Forest & Wood Products Australia

Report

INDIGENOUS COMMERCIAL FORESTRY OPPORTUNITIES:

East Arnhem, northern Australia

February 2024

PROJECT NUMBER
VNC506-1920

Indigenous Commercial Forestry Opportunities: East Arnhem, northern Australia.

Prepared for

Forest & Wood Products Australia

by

John Meadows, Mark Annandale, Dallas Anson, Michael Brand & Rob McGavin

Publication: Indigenous Commercial Forestry Opportunities East Arnhem, northern Australia

Project No: VNC506-1920

This work is supported by funding provided to FWPA by the Department of Agriculture, Fisheries and Forestry (DAFF).

ISBN: 978-1-922718-39-6

Researchers: John Meadows[1], Mark Annandale[1], Dallas Anson[2], Michael Brand[2], Rob McGavin[3], Camila Ribeiro[1], Duncan Sayers[1], Sean Ryan[4], Dora Carias Vega[1], Fien Van den Steen[1], Moana Krause[1]

[1]Tropical Forests & People Research Centre, Forest Research Institute, University of the Sunshine Coast.
[2]Department of Industry, Tourism & Trade, Northern Territory Government.
[3]Department of Agriculture & Fisheries, Salisbury Research Facility, Queensland Government.
[4]Private Forestry Service Queensland, Gympie.

Project partners: This project was delivered by the University of the Sunshine Coast in collaboration with the Northern Territory Government, Queensland Department of Agriculture & Fisheries (QDAF), and Developing East Arnhem Limited (DEAL – as the representative for other funding partners the Northern Territory Department of Industry, Tourism & Trade [DITT], NT Department of the Chief Minister & Cabinet [CM&C], Gumatj Corporation, National Indigenous Australian Agency [NIAA], the Northern Land Council [NLC], and Arnhem Land Progress Association [ALPA]). Other partners over the course of the project have included Traditional Owners of the Birany Birany community, Private Forestry Services QLD (PFSQ), Marngarr Resource Centre Aboriginal Corporation, and Nawa Nawa Consultants.

Forest & Wood Products Australia Limited
Level 11, 10-16 Queen St, Melbourne, Victoria, 3000
T +61 3 9927 3200 F +61 3 9927 3288
E info@fwpa.com.au
W www.fwpa.com.au

Executive Summary

The '*Indigenous Commercial Forestry Opportunities: East Arnhem, northern Australia*' research for development project investigated the potential for Indigenous-led commercial native forestry in the East Arnhem Land region of the Northern Territory. The project conducted preliminary research and development activities to facilitate sustainable (long-term) forest-based livelihood benefits for East Arnhem Traditional Owners and Indigenous communities.

Key project objectives were to:

- Better understand the interests and capacities of East Arnhem Traditional Owners to participate in a regional commercial native forestry industry;
- Better understand the East Arnhem commercial native forest resource; and
- Develop new value-added timber products derived from East Arnhem Indigenous-owned native forests.

The project's activities and outputs centred around 4 concurrent and interrelated phases:

Phase 1. Forest Product Development Pilot – A harvesting and marketing pilot to identify, manufacture, and market-test value-added timber products was completed. A Sustainable Native Forestry Demonstration Site was established in an Indigenous community-owned forest. Harvested timbers were processed in the community and used in community shelter constructions, demonstrating the potential to reduce reliance on imported timbers for community infrastructure. Traditional artefacts were produced from sawmilling offcuts, and bark from harvested trees was processed using traditional techniques and sold through local markets. The Demonstration Site was showcased to regional stakeholders through multiple Workshops. New prototype value-added timber products (Darwin stringybark bollards and a 'shelter kit') were developed, alongside product processing protocols and promotional materials. A market assessment of the bollard product was conducted, identifying interest and demand for multiple applications.

Phase 2. Traditional Owner Engagement – Consultation was conducted with Indigenous communities interested in commercial forestry to share information about the project, to understand their commercial forestry business capacities, to inform them of industry opportunities and practicalities, and to prioritise locations for subsequent Phase 3 works.

Phase 3. Forest Resource Assessment (inventory) – Desktop analysis and field-based surveys of commercial native forests of East Arnhem were conducted. The inventory filled knowledge gaps around the commercial forest distribution, forest productivity, and the potential commercial product mix of East Arnhem native forests. Simple but credible forest assessment tools (including a mobile phone app) were developed, to support the capacity of Indigenous communities to undertake future forest assessments.

Phase 4. Indigenous Community Capacity Building – Forestry workforce and business development initiatives were implemented. Traditional Owners were trained in technical forestry operations, sawmilling, and construction. Traditional Owners from communities with commercial forestry potential were linked with prospective product purchasers and other collaborative business partners and investors. Multiple tools to support, and progressive steps towards, Indigenous commercial forestry business development in East Arnhem were delivered, including a Forest Management Plan template, a culturally appropriate Northern Territory forestry training program proposal, and other recommendations for operation of a proposed East Arnhem Indigenous-led commercial forestry 'hub and spoke' business model.

The project has achieved its core goal of supporting development of an Indigenous-led commercial forestry industry in East Arnhem. It has demonstrated the potential for multiple timber and non-timber forest products, including ecosystem services, that could underpin sustainable Indigenous-led commercial forestry in East Arnhem. The project has also successfully raised regional stakeholder awareness of sustainable native forestry, and created expanded interest in this industry, and its potential to support Indigenous livelihoods and regional development. It is recommended to build on this momentum through continued work with remote communities, Gumatj Corporation, and other collaborative partners in a follow-on project to further test the commercial viability of Indigenous-led community forestry in East Arnhem.

Table of Contents

Introduction

The '*Indigenous Commercial Forestry Opportunities: East Arnhem, northern Australia*' research and development (R&D) project (hereafter the 'East Arnhem project') investigated the potential for Indigenous-led commercial forestry in the East Arnhem Land region of the Northern Territory (Figure 1). The project sought to provide preliminary R&D support to underpin the development of a commercially viable Indigenous forestry industry in East Arnhem, aiming to facilitate sustainable (long-term) forest-based livelihood benefits for the region's Traditional Owners and Indigenous communities that own commercial forest resources and have an interest in commercial forestry businesses. The project results are translatable beyond East Arnhem, to other parts of northern Australia where there is identified potential for Indigenous forestry development.

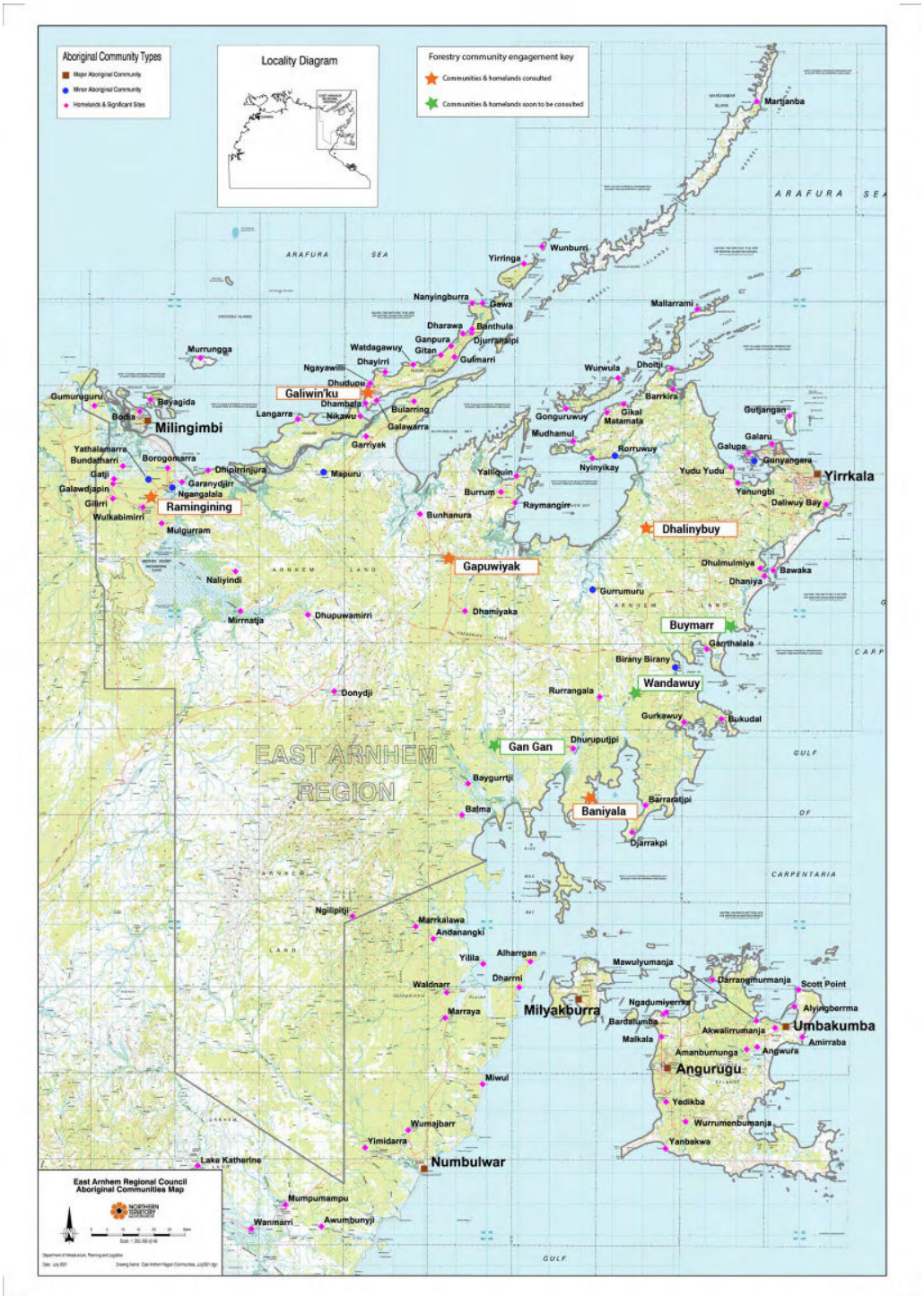

Figure 1. The East Arnhem Land region in the Northern Territory – the focus area of the project. **(Source: DEAL 2022).**

The project's overarching objectives were to:

- Understand the interests and capacities of East Arnhem Traditional Owners to participate in the forestry industry, and to support community capacity to operate viable commercial forestry businesses;
- Understand the East Arnhem forest resource, including commercial forest distribution, forest productivity, the potential timber (and non-timber) product mix, and what products have the best commercial potential; and
- Develop value-added timber products from logs sourced from East Arnhem Indigenous-owned native forests, to better understand the product characteristics, specifications and processing protocols, and potential markets for these products including the constrains for product development and delivery to buyers, and buyers' perceptions of/experiences with the products and supply chain.

