.

Table 54 Highest value opportunities and recommended actions in NT field crop industry

Rank	Opportunity	2030-31 Additional Value (\$M)	Recommended actions
1	Expansion of cotton production and local ginning	\$139	Undertake the necessary planning for increased production, including attracting R&D, supporting services (machinery, chemicals, fertiliser, agronomy, irrigation, transport), and facilitating changes in land-use, transport demands and supply of water and utilities. Continue to explore the feasibility of establishing a cotton spinning plant, including overcoming energy affordability challenges.
2	Development of complementary crop rotations and production techniques	\$14	Further R,D&E to define optimal crop rotations and techniques for irrigated and dryland conditions.
3	Establishment of producer owned processing and marketing cooperatives	\$4.7	R&D funding to understand the key markets, supply/value chains, storage and handling capacities and requirements in NT.
4	Commercialisation and adoption of suitable wild rice varieties	\$2.8	Chapman et al. (2020) outlined 10 recommendations to develop the industry including developing a tropical rice breeding and varietal development program as well as communication, education and outreach.

Rank	Opportunity	2030-31 Additional Value (\$M)	Recommended actions
5	Validation of research findings and updating crop and climate models with actual dryland crop production data in NT	\$2.0	Validation of dryland crop production and small-scale trials in commercial settings (rotation options in various farming systems). Commercial production data needs to be generated and accessed to validate and update previous modelling predictions as well as providing feedback on how current, small-scale trial results are best implemented into commercial farming business operations to maximise profit and sustainability.
6	Establishment of industrial hemp processing facilities	\$0.3	Development of a best practice material. Promotion of investment opportunities, in particular for post-harvest supply chain. Market research into local opportunities for novel products.

Source: GHD modelling results.

Appendix F

Seafood value-add opportunities

F-1 Industry overview

In 2020-2021, the value of Territory seafood production was \$145 million and contributed an estimated 11.5% of the total value of Territory primary industry and seafood production value (DITT, 2022). Aquaculture (\$53 million), Northern Prawn Fleet crustaceans (\$47 million) and Fish (wild stock catch – \$39 million) are the highest value activities within Territory seafood production. As of April 2021, the commercial fishing industry had 227 commercial fishing and aquaculture licences (209 fishing, 18 aquaculture), 147 registered fishing vessels and harvested over 5,500 tonnes of fish and marine life each year. There was commercial activity in 14 different wild harvest fisheries.

Crustacean production in the NT is dominated by prawns and mud crabs. Fish production largely comprises snapper, barramundi and mackerel. Aquaculture in the NT is primarily related to pearls and barramundi, with a small contribution from aquarium fish and spirulina production. The Northern Prawn Fisheries produces four common commercial species of prawns including white banana prawns, tiger prawns, eastern king prawns and endeavour prawns.

A report by the Fisheries Research and Development Corporation and the Institute for Marine and Antarctic Studies in 2019 found that the NT seafood Industry directly employs 941 people (FTE) and 166 people (FTE) indirectly throughout the rest of Australia.

F-2 Production systems and supply chains

Most Territory seafood is transported interstate (to be either exported or consumed domestically) – significant value not being captured in the NT – potential for value-add processing of seafood in the NT (KPMG, 2020b).

CRCNA (2022a) completed supply chain mapping for the NT aquaculture and fisheries (Figure 22) and identified supply chain gaps which may be constraining industry development and exposure to a wider range of domestic and international markets. The analysis identified the following supply chain gaps:

- Major food retailers require testing of all fish products by the NATA in an approved laboratory, and none are present in the NT.
- The absence of a frozen container facility in Darwin requires product to be transported interstate before shipment to export markets.

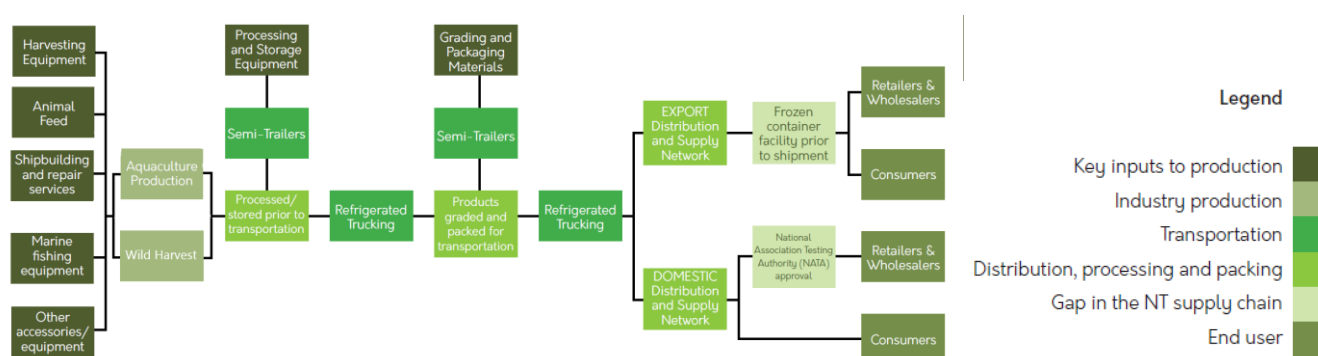


Figure 22 NT seafood industry supply chain map

Source: GHD based on CRCNA (2022a).

F-3 Previous studies into value adding opportunities

Value-adding opportunities for the NT seafood industries have been previously explored in the following studies:

- Marine oils from Australian fish: characterisation and value-added products (Nichols et al., 1997)
- The handling and value adding of farmed Barramundi (Ruello, 1997)

- A pilot investigation of northern Australian shark liver oils: characterisation and value-adding (Nichols et al., 2001)
- Agricultural trials of a fish-based fertiliser produced from seafood processing wastes (Surapaneni, 2007)
- NT Fisheries Infrastructure: Identifying infrastructure needs that underpin growth of the NT seafood industry in the next 10 years (Saunders, 2019)
- Northern Australia aquaculture situational analysis (Cobcroft et al., 2020)
- Scoping study of Darwin Seafood Processing facility (KPMG, 2020a)
- Northern Territory Seafood Council Export Strategy (KPMG, 2020b)
- Northern Australia agribusiness supply chains: a review of the literature (Tremblay et al., 2020)
- An evaluation of Northern Territory agriculture supply chains and export opportunities (CRCNA, 2022a)
- Future-proofing the NA aquaculture industry need for skilled staff to 2050 (Nankervis et al., 2022).

F-4 Barriers and opportunities for growth

- The recently completed *Evaluation of Northern Territory agriculture supply chains and export opportunities* (CRCNA, 2022a), summarised the barriers and opportunities for NT seafood in the following SWOT Analysis (Table 55) and the identified sector constraints, trends, priorities and opportunities.

Table 55 SWOT analysis (NT seafood supply chain)

Strengths	Weaknesses
<ul style="list-style-type: none"> – Northern Australian aquaculture production has increased steadily in the last decade – Strong government support for the aquaculture industry – Advantageous environment for niche aquaculture opportunities 	<ul style="list-style-type: none"> – Minimal seafood export from the NT – Persistent supply chain limitations – Processing and exporting largely occurs in eastern states – Limited research and development – Connectivity and telecommunications access
Opportunities	Threats
<ul style="list-style-type: none"> – Growing domestic and global demand for alternative protein sources – Growing domestic demand for sustainable wild harvest produce – Potential for small-scale inshore Indigenous fisheries businesses – Potential for the NT processing facilities and utilising new Darwin cold storage facilities 	<ul style="list-style-type: none"> – Portion of local communities opposed to the seafood industry – Declining number of experienced skippers – Competition for road freight during other agricultural seasons – Lack of sufficient inputs for future aquaculture projects – Unique challenges with tenure and the access

Source: CRCNA (2022a).