To achieve the overarching objectives, the project was delivered through four concurrent and interrelated phases (each with their own set of objectives, outlined later in this report):

- Phase 1 – Forest product development pilot.
- Phase 2 – Traditional Owner engagement.
- Phase 3 – Forest resource assessment.
- Phase 4 – Indigenous community capacity building.

The following sections provide background context to (and justification for) the East Arnhem project, details for each of the project's four Phases, and an overview of the structure and content of the remainder of this project Final Report.

Background to the project

The project concept was first developed in discussions with Gumatj Corporation in 2017/18. Gumatj were concerned about their long-term sustainable timber supply, given that the organisation's sawmilling operations have relied on timber sourced from bauxite mine leases prior to land clearing for mining operations, and that bauxite mining in the East Arnhem region would end in the years ahead. Gumatj therefore considered where on its traditional lands timber could be sourced after mining. After discussions with the Birany Birany elders and other community members over an extended period, it was decided to go ahead with a native forestry trial in this community. The broader project concept then developed from these with Gumatj and the Birany Birany community.

The need for the R&D work undertaken in the East Arnhem project was then identified and formally documented in the Cooperative Research Centre for Northern Australia (CRCNA) project '*Northern Forestry & Forest Products Industry Situation Analysis*' (Stephens et al. 2020).

UniSC was a partner in the delivery of the 'Situation Analysis' project (alongside Timber QLD, ABARES, the NT Department of Primary Industry & Resources, the QLD Department of Agriculture & Fisheries, and Industry Edge). UniSC's role was to undertake a review of Indigenous forestry in northern Australia. That work resulted in a research paper – '*Developing Indigenous commercial forestry in northern Australia*' (Meadows et al. 2020), published in the peer-reviewed scholarly journal Australian Forestry.

Some of the key needs for developing a commercial Indigenous-led forestry industry in northern Australia identified in Meadows et al. (2020) were implemented as part of this East Arnhem project.

A brief literature review

The following literature review is an adapted excerpt from Meadows et al. (2020).

The East Arnhem region in the Northern Territory contains more than 3 Mha of native forests (approximately half of the total forest in 'Arnhem Land', as depicted in Figure 2). These forests vary greatly in their character, condition, and productive potential, reflecting the variable climatic and edaphic conditions and forest management histories. East Arnhem's forests have globally important biodiversity and ecosystem service values (MIG & NFISC, 2018). The region's native forests have also been assessed as being potentially available and suitable for commercial wood production[1] (MIG & NFISC, 2018) (Figure 3). These potentially commercial forests are dominated by expansive tracts of eucalypt woodlands and open forests of medium height. Commercial species include *Eucalyptus tetrodonta* (Darwin stringybark), *Corymbia nesophila* (Melville Island bloodwood), *Erythrophleum chlorostachys* (ironwood) and *Callitris intratropica* (northern cypress pine). The region's native forests currently support a very small but socioeconomically important forestry and forest products industry.

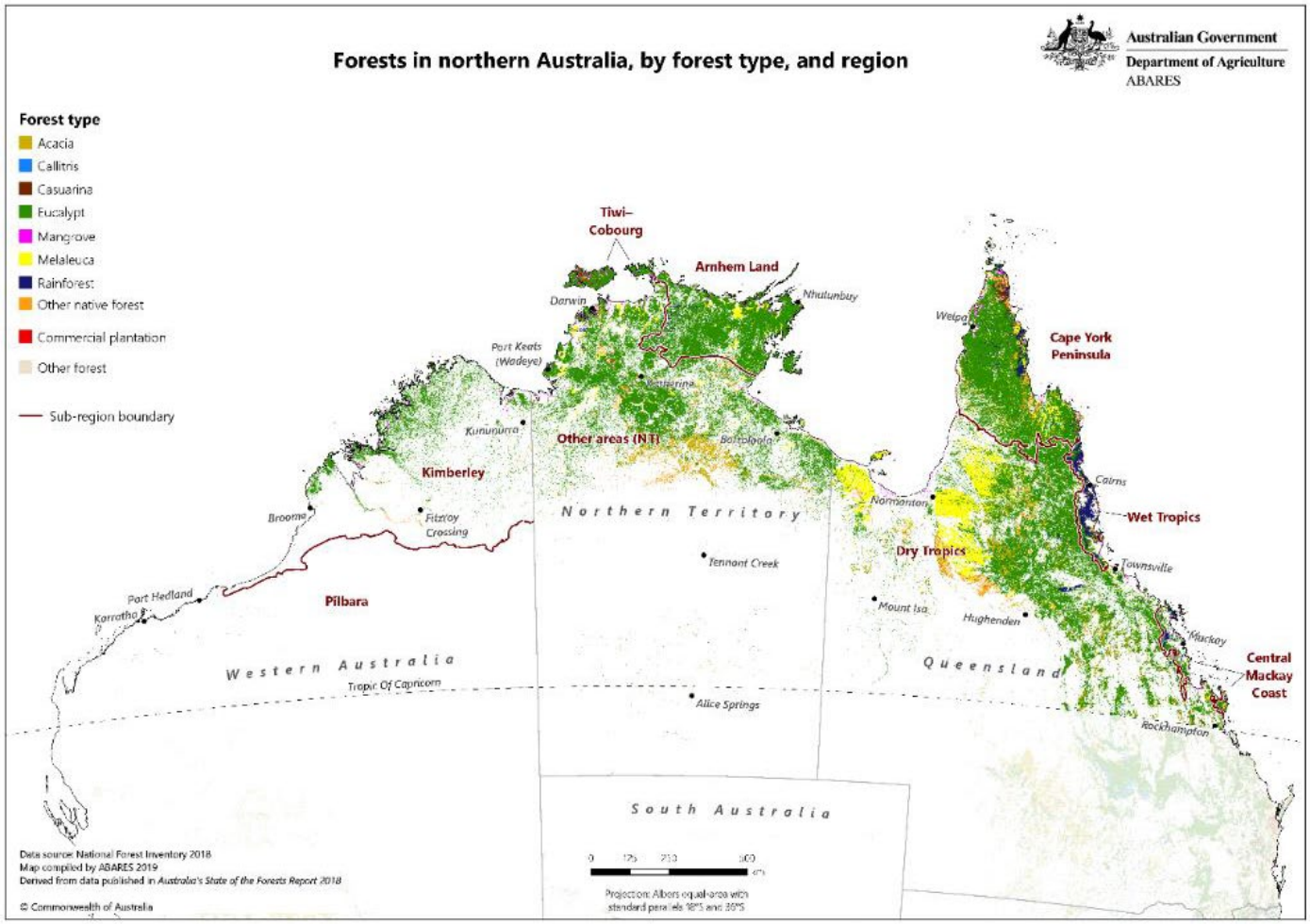

Figure 2. Forest types in northern Australia, by jurisdiction and region. **Source: ABARES (2019, data provided for the CRCNA [Stephens et al. 2020] project).**

All of East Arnhem's native forests are on Indigenous land. These forests are an important part of northern Australia's Indigenous forest estate, which is defined as forests over which Indigenous peoples and communities (i.e., Aboriginal and Torres Strait Islander peoples and communities) have ownership, management or special rights of access or use (MIG & NFISC, 2018). The estate comprises four Indigenous ownership and management categories – Indigenous owned and managed, Indigenous managed, Indigenous co-managed, and other special rights. In the East Arnhem region, all of the forests are 'Indigenous owned and managed'. This includes Native Title and other freehold lands (e.g., Aboriginal Lands under the Aboriginal Land Rights Act [NT] 1976, Deed of Grant in Trust lands), areas subject to Indigenous Land Use

[1] Includes areas mapped as potentially 'available' (i.e., on suitable tenures – not legally restricted from wood harvesting) and 'suitable' (i.e., having a commerciality rating of very low or higher) for commercial sawlog (or veneer log or high-value equivalents) production. 'Commerciality' is derived from a combination of merchantability and productivity.

Agreements (ILUAs, e.g., mining and infrastructure developments) and some Indigenous Protected Areas (IPAs). These areas could be available and suitable for commercial wood production. But there is limited knowledge of the commercial values of these forests. Current (but limited) Australian government datasets suggests that these forests have a low (i.e., MAI 0.15-0.28 m3/ha/yr) or no commercial potential (Davey and Dunn, 2014; and contrast Figures 2 & 3). The allocation of commerciality rating in this dataset is restricted to sawlog commerciality and does not consider access, transport, management intent, market changes or changes in broader economic factors. Nor does it indicate the volumes of standing merchantable sawlog (or other product) potentially available for harvest. Finer-scale analyses are therefore needed to more accurately determine the commercial values of East Arnhem's native forests.

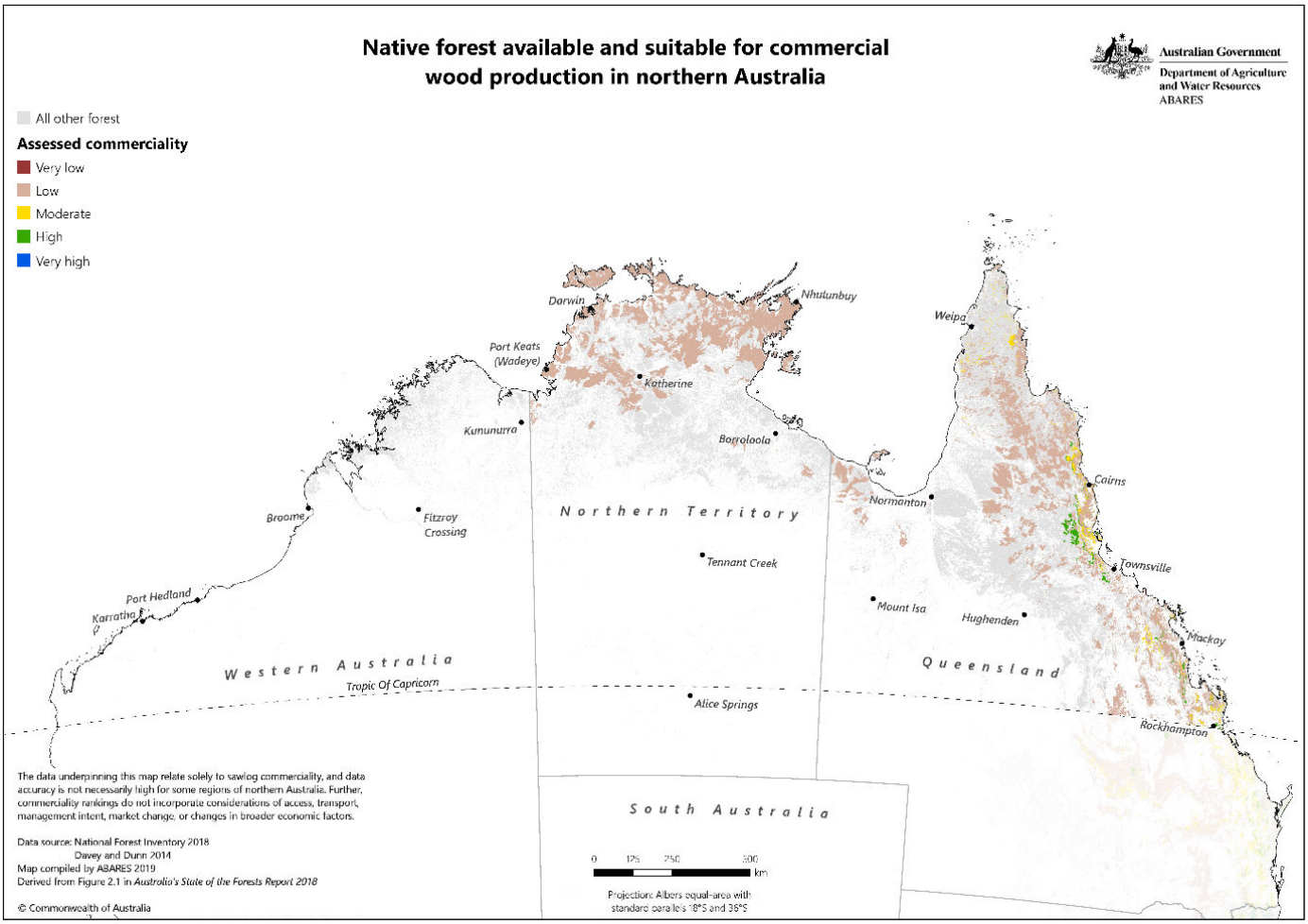

Figure 3. Areas assessed as being potentially available and suitable for commercial wood production in northern Australia. Source: ABARES (2019, data provided for the CRCNA [Stephens et al. 2020] project). All other forest = areas either not available or not suitable for commercial wood production.

Along with other parts of northern Australia, East Arnhem's Indigenous forestry industry is small and fragmented (BDO Consulting, 2004), with limited examples of Indigenous owned and managed land being used for commercial forestry (MIG & NFISC, 2018). Small-scale sawmills have operated in some communities in the region (e.g., Annandale & Taylor, 2007; Feary, 2008; Pearson & Helms, 2012; ALC, 2018). An integrated Indigenous forestry businesses (i.e., Gumatj Corporation) is harvesting from native forests, including salvage harvesting ahead of mining developments, and marketing logs, sawn-wood and other value-added products (Pearson & Helms, 2010; Marley, 2017). Native forest operations also include small-scale harvesting for production of high-value art and craft (e.g., yidaki [didgeridoo], sculptures) (Griffiths, 2003; Koenig et al. 2011a) and bespoke, high-end furniture (Pearson & Helms, 2011). These activities provide opportunities for Indigenous training, employment, and direct involvement in forest management (Halkett et al. 2012; Loxton et al. 2012; MIG & NFISC, 2018), but the sector remains far from its potential for increased Indigenous community participation (Feary et al. 2010). The 2005 National

Indigenous Forestry Strategy (BDO Consulting, 2004; Anon., 2005[2]) highlighted this potential and proposed a framework to support industry development, but there has been little progress on implementation. The Australian Government's current (2018) National Forest Industries Plan[3] notes that there continues to be significant opportunities for development of forest resources on Indigenous owned and managed land. Australia could learn from the progress on Indigenous community forestry and the driving support programs in other countries including Canada and other parts of the Americas (e.g., Donovan et al. 2006; Smyth, 2007; Stevenson & Perraeult, 2008; Wyatt et al. 2013; Hogdon & Sandoval, 2015; Mausel et al. 2017; Sessions et al. 2017; and see websites[4]). But there remain significant challenges to enterprise and industry development in the East Arnhem region, including resource knowledge and access, business management deficiencies, and biophysical, supply chain and social factors (BDO Consulting, 2004; Halkett et al. 2012; MIG & NFISC, 2018). Lessons from the experiences of Australian and overseas-based Indigenous forestry enterprises (past and present), and better understanding of local-level opportunities, challenges and needs, will help inform industry development.

Development of Indigenous forestry enterprises in East Arnhem could benefit the region's Indigenous communities. Many of these communities are remote and among the most socio-economically disadvantaged in the country (Annandale & Feary, 2009; Whitehead, 2012). Limited availability of 'real jobs' and low employment, poverty, inadequate housing, poor health, and low levels of education and skills are common (Whitehead, 2012). Elders are increasingly concerned about a declining connection to country and decreasing traditional knowledge among younger generations. Development of Indigenous forestry enterprises can help to overcome these issues. Such businesses could provide meaningful jobs and income, training and skills development, and create a job-ready workforce. Indigenous forestry enterprises could also support local infrastructure developments, reducing expensive timber imports, and benefit the environment through increased active forest management. An Indigenous forestry and forest products industry is also considered culturally appropriate development, matching the Indigenous peoples' long tradition of forest management to support livelihoods through 'Caring for Country' (Feary, 2008; Whitehead, 2012) and community interests in forest-based economic development (BDO Consulting, 2004). The integration of Indigenous land management practices with contemporary forestry management may assist in transferring traditional knowledge and practices to the next generation of young Indigenous people.

Development of Indigenous forestry enterprises throughout East Arnhem Land could advance Indigenous self-determination and economic independence, reducing the problem of intergenerational unemployment and welfare-dependency (Anon, 2005). Development of Indigenous forestry should therefore be a priority for developing the East Arnhem region (and elsewhere in northern Australia).

Project phases

Phase 1 – Forest product development pilot

A native forest harvesting, product identification, manufacturing, performance testing, and market assessment pilot.

The Phase 1 pilot included a Sustainable Native Forestry Demonstration Site (hereafter the 'Birany Birany Demonstration Site) established within commercially productive community-owned forest of the Birany Birany Homelands[5], infrastructure constructions in Birany Birany using timbers harvested from the Demonstration Site and processed on-site, supply of harvested logs to project partner QDAF's Salisbury

[2] www.agriculture.gov.au/forestry/policies/nifs
[3] www.agriculture.gov.au/forestry/publications/growing-better-australia
[4] Taan Forest https://www.taanforest.com/ and other Indigenous forestry enterprises in Canada https://ca.fsc.org/enca/newsroom/id/580 and the USA - Nez Perce Forestry (ID, USA) https://nezperceforestryandfire.com/forestry/ , Yurok Tribe Forestry (CA, USA) https://www.yuroktribe.org/departments/forestry/ , Menominee Tribal Enterprises (Wisconsin, USA) https://www.mtewood.com/Sawmill
[5] The Birany Birany community was selected as the location for the Demonstration Site based on the strong interest among community members to participate in this 'commercial forestry development' project. This interest was first expressed to project team members (Mark Annandale and Mila Bristow) during discussions and formal consultations that commenced in 2018, which were conducted as part of the preliminary planning for this project.

Research Facility (Brisbane) for processing and product development trials, and a survey of potential purchasers (and end-users) of the roundwood (bollard) product developed by QDAF.

Phase 1 objectives:

- Field-test a forest inventory approach at the pilot-scale for broader application in Phase 3.
- Establish a commercial forestry Demonstration Site within an Indigenous community-owned forest to understand local operational constraints associated with felling, hauling, processing, and getting forestry products to market.
- Integrate practical hands-on forestry training for East Arnhem Indigenous people into all aspects of the Demonstration Site.
- Use start-of-the-art small-diameter log processing technology to develop new forest products.
- Understand the characteristics and specifications of East Arnhem timber products.
- Identify potential local markets of interest for East Arnhem forest products.
- Determine further information needs to understand the viability of East Arnhem timber resources supplying the regional construction and import substitution market.
- Determine the price(s) the market is willing to pay for timber products that can be developed from East Arnhem forestry resources.
- Better understand the potential and success criteria for viable commercial forestry businesses in East Arnhem.

Phase 2 – Traditional Owner engagement

Consulting with Indigenous communities interested in commercial forestry and informing them of industry opportunities and practicalities.

The Phase 2 consultations were led by project partner DEAL, delivered through the organisation's '*East Arnhem Landowner Prospectus*' project in collaboration with other regional stakeholders and with support from the Northern Land Council (NLC), and UniSC and NT Government researchers.

Phase 2 objectives:

- Understand which East Arnhem Traditional Owner communities are interested in commercial forestry and their capacities to pursue this business opportunity so that these locations/communities could be prioritised during Phases 3 and 4.
- Support the provision of further technical engagement with communities who have expressed an interest in commercial forestry.

Phase 3 – Forest resource assessment

An assessment (inventory) involving desktop analysis and field-based surveys of the commercial forests of East Arnhem.

The Phase 3 inventory quantified timber (and non-timber) resources located on the traditional lands of Indigenous communities throughout East Arnhem. This Phase built on technical outcomes of the Phase 1 pilot and became an endorsed next step for assessments on the lands of Traditional Owner communities interested in forestry, after positive engagement with these communities through the outcomes of Phase 2. The forest inventory involved Traditional Owners as active participants (including trainees and field guidance from elders).

Phase 3 objectives:

- Understand (geographically) what forests of East Arnhem have commercial forestry potential and what the productivity and product mixes of these forests are.

- Integrate government mapping, spatial data, and other technologies to complete the forestry inventory in prioritised locations.
- Identify forest products that can be sustainably harvested to maximise local utilisation and community benefits through local value-adding opportunities.

Phase 4 – Indigenous community capacity building

Working with the Indigenous communities with identified potential to operate forestry enterprises to develop their forestry workforce and business opportunities.