F-5 Historical and projected growth in value

The aquaculture industry has been the most significant growth area for this sector recently. It has surpassed the value of fin fish and the overall crustacean value. This is shown in Table 56 and Figure 23 below. Some key recent developments should also be noted as creating greater projected growth including:

- The Territory Government is delivering a significant upgrade, costing \$20 million, of the Frances Bay Mooring Basin lock with work onsite underway in 2023 (DIPL, 2023). This will provide an improved facility for the commercial fishing and other seafood industries.
- Identification of key infrastructure needs through the 2019 report *NT Fisheries Infrastructure: Identifying infrastructure needs that underpin growth of the NT seafood industry in the next 10 years* (Saunders, 2019). This report was co-funded by the NTSC and NT government.

- Grants and financing accessed by NT seafood producers. For example, Austral Fisheries received a significant grant, \$9.6 million, in 2022 from the Northern Australia Development Program – Industry Transformation Stream intended to support Austral’s intended \$65 million into expanding its NT FinFish operations (Austral Fisheries, 2022).
- The Territory Government’s Local Jobs Fund provided a \$2 million business concessional loan to assist Headland Food Group Pty Ltd with the expansion of its commercial fishing operations, and to establish a seafood processing facility in Darwin. It is expected to create 22 local jobs (Invest NT, 2022).
- Development of strategic partnership in the seafood sector. In December 2022, Barramundi Group Ltd entered into a strategic partnership with Wild Ocean Australia Pty Ltd which would allow for significant expansion of current operational capacity in the region across 13 seawater sites and ultimately allow the sustainable production of up to 30,000 tonnes annually (Barramundi Group, 2022).

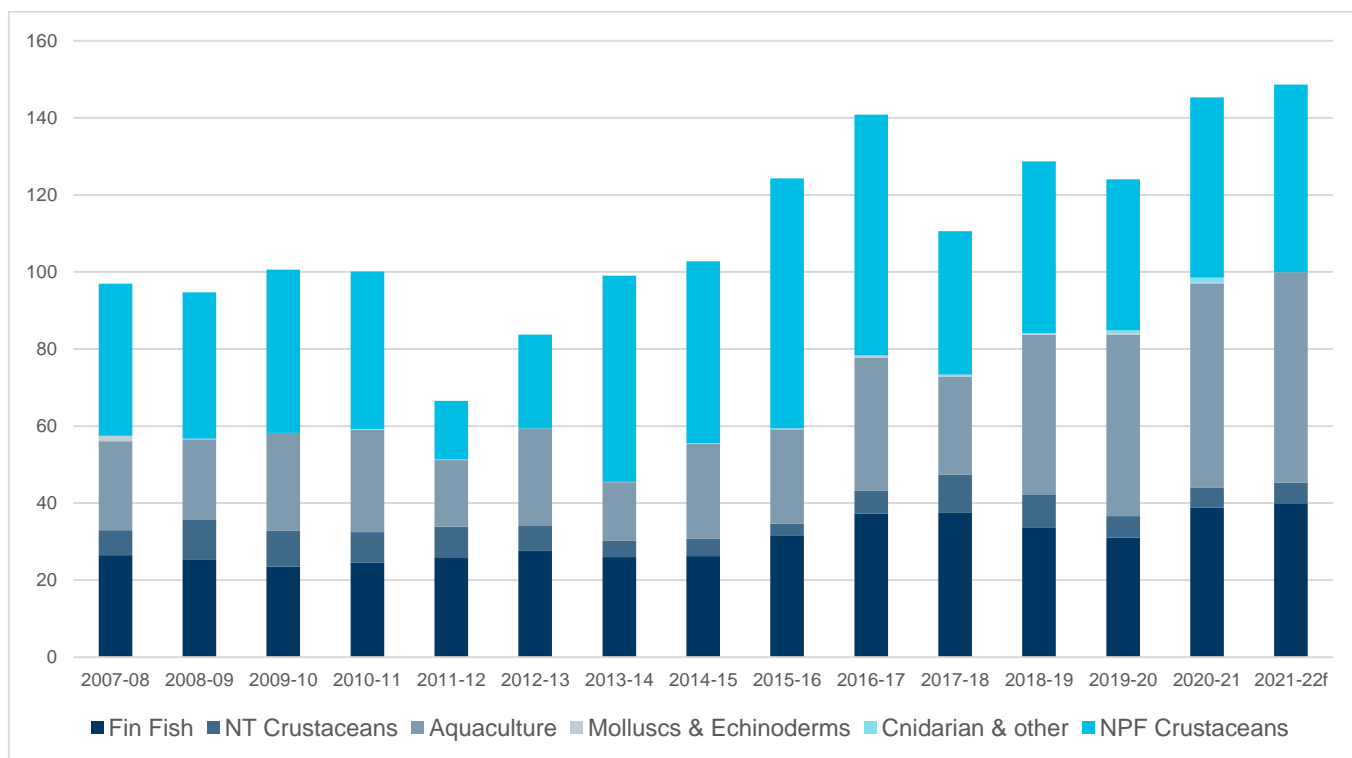


Figure 23 Distribution of value within seafood sector, \$million

Source: GHD based on DITT (2022). (Note: 2021-22f: forecast).

Table 56 Past three years of recorded value; seafood

Commodity	2018-19 (\$M)	2019-20 (\$M)	2020-21 (\$M)
Fin fish	\$33.6	\$31.6	\$38.8
NT crustaceans	\$8.7	\$5.5	\$5.1
NPF crustaceans	\$44.6	\$39.1	\$46.8
Aquaculture	\$41.4	\$47.1	\$53.1
Molluscs & echinoderms	\$0.5	\$0.4	\$0.3
Cnidarian & other	\$0	\$0.9	\$1.2

Source: DITT (2022).

F-6 Value-add opportunities

Outlined below are the shortlisted opportunities which were assessed as most likely to add value to the NT seafood sector. These opportunities were shortlisted following stakeholder consultation and literature review, before the likely impact and feasibility were estimated and modelled. Opportunities are presented in descending order based on the modelled impact on the value of NT agribusiness by 2030-31.

F-6-1 Project specific infrastructure and support to attract and retain seafood businesses

Large scale seafood or aquaculture developments and expansion opportunities are regularly explored in the NT, often with potential to achieve a step change in industry output and value. Stakeholders cited opportunities to provide more certainty to investors and project proponents as to the enabling infrastructure and services which will be provided if/when developments proceed. Stakeholders cited power and water supply and supply chain infrastructure as key requirements to help de-risk projects and attract investors to the NT ahead of other jurisdictions.

Table 57 Project specific infrastructure and support to attract and retain seafood businesses

Opportunity	Project specific infrastructure and support to attract and retain seafood businesses
Impact	40.0% Stakeholders suggest there is a current situation of no further investment or even businesses considering leaving the NT seafood industry - could represent saving 20% and increasing 20% through further investment.
Feasibility	40% Any investment by government would need to be assessed on a case-by-case basis and would be necessitated on projects progressing.
Feasibility weighted impact	16.0%
Modelled growth by 2030-31	\$39M
Confidence rating	Low No details were provided by stakeholders as the specific projects and infrastructure requirements.
Recommended actions	<ul style="list-style-type: none"> Consideration of enabling infrastructure as a means of attracting and retaining project investors.
Sources	GHD (2022)

F-6-2 Further production of black lipped rock oysters

Black lipped rock oysters have been identified as a highly suitable and profitable species for production in the NT, largely due to their suitability to the climatic conditions along with favourable premium prices in markets. Research into key production techniques, such as breeding, has paved a strong foundation for the growth of this industry.