The Phase 4 activities helped build the business capacity of Traditional Owner communities with commercial forests, and interests in and potential to operate commercial forestry enterprises, as identified through project Phases 1-3. This Phase of the project also helped to enhance the potential for long-term support for commercial forestry development in East Arnhem by increasing the understanding of regional stakeholders of what sustainable native forestry is and its potential to support regional development.

Phase 4 objectives:
Workforce development –

- Train community members in forest resource assessment for supply of commercial timber and non-timber forest products.
- Train community members in managing forest harvesting operations and value-adding processes for forestry products.

Business development –

- Support the establishment of business structures to enable forestry development, including models such as joint ventures and partnerships for product manufacturing.
- Identify collaborative opportunities and synergies of operations.
- Small business incubation as required.
- Identify infrastructure and capital needs to establish commercial forestry businesses.
- Build capacity of the Community Development Program (CDP) to further incubate Indigenous employment and business opportunities.

Report structure and content

The remainder of this Final Report is structured as follows – the methods used in implementing the project's key activities are provided next, followed by a Results and Discussion section. This first outlines how the project has achieved its overarching objectives, its milestones, and the key deliverables for each project Phase, before discussing results of each of the project's key activities. Throughout the Results & Discussion sections, key project documents/outputs are referred to for further detail. Recommendations regarding future needs and further research for development relating to the work undertaken in this project are then outlined, followed by concluding comments. References and Acknowledgements sections follow. The report ends with an Appendix providing a comprehensive list of the project's outputs, including all reports, posters, factsheets and other documents, and media outputs including presentations, videos, and recordings.

Methodology

An overview of the methods applied for each of the project's key activities are outlined below.

Sustainable Native Forestry Demonstration Site

The Birany Birany Demonstration Site was established in September 2020, located within an ~200 ha area of the Birany Birany community forest, under the guidance of the Birany Birany Traditional Owners. Birany Birany community members designated an area adjacent to the community airstrip to be utilised for the harvesting and silvicultural management activities to demonstrate commercial forestry operational and silvicultural management principles to the community and other regional forestry and economic development stakeholders.

Discussions with the Birany Birany community on forest harvest planning, low-impact harvesting, tree selection, site selection for sawmilling operations, and other technical forest management information were held in November 2020 and February 2021. Harvesting/silvicultural treatment within the Birany Birany site was then conducted during a three-week fieldtrip in May (4-25) 2021. All logs cut were documented for species, size class, and product. All harvesting operations adhered to industry best-practice silviculture and Workplace Health & Safety guidelines (i.e., QLD Code of Practice for Sustainable Native Forest Harvesting), and had the Indigenous community's free, prior and informed consent (FPIC – evidenced through the prior consultations with the Birany Birany community dating back to 2018, and the Northern Land Council [NLC] research permit obtained for the work).

Trees were harvested from an approximately 7.7 ha area within the Demonstration Site and processed on site using the portable Lucas sawmill (purchased specifically for this project). The processed timbers were used for the shelter constructions in Birany Birany (and all offcuts used for other applications, detailed elsewhere in this report). Products harvested were primarily sawlogs, with some small poles processed into boxed-heart poles. All bark from harvested trees was utilised, being processed using traditional preparation/preservation methods, and then sold as a high-value non-timber forest product to the regional Buku-Larrnggay Mulka Art Centre (in Yirrkala).

The Birany Birany Demonstration Site was an integral component of the project's activities around facilitating practical (hands-on) Indigenous community forestry workforce capacity and skills building (Phase 4). This included capacity building in forest inventory, sawmilling, and construction. In collaboration with the Birany Birany community members, the forest inventory method (using a data collection mobile phone app specifically developed for this project) was purposefully field-tested and refined at the Demonstration Site before more widespread application at other community forests as part of Phase 3 activities.

Further details of the Birany Birany Demonstration Site establishment were provided in the **Milestone 1 Report** and **Milestone 2 Report**, and location details provided in the **Birany Birany Harvest Area Map_May 2021** document.

Traditional Owner engagement

Facilitated group discussions with Traditional Owners in remote communities were conducted by DEAL as part of the organisation's '*East Arnhem Landowner Prospectus*'. The consultations used best-practice community engagement techniques developed by the NLC and ARDS Aboriginal Corporation, and were appraised by Arnhem Land Progress Aboriginal Corporation (ALPA), Northern Territory Government (NTG), and National Indigenous Australians Agency (NIAA). Using technical knowledge and stakeholder relationships, DEAL with their collaborative partner Social Ventures Australia (SVA), also developed consultation materials and site-specific mapping as part of these consultations. The practical applications of this material was assessed with Traditional Owners ahead of consultations to ensure aptness.

The consultation process also adopted learnings from the methodology developed by UniSC on forestry engagement (through a prior related project undertaken with the Birany Birany community in 2019), to provide technical forestry information in a format for informed discussions. UniSC and NT Government researchers supported the Prospectus by contributing to the consultation materials and participating in follow-up in-field discussions with communities (to address technical forestry-related questions) where interest in commercial forestry was identified. The UniSC and NT Government researchers conducted all initial and more intensive follow-up consultations with the Birany Birany community as this community became a core project partner by hosting the Demonstration Site.

Full details of the Traditional Owner engagement and implemented consultation approach are provided in the document entitled '**Phase 2 (Traditional Owner engagement) MS3 Progress Report, 1 August 2021 – 28 February 2022**' prepared by DEAL and completed in February 2022.

Forest resource assessment

Forest inventory datasets were gathered from 5 prioritised 'communities/sub-regions' – Birany Birany, Baniyala, Central Arnhem Highway, Dhalinbuy, and Gove Peninsula (Rio Tinto Mining Leases). The most intensive inventory was intentionally conducted in areas within a viable transport distance of the Gumatj sawmill (the Gove Peninsula sub-region), and within the Birany Birany Demonstration Site.

The inventory used a stratified random sampling technique. Data were collected using 10 m-wide striplines of varying lengths (from 40 m up to ~1.3 km). Striplines were located within areas that were representative (of similar type and appearance) of the forest throughout the broader surrounding area. The selected areas were also easily accessible from nearby roads/tracks. To avoid edge effects biasing the sample, forest inventory teams walked 20-50 m into the forest from nearby roads/tracks before commencing the inventory. A total of 69 striplines were completed.

All trees within the striplines at or above 10 cm diameter at breast height over bark (DBHOB) were identified for species and assessed for DBHOB, tree category (i.e., commercial product [sawlog or 'other'], habitat tree, and a silvicultural strategy of 'cut' or 'keep'), and product length. Data were recorded using the mobile phone app developed specifically for this project. All inventory work was conducted in collaboration with the local Traditional Owners as part of the local capacity building initiative supported by the project, whereby the Traditional Owners were trained in commercial forest assessment, decision-making, and associated data collection using the app.

Cleaned inventory data was imported into Quantum GIS (QGIS) v3.16.7 and a Microsoft Excel spreadsheet. In the absence of site/species-specific taper functions, potentially merchantable volumes were calculated using Huber's formula (West, 2015). An estimate of centre diameter under bark was made using a formula derived from Matthews (n.d.). Volumes, basal area, and stem-counts from samples were summarised in Excel using pivot tables and charts.

A 20% 'dud factor' was applied to the estimated standing commercial timber volumes and mean merchantable stems per hectare. This accounts for trees assessed as merchantable through visual inspection but that could contain unseen defects rendering them unsuited to commercial timber production.

Full details of the forest inventory method are provided in the '**East Arnhem Forest Inventory – Summary Report**' completed in August 2023.

Timber product development

A shipping container of short-length (approx. 2.2 m) small-diameter (ranging from 168 – 358 mm centre diameter over bark) Darwin stringybark (*Eucalyptus tetrodonta*) logs (108 in total) harvested from the

Birany Birany Demonstration Site was sent to project partner QDAF's Salisbury Research Facility (Brisbane) for a product development trial. The QDAF study aimed to provide a preliminary technical investigation into both roundwood processing (targeting bollard production using spindleless lathe technology) and rotary veneer processing using the supplied logs.

The roundwood processing experiment commenced with the allocated logs being debarked and rounded in a dedicated rounding lathe targeting the removal of the non-durable sapwood, log ovality, log sweep and log taper. This process resulted in a cylindrical bollard or post type roundwood product containing only the naturally durable heartwood. The bollards were then subject to different treatments – 2 x drying methods and 3 x surface coating systems, a total of 6 different treatment groups. The 2 drying methods were: 1) an indoor, weather protected ambient South-east Queensland (SE Qld) air-drying condition, and 2) accelerated drying in a solar kiln. The solar kiln drying conditions were selected to simulate similar conditions (temperature and humidity) to what the roundwood products might be exposed to if air-dried in the northern Australia region, while the gentler drying conditions of air-drying in SE Qld represented more conservative conditions aimed at minimising possible drying degrade (e.g., splitting). Thirty-six roundwood products were assigned to each drying method. The three surface coating systems targeted a reduction in drying induced degrade by slowing the roundwood product drying rate. The surface coating treatments were: 1) a control (no coatings), 2) emulsified wax end-sealant applied on the roundwood ends only, and 3) emulsified wax end-sealer applied on the roundwood ends and the longitudinal surfaces coated with a penetrative oil. Following their surface coating application, the bollards were exposed to their respective drying conditions for 171 days, during which measurements of maximum end check, largest end split, and surface checking were taken at regular intervals.

The rotary veneer processing experiment commenced with the allocated logs being pre-heated using saturated steam until the log cores reached approximately 55ºC. Immediately after being pre-heated, logs were debarked, and rounded in a dedicated rounding lathe before being peeled into rotary veneer. Veneer processing was undertaken using a semi-industrial scale spindleless veneer lathe. For this study, nominal dried veneer thickness was selected as 3.0 mm. The resulting veneer ribbon was subsequently clipped, targeting a maximum sheet width of 1300 mm (targeting a final dried and trimmed veneer sheet width of 1200 mm). Sheets with widths below 1300 mm, but above 300 mm, were also recovered. Clipped veneer sheets were labelled with a unique identifier and dried in a solar kiln to approximately 10% moisture content. The dried veneer sheets were subsequently measured for dried veneer thickness, and dried veneer width. Assessments of veneer quality (in accordance with Australia and New Zealand Standard AS/NZS 2269.0:2012) and veneer recovery were also undertaken.

Full details of the timber product processing experiments including data analysis methods are provided in the '**Roundwood & Veneer Processing Investigations**' report (prepared by QDAF) completed in September 2022.

Market survey

The market research focused on the Darwin stringybark (*Eucalyptus tetrodonta*) timber bollards developed by project partner QDAF as one component of the project's Phase 1 activities. The market assessment was a preliminary analysis of the commercial viability of the stringybark bollards. Using a questionnaire and interviews, potential bollard purchasers were surveyed about their perceptions of and experiences with the product, including quality and suitability to end-user needs. A shipment of finished bollards was returned to Darwin and East Arnhem for display and trial end-use application. This was an important means of promoting the product, ensuring that some of the survey respondents were able to obtain 'hands-on' experience with the product, and to commence preliminary monitoring and evaluation of the product's in-ground performance.

The market assessment component of the Phase 1 Pilot was reviewed by the UniSC Office of Research (Human Research Ethics Committee - HREC) and granted ethics approval. Initial approval was granted on 16th July 2020. Following amendments to the survey process and questionnaire, an additional review was sought. Ethics approval was again granted on 6th July 2022 and was valid until 16th July 2023 (approval no. A201406). The ethics approval number was stated on all survey documents provided to survey respondents. Contact details for the project's UniSC Project Lead (Dr John Meadows) and the UniSC HREC were also provided on all survey documents. Respondents were encouraged to use these contacts if they had any concerns or complaints about the way the project was conducted.

A short qualitative review of Gumatj Corporation's current and planned future timber production, markets, and marketing strategies was also undertaken, given that the Gumatj-operated Nhulunbuy sawmill is a key regional timber processing facility with potential to support bollard and other commercial timber production opportunities for East Arnhem's remote Indigenous communities and Homelands.

Full details of the market assessment methodology are provided in the '**East Arnhem Forest Product Market Assessment Report**' completed in June 2023.

Indigenous community capacity building

The Indigenous community capacity building included commercial forestry workforce development and commercial forestry business development activities.

The **workforce development activities** centred around training of Traditional Owners. Practical, on-the-job (paid) forestry training and skills building was an integral part of the project. Training activities, two-way learning, and knowledge sharing between the project team and Traditional Owners occurred as part of the Birany Birany Demonstration Site, the forest resource assessments (inventory) conducted at three Homelands (Birany Birany, Dhalinbuy and Baniyala), the selective harvesting, milling and shelter construction activities at Birany Birany, and the Forest Garden design and establishment at Birany Birany.

The **business development activities** centred around communicating the value proposition of sustainable native forestry business, and Indigenous provenance timber and non-timber forest products, among East Arnhem Traditional Owners, potential collaborative business partners, and other regional stakeholders, supporting the development of Gumatj's new Indigenous-led forestry business strategy, and supporting commercial forestry business development at the remote Indigenous community/Homelands level. Focus was on the Birany Birany Demonstration Site and roundwood product manufacturing.

Results & Discussion

Achievement of project objectives

- **Understand the interests and capacities of East Arnhem Traditional Owners to participate in the forestry industry, and to support community capacity to operate viable commercial forestry businesses.**

The project has achieved an increased understanding of the interests and capacities of a small sample of East Arnhem communities to participate in a sustainable, small-scale native forestry industry (e.g., Birany Birany, Baniyala, Dhalinybuy). It has commenced the process of workforce and business development by focusing on informing, educating, and upskilling members of the Birany Birany community in commercial native forestry operations and associated business opportunities (including business planning and management tasks). The project's workforce (training) and business development outputs (with an emphasis on the Birany Birany Demonstration Site) can be a model for Indigenous community native forestry capacity building that can be refined for application in other East Arnhem communities and other areas of northern Australia.

- **Understand the East Arnhem forest resource, including commercial forest distribution, forest productivity, the potential timber (and non-timber) product mix, and what products have the best commercial potential.**

The project has achieved an increased understanding of the East Arnhem forest resource, from a commercial forestry perspective, while also highlighting the need for further forest inventory throughout East Arnhem. Multiple Indigenous community forests have been identified that should be priority areas for further inventory work. Products (and services) identified to have the current best commercial potential are – solid sapwood-free naturally durable roundwood products in the 100-300 mm diameter range and in lengths of up to 3 m, 'shelter kits' utilising sawn timber and/or roundwood products, yidaki sourced from small hollow trees, other traditional artefact products made from small stems (thinnings) and local processing off-cuts (including spears 'Gara' and clapsticks 'Bilma'), bark sheets (canvasses) for sale to the local art market, and ecosystem services (including biodiversity and cultural ES, and carbon storage).

- **Develop value-added timber products from logs sourced from East Arnhem Indigenous-owned native forests, to better understand the product characteristics, specifications and processing protocols, and potential markets for these products including the constrains for product development and delivery to buyers, and buyers' perceptions of/experiences with the products and supply chain.**

The project has developed value-added products from logs sourced from East Arnhem forests, focusing on roundwood (short-length, small-diameter posts and bollards) and 'Shelter Kits'. The research into the roundwood processing and product development has increased understanding of the characteristics of the logs suited to this product and the processing protocols for commercial roundwood production. A construction protocol for the 'shelter kit' product was prepared. A market survey for the bollard product was completed, giving valuable insights into potential purchasers' interests in, demands for, and expectations around product quality.

Achievement of project milestones

All project Milestones have been achieved. Milestone Reports 1 to 6 were completed in full and submitted on time to the Project Steering Committee and FWPA (details in Table 1). All Milestone Reports were accepted (endorsed) by the Project Steering Committee and FWPA.

Table 1. Milestone Reporting Schedule*

Milestone	Milestone Achievements	Due Date	Status
Commencement	Project start	26th June 2020	Commenced
Milestone 1	Phase 1, EO**1 (progress)	15th December 2020	Completed (and endorsed)
Milestone 2	Phase 1, EO 1 (complete)	1st August 2021	Completed (and endorsed)
Milestone 3	Phase 1, EOs 2 & 3 (progress); and Phase 2, EO 1 (progress)	28th February 2022	Completed (and endorsed)
Milestone 4	Phase 3, EO 1 (progress); Phase 1, EO 2 (complete) & EO 3 (progress); Phase 2, EO 1 (complete)	16th September 2022	Completed (and endorsed)
Milestone 5	Phase 1 EO 3 (complete); Phase 3, EO 1 (complete)	15th December 2022	Completed (and endorsed)
Milestone 6	Phase 4, EOs 1 & 2	31st August 2023	Completed (and endorsed)
Milestone 7	Milestone 7 Short Report & Final Report	30th November 2023	Completed (and endorsed)

*Milestone Achievement details and due dates for some Milestones were changed from those outlined in the project's initial 'Funding & Project Agreement'. Changes were formalised through variations signed off by FWPA and UniSC, generating 'Revised Milestone Schedules'.
**EO – Expected Outcome
Phase 1, EO 1 = Harvest trial/demonstration site.
Phase 1, EO 2 = Hardwood product development.
Phase 1, EO 3 = Assessment of product markets/potential purchasers.
Phase 2, EO 1 = Traditional Owner engagement/East Arnhem Prospectus.
Phase 3, EO 1 = East Arnhem forest resource assessment.
Phase 4, EO 1 = Indigenous capacity building (workforce development/training).
Phase 4, EO 2 = Indigenous capacity building (developing business opportunities).

Achievement of project phase deliverables

The Phase 1 key deliverable was met – A harvesting and marketing pilot to identify, manufacture and market-test value-added timber products from logs sourced from East Arnhem native Indigenous-owned forests was completed.

The Phase 2 key deliverables were met – mapping of East Arnhem showing interested communities and their relevant Country, to assist in prioritising and focusing forest inventory during subsequent Phase 3 works, was completed. A Progress Report on the consultations conducted by DEAL (up to August 2021) was completed, articulating the forestry discussions held and identifying areas for further engagement and information sharing around potential forestry development opportunities and their respective challenges. A Final Report on the community (and business/organisational) engagement and consultations planned by DEAL for implementation during 2022 (as noted in the Progress Report) was not received.

The Phase 3 key deliverables were met – mapping and reporting of East Arnhem forests with commercial forestry potential, and development of simple but credible forest assessment tools (including a mobile phone app for data collection) that can be utilised by local Indigenous communities to undertake inventories of their forests were completed.

The Phase 4 key deliverables were met – Traditional Owners were trained in technical forestry operations, new forest products were manufactured to support Gumatj's plans for expansion of its current sawmilling business, and Traditional Owners from communities with commercial forestry potential were linked with prospective product purchasers and other collaborative business partners and investors.

Sustainable Native Forestry Demonstration Site

Establishment and management of the Birany Birany Demonstration Site was effective at showcasing to a range of stakeholders the entire operational process involved in a sustainable, small-scale, selective, and integrated harvest forestry operation, including subsequent use of the harvested and locally milled timbers in community infrastructure. The Demonstration Site was also a highly effective 'practical tool' in the training of Birany Birany Traditional Owners in managing forest harvesting operations and value-adding processes.

Demonstration Site activities that supported the training of Traditional Owners included the process of site selection for the Lucas mobile (portable) mill, collecting forest resource data, assessing the forest resource to determine how and where harvesting would take place, selecting trees for harvest, the felling and merchandising of trees into logs, the collection and transport of logs from the forest to the mill, and the milling of timber for specific value-added end-uses, including the shelters constructed in the community and the assembling of 'Shelter Kits' that were provided to Gumatj Corporation in Nhulunbuy as a prototype commercial forest product.

A total of 49 Darwin stringybark trees were harvested from the approximately 7.7 ha harvested area within the Demonstration Site. These harvested trees amounted to around 14 m^3 of merchantable logs, of which approximately 1.8 m^3/ha were sawlogs. Income was generated for 8 Birany Birany women through sale of the bark that they collected from the harvested trees and processed using traditional methods.

There is anecdotal/observational evidence that the selective timber harvesting and post-harvest silvicultural treatment (thinning) and other subsequent disturbances (including fire and indiscriminate bark harvesting within the established Permanent Growth Plots) not managed by the project team have resulted in a substantial regenerative growth response in the forest. Traditional Owners and project team members have observed a marked increase in species diversity in the regenerating understorey. Scientific validation of these observations is required to quantify the growth response from a range of perspectives, including future commercial timber productivity, and local biodiversity and cultural value (e.g., traditional bushfood and medicinal species) enhancements.