Table 58 Further production of black lipped rock oysters

Opportunity	Further production of black lipped rock oysters
Impact	10.0% The potential to grow the diversity and value of production from this new industry in the NT is a significant long term growth sector.
Feasibility	80% There has been a significant amount of foundational work in research and trials that has produced positive outcomes for black lipped rock oyster production, suggesting a successful industry is likely.
Feasibility weighted impact	8.0%

Opportunity	Further production of black lipped rock oysters
Modelled growth by 2030-31	\$19M
Confidence rating	Medium
	The opportunity for black lipped oysters is well established and stakeholders are already adopting. However, the eventual value of this and other markets is still unclear.
Recommended actions	<ul style="list-style-type: none"> Further support provided to the research and establishment of black lipped rock oysters in the NT.
Sources	GHD (2022)

F-6-3 Greater clarity of ongoing water access and resources

Stakeholders discussed difficulties with investments due to the current uncertainty around water access. The ongoing Blue Mud Bay negotiations are a cause of distress to incumbent, non-Aboriginal companies that see the uncertainty surrounding future access as limiting investment to NT fisheries. The process of section 19 land use agreements for these companies to continue to grow is uncertain and still being debated, also incurring a large cost to industry.

Table 59 Greater clarity of ongoing water access and resources

Opportunity	Greater clarity of ongoing water access and resources
Impact	7.0%
	Greater clarity of water access and resources would increase confidence and overall investment into the NT's fisheries sector, which through consultations is understood to be decreasing currently.
Feasibility	90%
	There is a currently strong need to develop a suitable framework with industry pushing for this to be done and negotiations ongoing.
Feasibility weighted impact	6.3%
Modelled growth by 2030-31	\$15M
Confidence rating	Low
	GHD was not able to contact Aboriginal Sea Company and had limited contact with representatives from wild-catch fisheries.
Recommended actions	<ul style="list-style-type: none"> Continued collaboration for section 19 consultation to establish clear water and resources access to allow greater certainty for investors.
Sources	GHD (2022)

F-6-4 Project Sea Dragon or similar developments at the proposed site

Project Sea Dragon is a large-scale, integrated, land-based prawn aquaculture project. The developer, Seafarms Group Ltd., is currently considering the expanded project's viability, however a scaled-down pilot version of the project may proceed in the coming years. The eventual development of Project Sea Dragon remains uncertain, as reflected in assumptions, and may depend on future market and production conditions. Regardless, the NT Government has made extensive upgrades to road infrastructure to the site, which may support other aquaculture or agribusiness project developments.

Table 60 Project Sea Dragon or similar developments at the proposed site

Opportunity	Project Sea Dragon or similar developments at the proposed site
Impact	120.0%
	At full development Seafarms has estimated production of 180,000 tonnes (estimated 27,000 possible by 2031) of black tiger prawns at \$15/kg, with 75% of value expected to be captured in the NT.
Feasibility	5%
	Infrastructure and land tenure agreements are in place and aspects of the business case remain viable, however, any development at the site is likely to be of a smaller scale than the original proposal.
Feasibility weighted impact	6.0%
Modelled growth by 2030-31	\$15M
Confidence rating	Medium
	Assumptions based on stakeholder input and publicly available information, however GHD were not able to obtain an update from Seafarms Ltd.
Recommended actions	<ul style="list-style-type: none"> Continue to promote the opportunity for development at the site.
Sources	Seafarms (n.d); GHD (2022)

F-6-5 Improved supply chain infrastructure including packing, chilling, storage and out-loading facilities

To access premium markets the NT seafood and aquaculture industry must have a highly efficient supply chain, delivering high value products to markets in minimal time, effort and downgrades. Stakeholders identified opportunities for targeted infrastructure upgrades to facilitate more efficient packing, chilling, cold storage and out-loading. Infrastructure needs are detailed and assessed in the 2019 report *NT Fisheries Infrastructure: Identifying infrastructure needs that underpin growth of the NT seafood industry in the next 10 years* (Saunders, 2019.)

Table 61 Improved supply chain infrastructure including packing, chilling, storage and out-loading facilities

Opportunity	Improved supply chain infrastructure including packing, chilling, storage and out-loading facilities
Impact	5.0%
	Opportunity to reduce supply chain costs, waste and downgrades, and also potential to access higher markets. Assume 5% benefit through cost reductions and price premiums.
Feasibility	80%
	The feasibility and benefits of individual infrastructure investments will need to be established, however there are no major barriers to these
Feasibility weighted impact	4.0%
Modelled growth by 2030-31	\$9.6M
Confidence rating	Low
	No specific detail of required infrastructure or benefits was available.
Recommended actions	<ul style="list-style-type: none"> Progress local, or niche processing opportunities, with primary focus on supplying higher value unprocessed markets. Facilitation and encouragement of supply chain investments.
Sources	Saunders (2019); KPMG (2020a,b); CRCNA (2022a); GHD (2022)

F-6-6 Seafood processing

Opportunities exist to undertake value-adding processing of local seafood before it leaves the Territory. The feasibility of a Darwin based seafood processing facility has been explored by industry and government (KPMG, 2020a). This study identified potential processing activities, potential business models and suitable land to establish the facility. Some examples of identified species with a 'high' overall opportunity include barramundi, prawns, trepang, black jewfish and pearl meat. This 'high' classification refers to there being an attractive product for processing with a market that has high expected potential in financial returns for processed products from the NT. This preliminary scoping study is now being considered by industry.

Table 62 Seafood processing

Opportunity	Seafood processing
Impact	12.0%
	Analysis suggests 60% of seafood and aquaculture produce could be processed at the facility, adding an estimated 40% in local value-add.
Feasibility	20%
	The feasibility of this opportunity is being considered. Current thinking suggests greater opportunities exist in streamlining supply chains to allow for improved supply of higher value unprocessed products to domestic and export markets.
Feasibility weighted impact	2.4%
Modelled growth by 2030-31	\$5.8M
Confidence rating	Medium
	Assessment informed by completed feasibility analysis and stakeholder input, however feasibility remains unclear.
Recommended actions	<ul style="list-style-type: none"> Progress local, or niche processing opportunities, with primary focus on supplying higher value unprocessed markets.
Sources	KPMG (2020a); GHD (2022)

F-6-7 Increased restocking of mud crabs

The seasonal supply of harvestable mud crabs varies significantly from year to year, depending on climatic conditions. This variation and uncertainty placed a constraint on industry growth (KPMG, 2020a). Through the utilisation of an effective breeding program and hatcheries, mud crabs can be restocked to the environment to enable a greater capacity for sustainable harvesting.

Table 63 Increased restocking of mud crabs

Opportunity	Increased restocking of mud crabs
Impact	2.0%
	The GVP of mud crab is approximately 4-5 mil (3%).
Feasibility	80%
	High feasibility considering wide support and strong, uncomplicated business case.
Feasibility weighted impact	1.6%
Modelled growth by 2030-31	\$3.9M
Confidence rating	Medium
	Detailed analysis was provided by stakeholders.
Recommended actions	<ul style="list-style-type: none"> Seek a fisheries scientist's advice in terms of food source and survival conditions.
Sources	KPMG (2020a); GHD (2022)

F-7 Enhanced growth roadmap

The projected growth from industry-specific opportunities as well as cross-industry opportunities is summarised in Figure 24 below. Assuming the above value-add opportunities are implemented, the base case scenario would be a value of \$367 million realised by 2030-31.

Based on the confidence level applied to the value-add opportunities (as per Table 3), the total upper limit is estimated to be \$412 million and the lower limit is \$322 million in 2030-31.