Overall, the intensive engagement with Birany Birany community members through the Demonstration Site establishment and management enabled the sharing and discussion of Traditional Owner forest management knowledge, values, and practices in a hands-on way with the project team, and for the team to pass on knowledge around western science commercial forestry perspectives and practices. Beyond the high value of the Demonstration Site for this knowledge exchange and training of the Birany Birany Traditional Owners, it was also highly valuable in showcasing the Indigenous commercial forestry potential to other Traditional Owners in the region, and regional forestry, Indigenous land management and economic development stakeholders. This was achieved through the project Workshops held at Birany Birany in September 2022 and July 2023. Details of these Workshops, including attendees, activities, and topics of discussion, are provided in the **Workshop 1 Report 2022** and the **Workshop 2 Report 2023** documents.

Forest resource assessment

The initial aim of the forest resource assessment was to conduct 'a comprehensive inventory (desktop analysis and field-based surveys) of the commercial forests of East Arnhem'. Fieldwork constraints[6] limited the community forests that the project team could undertake inventory in. A 'comprehensive inventory' across the East Arnhem region, or even within some initially targeted communities (e.g., Ramingining, Gapuwiyak, Galiwin'ku), was not possible. The data collection was therefore shifted from a regional focus to a finer-scale community-level – with the inventory focusing on Birany Birany, Baniyala, Central Arnhem Highway, Dhalinbuy, and Gove Peninsula (Rio Tinto Mining Leases).

[6]Including Covid and seasonal travel restrictions, and incomplete Indigenous community engagement by project partner DEAL during the organisation's Phase 2 activities.

Despite the shift in coverage of the forest assessments, Phase 3 objectives and key deliverables were still met, namely:

- Improved understanding of the locations of forests with commercial forestry potential in East Arnhem, and analyses of the productivity and potential product mixes of targeted areas of these forests.
- The development and field-testing of a mobile phone app for conducting forest inventory in East Arnhem. Traditional Owners were trained to use the app to complete forestry inventories in prioritised locations. Development of the mobile phone app and the Traditional Owner training were part of the project's Indigenous community capacity building (workforce development) activities.
- The design of a simple and credible forest assessment methodology (supported by the mobile phone app) that can be replicated in other Indigenous community forests in East Arnhem, giving communities an improved understanding of the forest products that can be sustainably harvested from their forests and value-added and utilised in the community (or for external sales) for community benefits.

The inventory results give an indication of the types and quantities of timber and non-timber forest products that could be available from selective harvesting of commercially productive Indigenous community-owned forests elsewhere in East Arnhem. Key results are:

- The dominant commercial species is Darwin stringybark (*Eucalyptus tetrodonta*).
- The mean stems per hectare ranged from around 170-300.
- The forests are comprised of trees predominantly in the 10-30 cm DBHOB range.
- Basal Area ranged from around 7-10 m2/ha.
- The potentially merchantable standing volume ranged from around 11-20 m3/ha.

The full forest inventory datasets for the community-owned forests remain confidential. A decision to maintain data confidentiality was confirmed by Traditional Owners of the community forests, through a community-defined Free Prior and Informed Consent (FPIC) process with a local Indigenous interpreter, at a 3-day Workshop held at Birany Birany in July 2023. Traditional Owners confirmed that the data shall currently remain not for public distribution, and that they will decide who they share the data with and how it could be used to support any community-based commercial forestry activity in the future.

Key discussion points around the forest inventory results include:

- The potentially merchantable standing volume of 11-20 m^3/ha includes trees currently available for harvest and trees to be retained to grow into future commercial timber products. Harvestable timber and non-timber products could include:
  - Sawlogs (evidence from the Birany Birany Demonstration Site suggests the sawlog volume is a low proportion of the total standing merchantable volume. At Birany Birany, sawlogs amounted to ~1.8m^3/ha of a total of ~14m^3/ha of merchantable logs),
  - Roundwood (short posts, poles, and bollards),
  - Small logs (pieces) for high-value traditional artefacts (including didgeridoo, spears, clap sticks) or furniture, and
  - Bark canvasses.
- There is a high variability in forest productivity (commercial timber production potential) throughout East Arnhem, with a general trend of declining forest productivity from the east to the west. Forests with greater commercial forestry potential are expected to be found in areas closer to the coast in the northern and north-eastern parts of East Arnhem.
- Most forests will require increased active silvicultural management to maintain and enhance their commercial forestry potential. This includes forest thinning, controlled fire in ways that integrate western science and Indigenous traditional knowledge and practices, and sustainable bark harvesting practices.
- With consideration of forest productivity and access constraints, there is estimated to be ~131,000 ha of potentially commercial forest resource in targeted areas of East Arnhem. This includes areas

around the 5 assessed sub-regions plus Ramingining, Gapuwiyak, Galiwin'ku, Gan Gan, Wandawuy and Buymarr.

The project's forest inventory results provide an example of the commercial timber production potential in the East Arnhem context. The results cannot be considered representative of (or generalisable to) other parts of East Arnhem where forest inventory has not yet been undertaken. As a matter of due diligence, additional fine-grained forest inventory should be conducted in any East Arnhem community forest that is being considered for commercial timber production.

It is important to note that calculating a monetary value for the harvestable forest products was beyond the current project scope but could be undertaken in future research to inform Indigenous community decision-making about commercial native forestry business initiatives. Comprehensive forest valuations must include timber and non-timber products, particularly ecosystem service values, which could be traded in national and international markets (i.e., paid for by government and corporate investors).

In summary, the forest inventory has begun the process of addressing the knowledge gap regarding the lack of fine-scale, field-gathered data on the condition/productivity (and potential commercial product mixes) of East Arnhem's (and other areas of northern Australia) Indigenous-owned forests. The project's desktop analysis and ground-truthed data indicate that the region's forest resource is primarily in the 20-30 cm DBHOB size class with an upper size class sawlog limit at around 45 cm DBHOB, existing as a result of regular disturbance events such as cyclones, fires, and pest pressure from *Mastotermes darwinensis*. This provides integral information for the development of Indigenous forestry industries as it defines the products most suited to the resource. The information gathered (mapping and inventory data) and fieldwork experience gained by the Birany Birany and other Traditional Owners will support the community in their short-, medium- and long-term forest management decision-making, including in making informed decisions when dealing with potential external timber purchasers/enterprises.

Further details and discussion of the forest inventory results are provided in the '**East Arnhem Forest Inventory – Summary Report**'.

Timber product development

The forest resource in East Arnhem is dominated by Darwin stringybark (*Eucalyptus tetrodonta*). Darwin stringybark has a well-established reputation for providing high strength and naturally durable wood. Processed Darwin stringybark timber also has a long successful history of use in a range of structural products in construction projects, along with railway sleepers and timber bridge components. The project's forest inventory results indicate that logs available from commercial harvesting operations in the East Arnhem region are likely to be dominated by diameters of less than 40 cm, with a high proportion of logs being between 20 cm and 30 cm diameter. Logs larger than ~30 cm diameter can have a high likelihood of containing pipe, and logs larger than ~40 cm are almost certain to contain large pipes and other defects. While the wood properties of Darwin stringybark supports utilisation potential in a wide range of product options, the available log sizes and log qualities will constrain the product options.

The high potential for solid roundwood production from the Darwin stringybark resource was identified early in the project, hence it became a focus of the project's timber product development activity (led by project partner QDAF, at their Salisbury Research Facility) and the Market Assessment. The work by QDAF confirmed that solid roundwood products – specifically posts and bollards – are a new 'best-bet' commercial timber production opportunity for East Arnhem's Indigenous-owned forests. The work also determined that some roundwood products and veneer and engineered wood products (EWPs) are currently not viable timber product options to pursue in the East Arnhem context.

For the roundwood group of products, the supply of high-quality girders and poles from the East Arnhem forests would be expected to be negligible. The supply of piles may be more possible, however, markets for piles are often considered limited, cyclic in demand, and markets are likely to be substantial distances away from East Arnhem.

The log qualities available from the East Arnhem forests are insufficient to support a sliced veneer operation. Rotary veneer production is possible from the available logs from the East Arnhem forests and has been technically demonstrated in the project's trial studies (by partner QDAF). However, to establish a small-scale commercial operation would require a substantial investment (potentially in excess of $2M) in capital equipment. A significant skills capacity building program would also be required to support the initiative. In addition, markets for rotary veneer are relatively limited as commercial veneering operations mostly produce sufficient veneer for their own EWP manufacture (e.g., plywood).

Opportunities to manufacture EWPs in East Arnhem are also considered to be limited, at least in the medium term. The manufacture of glue-laminated beams (GLT) is probably the most possible, using suitable grade quality and seasoned sawn timber from milling operations. Depending on the end-use of potential GLT posts or beams, the manufacture would demand comprehensive quality assurance and certification processes. Darwin stringybark timber is also recognised as being difficult to glue, especially when targeting compliance with the relevant standards for structural products, therefore more detailed research would be required to support successful and market-ready GLT manufacture. Plywood and LVL are technically possible but would require substantial investment in addition to that noted above for rotary veneer production. Local market demand would also likely be insufficient to support a minimal scale of production, therefore requiring markets outside of East Arnhem to be accessed which may be economically challenging. Other EWPs such as reconstituted panels are unlikely due to be unsuitability of Darwin stringybark for many of these processes/products.

Roundwood (posts and bollards)

The work by QDAF has demonstrated a generalised roundwood product processing protocol. The logs were firstly debarked and rounded in the spindleless lathe (in equipment producing a 1.3 m product), targeting the removal of the non-durable sapwood, log ovality, log sweep, and log taper. This process resulted in a cylindrical bollard or post type roundwood product containing only the naturally durable heartwood. The bollards were then subject to different drying and surface coating treatments. Results included a highly acceptable log recovery rate of 44%. The drying trials indicated that the bollards dried without severe splitting and checking, either by air-drying or accelerated solar kiln drying. The coating trial found that applying end-sealer or end-sealer in combination with a penetrative oil coating showed some benefits in minimising log end-splitting and checking, alongside visual appearance improvements.

The roundwood processing, drying, and coating systems trialled by QDAF could all be easily applied in other timber processing settings, confirming the high potential for solid roundwood production (posts and bollards up to 3 m lengths) in the East Arnhem Indigenous community forestry context using the spindleless debarking lathe technology. Any further processing protocols would be inherently site- and business-specific, dependent upon factors including the log supply, target end-product and market requirements, and could be developed in a partnership between QDAF and the business operator.