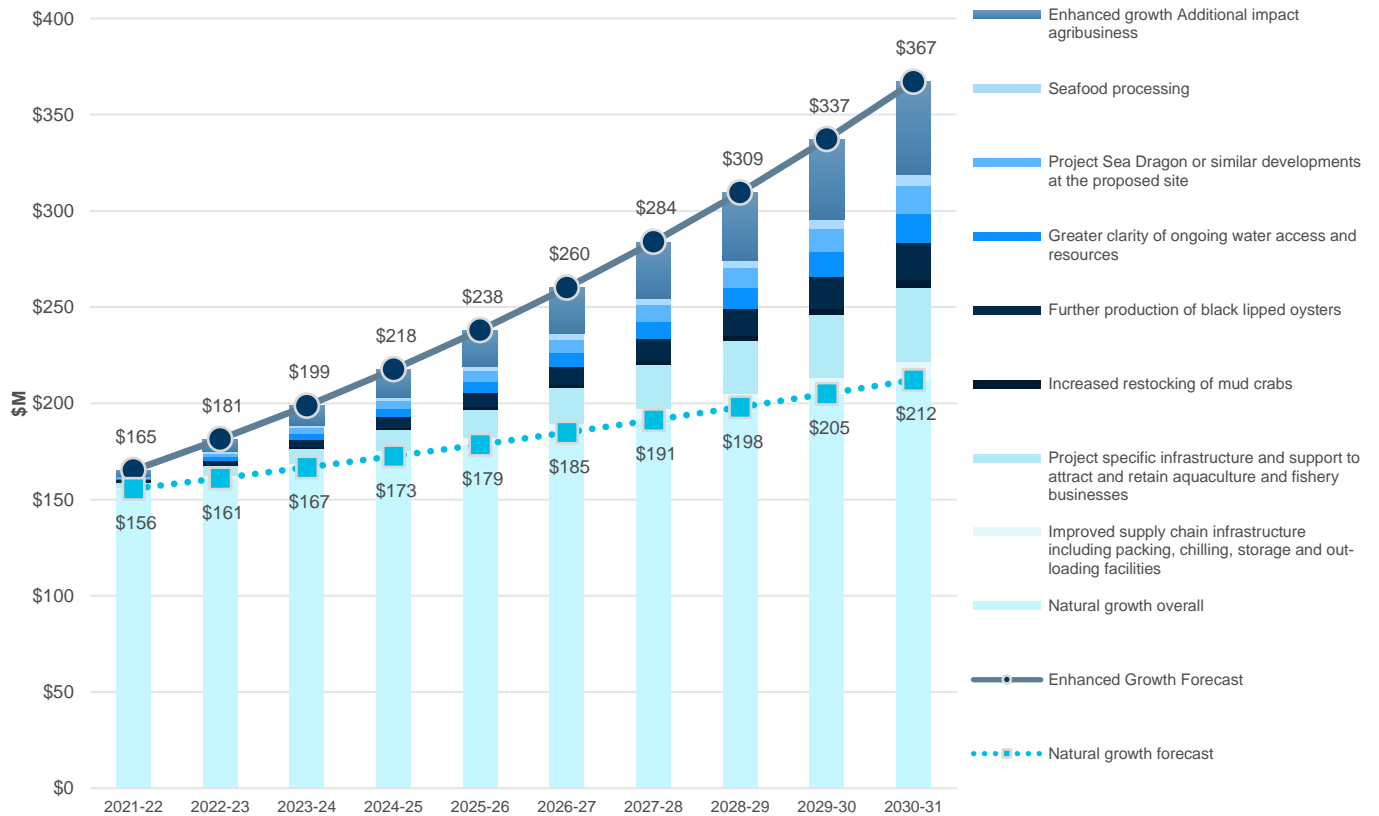


Figure 24 Potential seafood industry growth including value adding opportunities

Source: GHD modelling results.

The analysis identified the following opportunities as having the highest overall impact on the value of the NT seafood industry by 2030-31, presented in Table 64 below with the actions required to progress them.

Table 64 Highest value opportunities and recommended actions in NT seafood industry

Rank	Opportunity	2030-31 Additional Value (\$M)	Recommended actions
1	Project specific infrastructure and support to attract and retain seafood businesses	\$39	Consideration of enabling infrastructure as a means of attracting and retaining project investors.
2	Further production of black lipped rock oysters	\$19	Further support provided to the research and establishment of black lipped rock oysters in the NT.
3	Greater clarity of ongoing water access and resources	\$15	Continued collaboration for section 19 consultation to establish clear water and resources access to allow greater certainty for investors.

Rank	Opportunity	2030-31 Additional Value (\$M)	Recommended actions
4	Project Sea Dragon or similar developments at the proposed site	\$15	Continue to promote the opportunity for development at the site.
5	Improved supply chain infrastructure including packing, chilling, storage and out-loading facilities	\$9.6	Progress local, or niche processing opportunities, with primary focus on supplying higher value unprocessed markets. Facilitation and encouragement of supply chain investments.
6	Seafood processing	\$5.8	Progress local, or niche processing opportunities, with primary focus on supplying higher value unprocessed markets.
7	Increased restocking of mud crabs	\$3.9	Establishment of a restocking system.

Source: GHD modelling results.

Appendix G

Forestry value-add opportunities

G-1 Industry Overview

FIANT estimates that there is a total 42,000 hectares of plantations in the NT valued at \$1.32 billion (FIANT, 2022). Plantations on the Tiwi Islands of Acacia are used for paper pulp generally to Japan and more recently China. In the Douglas-Daly and Katherine regions, African mahogany is grown as high-value timber expected to be rotated between 18 and 25 years.

Also, in the Douglas-Daly and Katherine regions, Sandalwood is grown for oil and pharmaceuticals. The forestry industry is in a period of expansion with the establishment of Forest Industry Association Northern Territory (FIANT) which successfully applied to commonwealth funding for a forestry hub within the NT and Ord valley regions. Territory Natural Resource Management and FIANT have also developed Northern Territory specific forestry guidelines which aims to make investment and access to correct information more accessible.

G-2 Production systems and supply chains

CRCNA estimates that there are 13 million hectares of native forest with commercial potential and a further 22 million hectares of private forests in Northern Australia (not exclusive to NT).

Table 65 NT forestry and forest products industry snapshot

NORTHERN TERRITORY	<ul style="list-style-type: none"> 18.7 million ha – indigenous ownership or management 13.5 million ha – private 9.3 million ha - leasehold 	<ul style="list-style-type: none"> Total area ~ 51,000 ha 		
East Arnhem	<ul style="list-style-type: none"> Traditional owner resources 		<ul style="list-style-type: none"> Hardwood sawmill in Nhulunbuy (Gumatj) Provide sawn products to local markets 	
Tiwi Islands	<ul style="list-style-type: none"> Traditional owner resources Could support small-scale processing operations 	<ul style="list-style-type: none"> 32,000 ha - acacia pulpwood Interest in replanting with hardwood species to increase yield and market value 	<ul style="list-style-type: none"> Woodchip processing and wharf facilities on Melville Island Provide export chips for pulp and bioenergy markets Exported 196,000 green metric tonnes in 2017-18 valued at USD\$11 million 	
Douglas Daly and Katherine		<ul style="list-style-type: none"> 13,000 ha – African mahogany Yet to reach harvest age Interest in selective breeding/seed improvement for second rotation to increase yield Interest in silvopastoralism with cattle 6,000 ha - Indian sandalwood 	<ul style="list-style-type: none"> Evaluating wood processing options and markets \$390 million – projected value of African mahogany plantation estate at harvest age 	<i>Douglas Daly</i> <ul style="list-style-type: none"> Fleming road sealing for 35 kms Cadell road sealing for 20 kms Ooloo road upgrade Grid power for value adding (processing) Communications networks Accommodation facilities and community

Source: Stephens et al. (2020).

Stephens et. al. (2020) completed supply chain mapping for the NT forestry industries (Figure 25) and identified supply chain gaps which may be constraining industry development and exposure to a wider range of domestic and international markets.

The analysis identified the following supply chain gap:

- The NT does not have a complete offering of mills that are required to produce a full range of forestry and paper products.

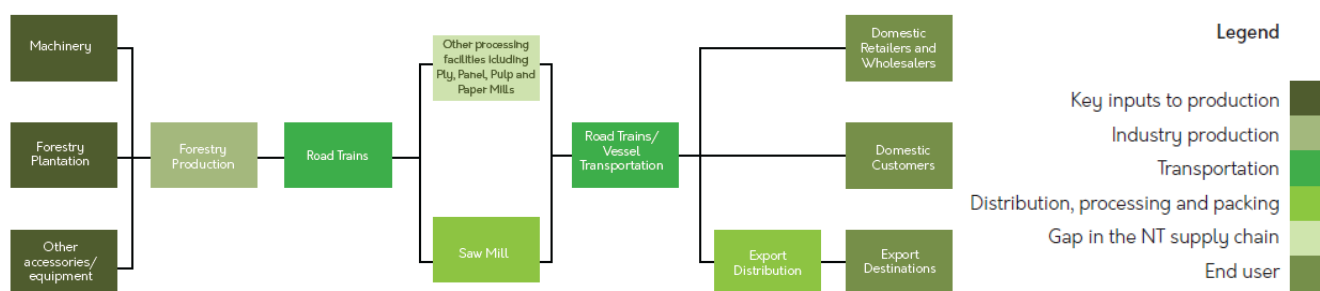


Figure 25 NT forestry industry supply chain map

Source: CRCNA (2022a).

G-3 Previous studies into value adding opportunities

Value-adding opportunities for the forestry industry applicable to the NT have been previously explored in the following studies:

- African Mahogany Grown in Australia – Wood quality and potential uses (Armstrong et al., 2007)
- Forestry and weeds the key to biochar’s future up North (Brann, 2013)
- Northern forest products industry opportunities final report (Stephens et al., 2020)
- Adding value and attracting investment to Northern Territory Timberlands (Miller, 2020)
- Biomass in Western Australia (DPIRD, 2022)
- An evaluation of NT agriculture supply chains and export opportunities (CRCNA, 2022a).

G-4 Barriers and opportunities for growth

• The recently completed *Evaluation of Northern Territory agriculture supply chains and export opportunities* (CRCNA 2022), summarised the barriers and opportunities for the NT forestry industry in the following SWOT Analysis (Table 66) and the identified sector constraints, trends, priorities and opportunities.

Table 66 SWOT analysis (NT forestry supply chain)

Strengths	Weaknesses
<ul style="list-style-type: none"> – Northern Australia makes up 48% of total forest in Australia. – Continued growth in domestic and global demand for wood fibre. – Growth in Australian demand for sawn wood products. – Development of a Regional Forestry Hub in the NT. 	<ul style="list-style-type: none"> – Remote geographical locations of plantations. – Large transporting distances. – Termites and other pests. – Inconsistency and seasonality of rainfall. – Lack of collaboration with traditional owners – Barriers to carbon market access. – High biosecurity expenses – Fit-for-purpose port facilities required
Opportunities	Threats
<ul style="list-style-type: none"> – Emerging markets in engineered wood products. – Silviculture production systems – Carbon farming initiatives – Future mine site rehabilitation – Niche/high-value forestry species such as Indian Sandalwood and African Mahogany. – Development of processing facilities. 	<ul style="list-style-type: none"> – Unproven processing technologies for some plantation species. – Climate and weather-related events (cyclones, droughts, bushfires). – High power costs may disincentivise processing investments. – Chinese ban on Australian timber imports.

Source: CRCNA (2022a).

G-5 Historical and projected growth in value

Based on the forward-looking rolling 10-year average by FIAN (2022), NT forestry currently harvests \$115 million per annum of product for the domestic and international markets. Over the next ten years, there is scope for the forestry and forest products industry to reach up to \$300 million per annum, as a consequence of increasing harvest levels, expansion of forest resources and potential for downstream processing and value-adding (Stephens et al., 2020).

In general, NT forestry industry has considerable uncertainty given data limitations. Key sectors of the industry have largely been based on establishing the underlying plantation forest resources for downstream processing and export markets. The harvesting stage differs for specific tree species, such as African Mahogany (currently mid-rotation phase, valued at \$100 million standing value), Indian sandalwood (early rotation phase, no standing value available) and Acacia (maturity phase, harvested and sold into the international woodchip market).

G-6 Value-add opportunities

Outlined below are the shortlisted opportunities which were assessed as most likely to add value to the NT forestry sector. These opportunities were shortlisted following stakeholder consultation and literature review, before the likely impact and feasibility were estimated and modelled. Opportunities are presented in descending order based on the modelled impact on the value of NT agribusiness by 2030-31.

G-6-1 Increased participation in the Emissions Reduction Fund

The ERF Plantation Forestry Method allows producers to claim Australian Carbon Credit Units, provided production accords with the prescribed regions and species of the National Plantation Inventory (NPI). As of 2022, African Mahogany and Indian Sandalwood plantations are now permitted to participate in the ERF which will generate additional income for existing plantations and should lead to additional investment into the sector going forward. Opportunities may exist to include additional plantation species and expand NPI regions to allow for increased participation in the ERF.

Table 67 Increased participation in the Emissions Reduction Fund

Opportunity	Increased participation in the Emissions Reduction Fund
Impact	20.0%
	Assume opportunity to increase overall investment by 20% as the feasibility becomes more positive for plantations. The estimation of 2% increase in the overall plantation's IRR would translate to greater investment.
Feasibility	80%
	African Mahogany and Indian Sandalwood plantations are now permitted to participate in the ERF, therefore opportunity and investment should follow.
Feasibility weighted impact	16.0%
Modelled growth by 2030-31	\$19M
Confidence rating	Medium
	Changes have already been made, however difficult to predict investment flows into forest industries.
Recommended actions	<ul style="list-style-type: none"> Promote to investors opportunities for increased forestry participation in the ERF. Monitor opportunities to include additional species, review NPI regions and promote other ERF methodologies.
Sources	Miller (2020); Stephens et al. (2020)

G-6-2 Improved seed stock and management of plantation grown trees

A number of issues may affect the profitability of converting plantation logs to high-value appearance grade timber, namely: wandering pith; the proportion of stem under heartwood at a young age (relative to native grown material); and the development of decay, and therefore stain – all of which are issues that could potentially be addressed through breeding and correct silviculture.

Table 68 Improved seed stock and management of plantation grown trees

Opportunity	Improved seed stock and management of plantation grown trees
Impact	5.0%
	Assumed 5% increase in the value of outputs through the outputs of research/extension
Feasibility	90%
	Likely with current research being adopted/extended.
Feasibility weighted impact	4.5%
Modelled growth by 2030-31	\$5.2M
Confidence rating	Medium
	The research is strongly suggesting that improvements in this area can lead to large value-add.
Recommended actions	<ul style="list-style-type: none"> Further research and extension.
Sources	Armstrong et al. (2007); Miller (2020); Stephens et al. (2020); CRCNA (2022a)

G-6-3 Biomass and/or biochar production

Biomass refers to biological materials from tree, animal and food crop residues that are waste by-products. When processed, this can be turned into bioenergy or biochar. This provides additional value adding of waste along with an extra source of income to producers. This opportunity is being considered by governments and large companies worldwide. As technological barriers and prices are overcome it could become a successful value-add to forestry waste and provide greater access to inputs for other agricultural industries.