Summary points justifying the project findings that solid roundwood products – specifically posts and bollards – are considered a new 'best-bet' commercial timber production opportunity for East Arnhem's Indigenous-owned forests include –

- **Post and bollard production is a match with the available forest resource –** the region's forests are dominated by trees in the small-medium diameter size classes (i.e., 10-30 cm), which are generally too small for sawlog production. The forests are arguably overstocked and would benefit (from a long-term commercial timber production perspective) from a reduction in the stocking, resulting in the removal of reasonable volumes of small-medium size class stems.

- **The high incidence of termite activity and piping in larger size class trees (generally 35+ cm diameter) –** many (or perhaps most) of the small-medium sized stems would contain hollow cores by the time they grew to larger sizes, rendering them less-suited or unsuited to sawlog production. It can be a more efficient outcome (from a commercial timber production perspective) to harvest and process small-medium sized stems before they are negatively impacted by piping that would substantially reduce their rate of commercial timber recovery.
- **Posts and bollards have multiple end-use applications in the East Arnhem region –** including for remote Indigenous community infrastructure (e.g., housing, shelters), IPA infrastructure (e.g., tourist facilities), and other landscaping applications (e.g., car parking, camping areas, segregation of restricted access zones). The high natural durability of the roundwood products, which means there is no need for chemical treatment, makes them particularly suited to use in environmentally and/or culturally sensitive locations.
- **The demonstrated interest in/demand for naturally durable post and bollard products** (evidenced through results of the Market Assessment, further outlined below) – indicating that there are local and regional markets that appear relatively easy and quick to establish.
- **The required processing equipment (spindleless debarking/rounding lathe) is relatively inexpensive and simple to operate and maintain** (i.e., it can be operated with basic skillsets and training attainable by the local workforce).

Further details and discussion of the timber product development results are provided in the '**Roundwood & Veneer Processing Investigations**' report (prepared by QDAF), the '**Opportunities for commercial roundwood production from Indigenous Homelands**' poster, and the '**Phase 4 Report – Indigenous community capacity building**' document completed in October 2023.

Market survey

Fourteen (14) survey responses were received from targeted potential purchasers of the Darwin stringybark bollards. Respondents were primarily located in East Arnhem, Darwin and elsewhere in the Northern Territory. One interstate response was also received. Key survey results and discussion points include:

- Price per bollard – Responses ranged from $30-$60/bollard to $80-$100/bollard (this latter range was most common). Many respondents were willing to pay a price premium based on the product being of an Indigenous provenance and one that would support/benefit a local Indigenous community. Higher prices (e.g., $120/bollard) were suggested for bollards that were longer and larger in diameter than the developed product.
- Product fit for purpose – The bollards were commonly considered to be superior to currently used products (including recycled plastic and steel), especially in terms of their aesthetic appeal and given their Indigenous provenance. Some respondents considered the bollards were not fit for purpose due to concerns about susceptibility to termite (*Mastotermes darwiniensis*) attack and degradation in tropical conditions.
- Comparison to bollards of other species – There was significant interest in and preference for the bollards as an alternative to CCA-treated pine posts and bollards, particularly for culturally significant and/or ecologically sensitive areas. The bollards were considered superior to treated pine bollards due to being non-toxic and in terms of their aesthetic appeal, strength, and durability, although concerns about termite resilience were again expressed.
- Potential purchasers and quantities – Nhulunbuy Corporation is a potential immediate and significant market for Darwin stringybark bollards. The Corporation is interested engaging in further discussions about purchases if/when production commences. The bollards have good potential application to Nhulunbuy town beautification works scheduled to commence in 2024, and to replace legacy CCA-treated timbers used for barriers around parks, roads, and gardens. Other key potential purchasers identified were the East Arnhem Regional Council, regional Indigenous Protected Area bodies and Traditional Owner Ranger groups, local schools, and the NT Parks & Wildlife Interpretation Department.

- Other products – There was strong interest in different sized (lengths and diameters) roundwood for use as signposts, gateposts, post and rail fencing, and other infrastructure (including heritage building/hut restorations). Some respondents (including IPA managers) were also interested in the 'shelter kit' product that the project has developed, highlighting that the kits are another local commercial forestry business opportunity.

A Darwin stringybark bollard 'factsheet' was developed to accompany the survey, providing an overview of the product's characteristics. The factsheet has use in promoting the product to a wider audience of potential purchasers. Due to the frequent concerns raised about the durability of the bollards, an additional 'Darwin stringybark durability factsheet' was developed to promote the product's natural termite resistance and other desirable wood qualities.

Solid, naturally durable, sapwood-free roundwood products have high suitability for the East Arnhem and broader Northern Territory market, and potentially interstate markets. The market assessment found an enthusiastic appetite for the Indigenous provenance Stringybark bollards and other similarly processed solid roundwood products, including a wealth of ideas on the use case for these products in East Arnhem, and some positive demand signals from interstate wholesalers. The bollards are considered a highly suitable alternative to expensive and chemically treated imported products.

A report was prepared to collate the collected market assessment data and inform future strategic marketing initiatives for East Arnhem timber products. Further details and discussion of the market assessment results are provided in the '**East Arnhem Forest Product Market Assessment Report**'. Further details of the Darwin stringybark bollards produced by the project and their natural durability are provided in the '**Timber bollards – Darwin stringybark**' factsheet (completed in October 2022) and the '**Darwin stringybark – Natural Termite Resistance**' factsheet (completed in May 2023).

Indigenous workforce development

Practical, on-the-job (paid) forestry training and skills building was an integral part of the project. Conducting the training on Country was critical to a two-way understanding of forestry operations in the East Arnhem context. The "Balanda" (non-Indigenous) research team was able to work with Traditional Owners to understand the cultural context and practical considerations for forestry work on Country. Traditional Owners shared cultural knowledge on an array of subjects including botany, fire ecology, kinship relationships, and traditional uses of plants including the Darwin stringybark tree (*Eucalyptus tetrodonta*), or "Gadayka", being of particular interest to the project team as it is the region's dominant commercial forestry species.

Over the course of the 3.5-year project, a total of 35 individuals (Traditional Owners) were trained and upskilled in a range of commercial forestry activities. A total of 1,647 hours of paid training was completed by Traditional Owners, injecting $47,763 into the East Arnhem Homelands.

Additional details of some of the different training activities and outcomes are provided below. Full details are provided in the '**Phase 4 Report – Indigenous community capacity building**' document.

Forest inventory

A key goal of the forest inventory was to build capacity of Traditional Owners to supply timber and non-timber forest products into the local market. Engaging local Traditional Owners in forest inventory training helped build on their traditional knowledge by introducing them to concepts of commercial forestry resource management.

The project's mobile phone app developed for conducting the forest inventory was field-tested in collaboration with Traditional Owners. Training the Traditional Owners in use of the app was successful in helping build their capacity to collect forest resource data. The project team and the Traditional Owners at Birany Birany, Dhalinbuy, and Baniyala worked together to modify the app's functionality and language to be more culturally appropriate and therefore easier to use.

A total of 28 participants across all three Homelands were involved in the forest inventory and received training in the following technical skills (in ascending order of complexity):

- Basic numeracy and literacy (utilising DBH tapes);
- Tree height estimation;
- Data input into the mobile phone app;
- Plant identification ("Balanda" [non-Indigenous] species and/or common names);
- Subjective assessment regarding potential timber products based on tree form;
- Identification of potential or actual arboreal habitat (for identifying 'habitat trees'); and
- Sustainable native forest silvicultural decision-making (e.g., harvesting or 'cut' versus tree retention or 'keep').

Sawmilling

Sawmilling training was conducted as part of the Birany Birany Demonstration Site and included the process of site selection for the Lucas mobile (portable) mill, and the milling of harvested logs into timber for specific value-added end-uses. At the Demonstration Site, the focus was on the milling of timber for the shelter constructions in the community and the three 'Shelter Kits' to be provided to Gumatj Corporation.

A total of 12 participants were involved in the sawmilling training and skills building. Sawmilling activities included (in order of the process):

- Lucas mobile sawmill set-up and levelling;
- Pre-start checklist for safe operation including appropriate PPE, and Operational Health & Safety;
- Sawmill start and stop procedure, assessing and sharpening blades, refuelling and other basic maintenance;
- Safe operation of the mill and milling procedures;
- Safe movement and loading of sawlogs into the mill;
- Measuring, marking, and cutting logs to specified board lengths/widths; and
- Grading and sorting of cut timber for specific end-uses.

Construction

Construction skills were taught during the building of the two shelters in Birany Birany (2021 and 2022) and the construction of the Forest Garden (2023). The constructions utilised the timbers harvested from the Demonstration Site and processed on-site using the Lucas sawmill, along with roundwood products generated through the QDAF-led processing trials.

A total of 14 participants were trained in basic carpentry practices including:

- Site assessment and considerations;
- Understanding the basics of building plans;
- Setting of string lines and squaring up for site preparation;
- Earthworks, concreting and setting footings;
- Measurements of timber boards for specific end-uses;
- Cutting timber boards with a circular saw to ensure straight cuts;
- Wood drilling for stirrup support bolt attachments;
- Chiselling notches for post and beam joining;

- Using a spirit-level to ensure posts, beams, joists, and bearers were plumb;
- Drilling batten screws to attach posts, beams, bearers, and joists;
- Angle grinding steel rods for bracing;
- Attaching roofing iron using roofing screws and an impact driver;
- Laying floorboards and fixing to joists with decking screws;
- Sanding and finishing with decking oil for timber protection; and
- Construction of timber fencing, raised garden beds, and support trellises, and setting bollards (Forest Garden).

Future training requirements

An initial aim of the Phase 4 workforce development activities was to integrate formal Conservation & Land Management (CALM) Certificate training into Phases 1 and 3. The project team realised early on that the opportunity to deliver training and skills building through a CALM Certificate qualification in East Arnhem would be limited (and likely not possible) due to challenges with Traditional Owners' language, literacy, numeracy and digital (LLND) capacity, and also the lack of suitable Registered Training Organisation (RTO) providers who could deliver a modified CALM Certificate training package that included specific forestry skillsets.

The training delivered by the project was introductory, and the project team recognises the need for more forestry workforce capacity building to support sustainable forest livelihoods development in East Arnhem. The capacity to deliver accredited forestry-focused activities or skillsets does not currently exist within the East Arnhem region. To help address this shortfall and other identified training challenges, project team members from the Northern Territory Government (Dallas Anson and Michael Brand), in collaboration with Charles Darwin University, Gumatj Corporation, Tiwi Plantations Corporation, Midway Ltd and the Forestry Industry Association of the Northern Territory, have recently (October 2023) finalised a Northern Territory forestry training program proposal. The proposal, titled '*Increasing First Nations participation in Northern Australia's forestry sector*', has been prepared for submission to the ForestWorks Ltd-led scoping study for the Commonwealth Government's Department of Agriculture, Fisheries and Forestry's $10M forestry workforce grant (see details here https://www.agriculture.gov.au/agriculture-land/forestry).