Table 69 Biomass and/or biochar production

Opportunity	Biomass and/or biochar production
Impact	10.1%
	With a sufficient source of biomass, there are options to replenish cleared sites, produce bioenergy or as biochar in intensive agriculture. Soils in the NT are typically low in carbon and hence locally sourced biochar would benefit intensive agriculture. Trials in the NT produced a 10-25% yield increase to zucchini crops when biochar is used.
Feasibility	40%
	Feasibility appears to be highly dependent on economic supply of forestry and agricultural by-products which will be dependent on further industry development, transport efficiency and other competing uses.
Feasibility weighted impact	4.0%
Modelled growth by 2030-31	\$4.7M
Confidence rating	Low
	The process and economics of utilising biomass at a commercial scale are complicated and would require further analysis to be confident in estimates.
Recommended actions	<ul style="list-style-type: none"> Further feasibility analysis including feedstock supply.
Sources	Brann (2013); Stephens et al. (2020); DPIRD (2022); GHD (2022)

G-6-4 Re-planting and extension of existing hardwood fibre pulp plantations with expected continuation of export market strength

Continued growth in global demand for hardwood fibre is expected over the next decade as global populations expand and their living standards increase. Already being harvested, the existing plantations can be re-planted and extended on the Tiwi Islands, the closest Australian location to the main Chinese and Japanese markets and the emerging Indonesian market. These plantations provide an example of targeted suitability plantation forestry.

Table 70 *Re-planting and extension of existing hardwood fibre pulp plantations with expected continuation of export market strength*

Opportunity	Re-planting and extension of existing hardwood fibre pulp plantations with expected continuation of export market strength
Impact	20.0%
	Expected high increase in prices/demand opportunities
Feasibility	20%
	Unlikely to be replanting a significant number of plantations within 10 years,
Feasibility weighted impact	4.0%
Modelled growth by 2030-31	\$4.6M
Confidence rating	Low
	Market conditions mean this could change before it is time to re-plant.
Recommended actions	<ul style="list-style-type: none"> • Further market research along with suitability of greater land.
Sources	Stephens et al. (2020); CRCNA (2022a)

G-6-5 Extension of Indigenous forestry management, wood products manufacturing and supply

Potential harvesting by indigenous companies of native forests, dependent on the information derived from the native forest inventory. The Tiwi Plantation Corporation is an example of this. The integration of Indigenous business and employment opportunities, with access to native forests and specific (local and international) demand and markets, provides significant scope for future developments.

Table 71 *Extension of Indigenous forestry management, wood products manufacturing and supply*

Opportunity	Extension of Indigenous forestry management, wood products manufacturing and supply
Impact	15.1%
	Could increase the total amount of forestry significantly.
Feasibility	20%
	Unlikely to gain consensus with traditional owners on a large scale quickly.
Feasibility weighted impact	3.0%
Modelled growth by 2030-31	\$3.5M
Confidence rating	Medium
	Requires willingness for hosting forestry on indigenous land.
Recommended actions	<ul style="list-style-type: none"> • Expansion of forestry and forest products industries requires meaningful engagement models between industry, investors and resource owners that is cognizant of economic and cultural norms.
Sources	Stephens et al. (2020); GHD (2022)

G-6-6 Adoption of silvopastoral systems

Opportunities exist for NT landholders to adopt silvopastoral systems which combine livestock grazing with forestry in a mutually beneficial way. Grazing of forestry land can provide valuable livestock feed, and short term revenue while longer term plantation investments mature. Miller (2020) estimated returns from silvopastoral systems of 11.1% internal rate of return (real) and Stephens et al (2020) provides a comprehensive review of past literature and findings, concluding that grazing of beef cattle may be integrated with tree growing, in land that could be marginal for both activities, without the other. Opportunities may also exist for silvopastoral systems to produce carbon neutral/positive beef and generate carbon or biodiversity credits.

Table 72 Adoption of silvopastoral systems

Opportunity	Adoption of silvopastoral systems
Impact	5.0%
	Could increase total investment into forestry if this is the most profitable way to utilise the land. Estimated 5% increase to industry through investment and returns.
Feasibility	60%
	Well documented opportunity but has not yet been widely adopted.
Feasibility weighted impact	3.0%
Modelled growth by 2030-31	\$3.5M
Confidence rating	Medium
	High level estimate of benefits and uptake
Recommended actions	<ul style="list-style-type: none"> Silvicultural awareness needs to be improved and supported with expertise and training for private native forestry.
Sources	Stephens et al. (2020); Miller (2020); CRCNA (2022a)

G-6-7 Targeting higher value sandalwood markets

Opportunities exist to target higher value sandalwood markets such as ceremonial, pharmaceutical and personal care purposes which would provide a premium compared to other uses. Currently, Indian sandalwood (*Santalum album*) is grown for oil and pharmaceuticals in the Douglas-Daly and Katherine regions of the NT.

Table 73 Targeting higher value sandalwood markets

Opportunity	Targeting higher value sandalwood markets
Impact	10.0%
	The value of sandalwood could be enhanced through targeting certain end products. The marketing of Quintis is a good example of this.
Feasibility	10%
	The benefits of marketing and revenue return are more likely to be done outside of the NT. However, some of the increased value's demand could feed back into the plantations value.
Feasibility weighted impact	1.0%
Modelled growth by 2030-31	\$1.2M
Confidence rating	Low
	Unsure of the scale or feasibility of entering these markets.
Recommended actions	<ul style="list-style-type: none"> Greater marketing of these properties of sandalwood, targeting of these markets by sellers.
Sources	Stephens et al (2020); CRCNA (2022a)

G-7 Enhanced growth roadmap

The projected growth from industry-specific opportunities as well as cross-industry opportunities is summarised in Figure 26 below. Assuming the above value-add opportunities are implemented the base case scenario would be a value of \$166 million realised by 2030-31.

Based on the confidence level applied to the value-add opportunities (as described in Table 3), the total upper limit is estimated to be \$180 million and the lower limit is \$151 million in 2030-31.

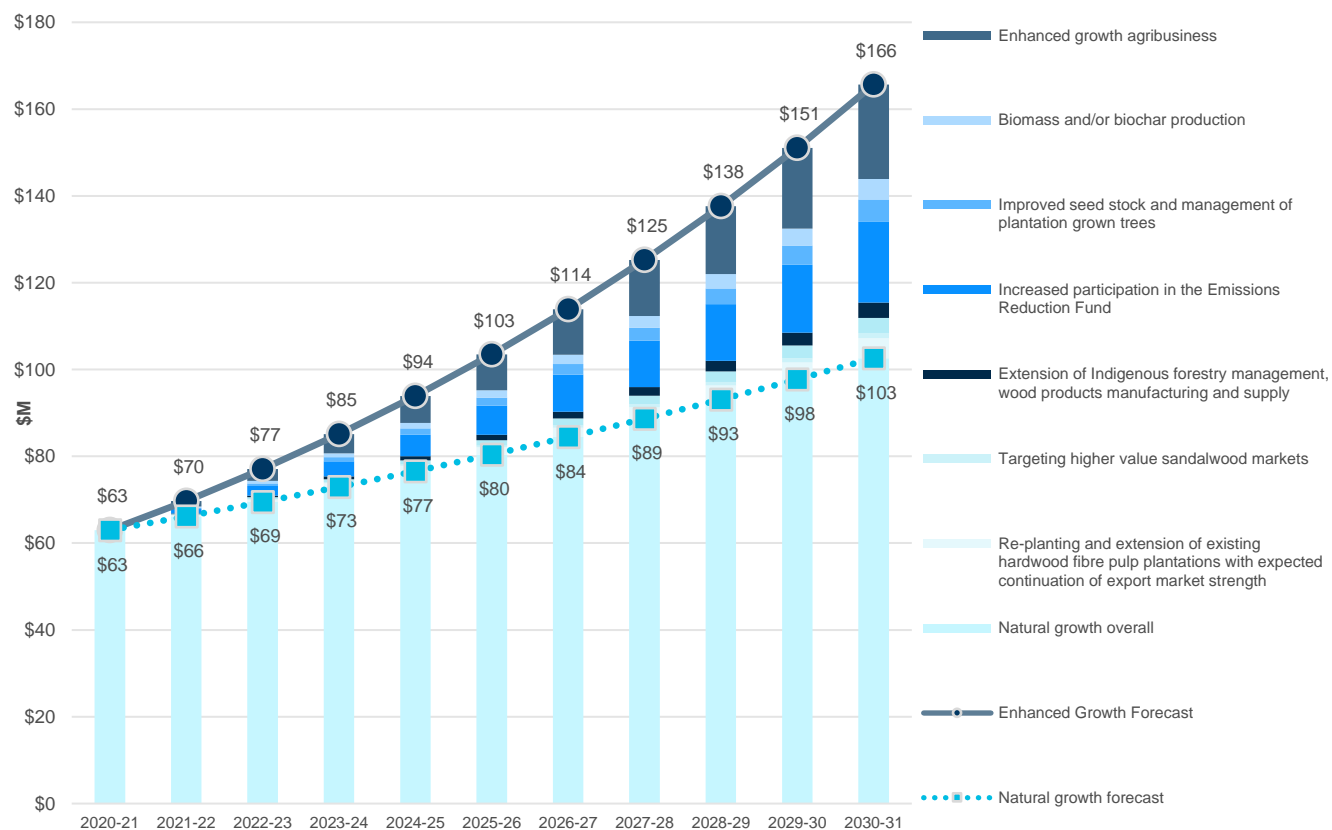


Figure 26 Potential forestry industry growth including value adding opportunities

Source: GHD modelling results.

The analysis identified the following opportunities as having the highest overall impact on the value of NT forestry industry by 2030-31, presented in Table 74 below with the actions required to progress them.

Table 74 Highest value opportunities and recommended actions in NT forestry industry

Rank	Opportunity	2030-31 Additional Value (\$M)	Recommended actions
1	Increased participation in the Emissions Reduction Fund	\$19	The Federal Department of Environment and the Climate Change Authority to review NPI regions and consider the inclusion of African Mahogany and Indian Sandalwood as eligible species in the Emissions Reduction Fund to claim Australian Carbon Credit Units.
2	Improved seed stock and management of plantation grown trees	\$5.2	Further research and extension.

Rank	Opportunity	2030-31 Additional Value (\$M)	Recommended actions
3	Biomass and/or biochar production	\$4.7	Further feasibility analysis including feedstock supply.
4	Re-planting and extension of existing hardwood fibre pulp plantations with expected continuation of export market strength	\$4.6	Further market research along with suitability of greater land.
5	Extension of Indigenous forestry management, wood products manufacturing and supply	\$3.5	Expansion of forestry and forest products industries requires meaningful engagement models between industry, investors and resource owners that is cognizant of economic and cultural norms.
6	Adoption of silvopastoral systems	\$3.5	Silvicultural awareness needs to be improved and supported with expertise and training for private native forestry.
7	Targeting higher value sandalwood markets	\$1.2	Greater marketing of these properties of sandalwood, targeting of these markets by sellers.

Source: GHD modelling results.

Appendix H

**Other Agribusiness value-add
opportunities**

H-1 Industry overview

Other Agribusiness opportunities is to capture any independent industries not already covered. Specifically, there are growing industries under the broad bushfood sector, bees for both honey and pollination services, farmers markets etc. It should be noted however that some overlapping opportunities were found between this section and overall agribusiness, the difference being the opportunities under 'Other agribusiness' are understood to be independent rather than integrated across sectors.

H-2 Production systems and supply chains

By its nature, other agribusiness sectors are emerging and therefore still establishing production systems and supply chains. For example, the bushfoods sector is produced currently through a wide mix of informal wild harvest along with some more established companies. Therefore, the challenges facing these industries are very specific to the few stakeholders involved.

H-3 Previous studies into value adding opportunities

Value-adding opportunities for the NT emerging agribusiness industries have been previously explored in the following studies:

- Value chain analysis of bush tomato and wattle seed products (Bryceson, 2008)
- By-products from agriculture & fisheries: adding value for food, feed, pharma and fuels (Simpson et al., 2019)
- Developing the north: learning from the past to guide future plans and policies (Ash & Watson, 2018)
- Spicing up Northern Australia with high value condiment crops (CRCNA, 2022b).

H-4 Barriers and opportunities for growth

The opportunities and barriers to growth in the NT emerging industries are summarised in the following SWOT Analysis (Table 75), adapted from analysis completed as part of *Evaluation of Northern Territory agriculture supply chains and export opportunities* (CRCNA, 2022a).

Table 75 SWOT analysis (other NT agribusiness supply chains)

Strengths	Weaknesses
<ul style="list-style-type: none"> – The Port of Darwin is ideally located to capitalise on growing Asian demand. – Access to unique and native foods – Access to tourist markets 	<ul style="list-style-type: none"> – High transport and labour costs – Climate conditions challenge road reliability (floods and annual monsoons). – Underdevelopment of value chain
Opportunities	Threats
<ul style="list-style-type: none"> – Increased marketing of native foods and indigenous collection or production. – Significant opportunity to increase the volume of trade towards ASEAN nations. – Development of agricultural hubs/precincts with shared facilities to enable the growth of plant-based agriculture. 	<ul style="list-style-type: none"> – Small scale of production and concentrated markets make emerging industries vulnerable to market shocks.

Source: GHD based on CRCNA (2022a).

H-5 Value-add opportunities

Outlined below are the shortlisted opportunities which were assessed as most likely to add value to the NT emerging agribusiness sector. These opportunities were shortlisted following stakeholder consultation and literature review, before the likely impact and feasibility were estimated and modelled. Opportunities are presented in descending order based on the modelled impact on the value of NT agribusiness by 2030-31.

H-5-1 Further development of niche markets for bush foods and bioprospecting

Bush foods are becoming mainstream, increasingly being incorporated into food service menus and consumer products. Territory native bush foods with commercial potential include Kakadu plum (gubinge), bush tomato (akudjura), a range of other plums, myrtles, wattles limes and a myriad of other species. Demand is currently outstripping supply in both domestic and export markets, creating opportunities for industry investment and expansion. Stakeholders cite challenges in achieving the required scale and consistency of production to satisfy the needs of high value customers in the food industry. Care needs to be taken when commercialising native foods to ensure provenance is protected and traditional owners are able to control their IP and share in the economic opportunities. A case analysis of indigenous, wild-harvested Kakadu plum across the tropical savannas of northern Australia demonstrated that this system would ideally operate at a landscape scale to ensure sustainability of harvest, maintenance of important patterns and processes for landscape health, and incorporate cultural and livelihood objectives (Gorman et al., 2020). Bioprospecting is an emerging industry involving the identification and isolation of key ingredients for use in medicine, textiles, food and other industrial products. Opportunities exist for bioprospecting to provide regional economic opportunities particularly for indigenous communities.

Table 76 Further development of niche markets for bush foods and bioprospecting

Opportunity	Further development of niche markets for bush foods and bioprospecting
Impact	150.0% Opportunity for the NT bushfoods and bioprospecting industries to grow significantly from a small base.
Feasibility	70% The bushfoods industry is already a focus for many key stakeholders, likely to drive greater production and distribution. Bioprospecting is an emerging industry with expectations of high growth.
Feasibility weighted impact	105.0%
Modelled growth by 2030-31	\$11M
Confidence rating	Medium GHD's experience in bush foods, current articles, and literature along with stakeholder sentiment all agree this could be a high growth area.
Recommended actions	<ul style="list-style-type: none"> Facilitation of the commercialisation and upscaling process, working to protect provenance, IP and economic opportunities for indigenous communities. Explore and promote opportunities for bioprospecting in the Territory.
Sources	Bryceson (2008); Honan & McCarthy (2017); EY (2018); Gorman et al. (2020); Sangha et al. (2022); GHD (2022)

H-5-2 Expansion of pollination industries

Expansion of horticultural industries requires bee pollination (in particular, melons). To achieve growth in the NT it will require a ramping up of pollination services by contract beekeepers. Certain horticultural crops can require up to seven hives per hectare during pollination season to achieve peak fruit set, particularly if wild pollinators are not present in high enough levels. Opportunities exist for NT beekeepers to ramp up services (as well as honey production) in response to the added demand. Currently there are five commercial beekeepers north of Ali Curung. Anecdotally the biggest limiter to industry growth has been a lack of information in the fledgling industry and lack of

communication with melon growers. The melon industry is the fastest growing farming industry in the NT and in the short-term beekeepers will struggle to meet demand. If NT beekeepers are able to remain free from varroa mite, opportunities may exist to supply interstate customers with varroa mite free-bee colonies.

Table 77 *Expansion of pollination industries*

Opportunity	Expansion of pollination industries
Impact	100.0%
	There could be a significant increase in the importance of honey bee populations and their services.
Feasibility	80%
	Growth is linked to expansion of horticultural production and increased need for pollination
Feasibility weighted impact	80.0%
Modelled growth by 2030-31	\$8.2M
Confidence rating	Medium
	Clearly defined need and opportunity
Recommended actions	<ul style="list-style-type: none"> • Provide targeted support for pollination industries, including assistance for apiarists to breed re-stocker queen bees, removing their reliance on southern suppliers susceptible to varroa mite. This may involve establishing a bee breeding site outside of the habitat range of the Rainbow Bee Eater. • Evaluate the feasibility of artificial insemination in laboratory conditions, potentially allowing apiarists to supply queen bees from the Territory's natural quarantine zone, to the rest of Australia and the world.
Sources	GHD (2022)

H-5-3 Development of a food incubator for entrepreneurial value adding

A food incubator space would allow entrepreneurs to access kitchen/simple processing facilities to allow value adding for their products and initialisation of emerging businesses. A business model may include fees for accessing the services for a certain amount of time. Some services provided could be industrial kitchen facilities, jarring machinery and bottling facilities. There has been success in establishing a similar facility in Cairns.

Table 78 *Development of a food incubator for entrepreneurial value adding*

Opportunity	Development of a food incubator for entrepreneurial value adding
Impact	50.0%
	Assuming applicable to 50% of 'other' produce (considering the encouraged growth in these products as well) and would double the value of these product.
Feasibility	50%
	The business model has been proven to work elsewhere along with support from some stakeholders. However, it would require funding to begin for it to be successful.
Feasibility weighted impact	25.0%
Modelled growth by 2030-31	\$2.6M
Confidence rating	Low
	The suggestion needs significantly more justification in the NT's environment which was not received through GHD's research.
Recommended actions	<ul style="list-style-type: none"> • Testing of stakeholder readiness for this kind of facility and feasibility and funding assessment.
Sources	FNQ Food Incubator (2022); GHD (2022)

H-6 Enhanced growth roadmap

The projected growth from industry-specific opportunities as well as cross-industry opportunities is summarised in Figure 27 below. Assuming the above value-add opportunities are implemented, the base case scenario would be a value of \$35 million realised by 2030-31.

Based on the confidence level applied to the value-add opportunities (as described in Table 3), the total upper limit is estimated to be \$42 million and the lower limit is \$28 million in 2030-31.

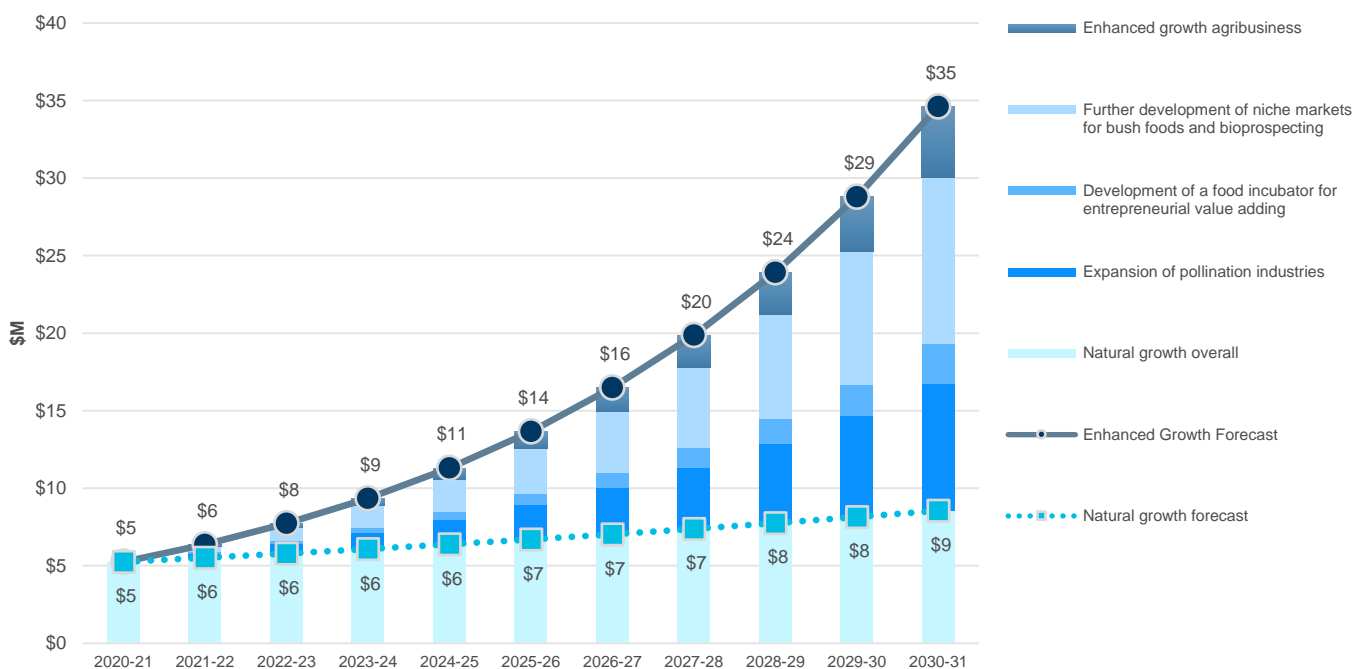


Figure 27 Potential other NT agribusiness industry growth including value adding opportunities

Source: GHD modelling results.

The analysis identified the following opportunities as having the highest overall impact on the value of NT emerging agribusiness by 2030-31, presented in Table 79 below with the actions required to progress them.

Table 79 Highest value opportunities and recommended actions in other NT agribusiness industries

Rank	Opportunity	2030-31 Additional Value (\$M)	Recommended actions
1	Further development of niche markets for bush foods and bioprospecting	\$11	Encouragement of grass root growers/wild harvesters. Facilitation of the commercialisation and upscaling process, particularly with indigenous businesses.
2	Expansion of pollination industries	\$8.2	Provide targeted support for pollination industries, including assistance for apiarists to breed re-stocker queen bees, removing their reliance on southern suppliers susceptible to varroa mite. This may involve establishing a bee breeding site outside of the habitat range of the Rainbow Bee Eater. Evaluate the feasibility of artificial insemination in laboratory conditions, potentially allowing apiarists to supply queen bees from the Territory's natural quarantine zone, to the rest of Australia and the world.
3	Development of a food incubator for entrepreneurial value adding	\$2.6	Testing of stakeholder readiness for this kind of facility and feasibility and funding assessment.

Source: GHD modelling results.



ghd.com

→ **The Power of Commitment**