The '*Increasing First Nations participation in Northern Australia's forestry sector*' proposal recommends that forestry training in East Arnhem should:

- Match the local context and Traditional Owner cohort;
- Be delivered by a region-specific RTO;
- Build trainees' English LLND skills;
- Incorporate accredited skillsets, micro-credentialing, and/or flexible delivery of full certificates; and
- Establish clear pathways to forestry employment.

The *Increasing First Nations participation in Northern Australia's forestry sector*' document also proposes the creation of a Training and Development Manager within Gumatj Corporation to drive education, training, and skills development initiatives to develop a forestry workforce to support the proposed expansion of Gumatj's forestry enterprise. Further details of this proposed expansion are provided in the 'A potential East Arnhem 'hub and spoke' business model' section below.

Further details of the training and skills building requirements for an East Arnhem Indigenous forestry workforce are provided in the '**Phase 4 Report – Indigenous community capacity building**' document.

Indigenous business development

The forestry business development activities delivered on communicating the value proposition of sustainable native forestry business among East Arnhem Traditional Owners, collaborative business partners, and other regional stakeholders, and delivered on supporting the development of Gumatj's new Indigenous-led forestry business strategy and supporting commercial forestry business development at the remote Indigenous community/Homelands level.

In addition to the field-based training of Traditional Owners provided by the project, additional 'tools' to support, and progressive 'steps' towards, Indigenous commercial forestry business development were delivered. These included:

- A relatively simple method for assessing the commercial productivity of a forest, including developing the user-friendly mobile phone app for Traditional Owners to record and analyse forestry data.
- A 'Forest Management Plan (FMP)' template which can be used to develop an FMP as a comprehensive business planning exercise for any community considering commercial forestry.
- Manufacture of prototype timber products (Darwin stringybark bollards and a shelter kit), documenting of processing protocols for these products (including a Shelter Kit Building Manual), and preparation of promotional materials (2 x factsheets) for the bollard product.
- A preliminary market assessment of the bollard product, identifying strong interest in the product and a potential high demand for multiple applications. Strong interest in the shelter kit product was also identified.
- Demonstration of the potential for integrated timber and bark harvesting (confirming the high value of bark in local/regional markets) and full utilisation of harvested trees (using sawmill offcuts for high-value traditional artefacts), promoting a more sustainable approach to bark supply and culturally appropriate zero-waste forestry.
- A series of workshops in Birany Birany (2022 and 2023) to showcase the Demonstration Site, communicate the forestry business opportunities to Traditional Owners and other stakeholders, and link Traditional Owners with prospective product purchasers and other collaborative partners and investors.
- Ongoing planning to support Gumatj's new Indigenous-led forestry business strategy, including considerations for a commercially viable and environmentally sustainable East Arnhem community forestry 'hub and spoke' business model whereby Gumatj operates as the regional processing and marketing 'hub', and remote Indigenous communities operate as 'spokes' of forestry operations to support community infrastructure and/or sustainable supply of raw and/or processed timbers to the Gumatj hub.
- Recommendations for timber processing equipment to support the proposed 'hub and spoke' business model, focusing on the spindleless debarking/rounding lathe technology and processing protocols to produce solid roundwood products.
- Clearer understanding of the opportunities (and benefits of) and challenges for remote Indigenous community (commercial) forestry, including to attain forest management and ecosystem services certification, and to trade in ecosystem services in the rapidly developing global payments for ecosystem services (PES) market. Through the Birany Birany Workshops, Traditional Owners have been supported in forming business development relationships with representatives from forest management and ecosystem services certification bodies.

Based on the project's forest inventory results and other visual inspections of East Arnhem forests by the project team, and the timber product development and testing (led by QDAF), market survey (and general discussions with multiple potential timber products purchasers and other stakeholders) and other research for development work undertaken over the course of the project, **the project has demonstrated the potential for multiple timber and non-timber forest products that could underpin Indigenous-led commercial forestry businesses in East Arnhem. These products include roundwood, shelter kits, sawn timbers, traditional artefacts, bark, and ecosystem services**. The roundwood product opportunity is described in

the preceding section of this report. Further details of the other forest product and service opportunities are provided in the next sections.

Shelter Kits

A sawn timber 'Shelter Kit' concept was developed, designed, and tested as part of the project. Community shelters were identified as a priority need by the Birany Birany community, and the project team committed to constructing some shelters in the community to demonstrate the benefits for the community and to prove the successful use of locally produced sawn timber. Two separate shelters were constructed as part of the Birany Birany Demonstration Site. These included a single shelter, and a larger modular shelter made up of three 'kits'.

Following the successful shelter constructions in Birany Birany (and strong enthusiasm for and use of the shelters among community members), and interest in the product identified through the Market Assessment, the project team considered that the 'shelter kit' concept could be developed as a prototype commercial forest product. In Birany Birany, additional timber was cut timber for a further three Shelter Kits. These three kits, along with all the required hardware (e.g., corrugated iron, bolts, bracing, footings), were sent to Gumatj Corporation in Nhulunbuy for the shelters to be erected in local recreation areas to further demonstrate the local application of the product.

To support the potential of the Shelter Kit as a commercial forest product, the project team prepared a 'Shelter Kit Building Manual'. The Building Manual details the material requirements and construction steps for a single shelter. Features of the timber shelters include:

- **Engineered design –** specifications and standards are set out in the 'Shelter Kit Building Manual'.
- **Sturdy and long-lasting –** when built on concrete and steel footings raised above the ground. The local Darwin stringybark timber has high strength and durability characteristics, giving the shelters cyclone resilience.
- **Modular and flexible –** adaptable to community needs and the local forest resource. For example, several shelters can be joined together to make a larger structure, sawn timber can replace plywood for flooring, and roundwood poles can replace sawn boxed-heart upright posts.
- **Multiple-use infrastructure –** could help address housing shortages in remote Indigenous communities in East Arnhem, provide extra accommodation for family members or visitors (e.g., during ceremonies or other cultural events), serve as shady workplaces for community art and craft work, and function as crèches and refuges for senior elders, providing shelter from the elements while still allowing them to participate in community life. There is also potential for the shelters to be used as accommodation for self-drive or guided tourism operations. Their low maintenance, aesthetic appeal, and local provenance make them ideal for this application.

The project has demonstrated that the Shelter Kit concept allows for a relatively low-cost multiple-use shelter to be constructed in remote communities using local timber resources. The kits and required hardware and tools can be easily transported on a flatbed truck. With the addition of some skills and labour, and approximately $4,000 in hardware, including concrete, a structure can be constructed in a remote community, where it is otherwise prohibitively expensive to build. Beyond this local application, a business opportunity exists through the export of Shelter Kits within the NT and nationally. The sawn and docked timber could be exported as a 'timber only' product with the purchaser to provide the hardware, a hardware kit could be supplied supplementary, or the kits could be sold through a building contractor as an installed product.

For further information see the '**Timber Shelters & Shelter Kits**' poster, the '**Shelter Kit Building Manual**', and the '**Phase 4 Report – Indigenous community capacity building**' document.

Sawn timbers

Sawn timber is a very sound target wood product type for East Arnhem commercial forestry operations. Sawn timber production is more suited to the larger logs (>30 cm diameter) available from the East Arnhem forest resource. Sawmilling can be undertaken in a wide variety of scales including small, part-time operations with low-cost equipment (e.g., portable sawmills – like that used in the project's Birany Birany Demonstration Site) through to larger fixed operations (e.g., Gumatj sawmill at Nhulunbuy) that demand a sizable full-time workforce and more sophisticated equipment. A key advantage of sawmilling is that the product produced at the back of the sawmill can be immediately used in many applications including in building constructions (as demonstrated in Birany Birany with the Shelter Kits). Therefore, sawmilling of almost any scale could provide valuable support for local infrastructure projects.

Given that the available logs from East Arnhem forests that are of a size suited to sawmilling will often contain piping, this will likely prevent the product recovery rates traditionally achieved by the general Australian hardwood sawmilling sector. This will also contribute to slower production rates. However, given reasonable local demand is likely to exist for the sawn boards produced, the higher production costs are likely to be comparable or more favourable than the cost of importing sawn hardwood into East Arnhem from other areas of Australia.

While unseasoned sawn hardwood can be readily used in a wide range of applications, further opportunities exist to value-add by seasoning (or drying) the sawn boards and profiling them into milled products such as tongue and groove flooring, and decking. Darwin stringybark is well suited to flooring and decking type products, and while these could be used in local markets, significant opportunities exist to access national or international markets, depending on costs of production. To pursue milled product manufacture, investments in timber seasoning and profiling infrastructure are required which would make it challenging in more remote areas of East Arnhem (i.e., challenging as a part-time operation in Homeland communities, where there would also be substantial skills development/training required). It is however a very sound scenario for larger, more centralised operations, such as the Gumatj sawmill. The Gumatj sawmill already have most of the equipment and processes required to produce milled and value-added products and have produced these products in variable quantities for some years. While the opportunities for more remote operations to produce milled and value-added product (i.e., dried and profiled timbers) is relatively limited, opportunities could reasonably exist for these operations to supply Gumatj sawmill with unseasoned sawn board feedstock. Having multiple suppliers of sawn board feedstock could be very advantageous for Gumatj sawmill and assist with producing sufficient minimal volumes of product to satisfy market demands.

Traditional artefacts

The production of traditional cultural artefacts including didgeridoo (Yidaki), spears (Gara), spear throwers (Bulman or Galpu), clapsticks (Bilma), and other decorative craft can be an integrated component of sustainable small-scale Indigenous commercial forestry operations in East Arnhem. There is an existing well-established market for these products, through sales to the regional Buku-Larrnggay Mulka (Yirrkala) Art Centre and direct sales to tourists. These can be high-value products to support local Traditional Owner livelihoods. Their integration into the forestry harvesting and processing operations makes them a viable by-product to other commercial timber production, without any impact on sawn or roundwood timber recovery. As part of community-desired (i.e., culturally appropriate) zero-waste operations, sawmill residues (or offcuts) and small sections of sawn timber that would otherwise not be useful as sawn boards, can be manufactured into various high-value artefacts. This includes flitches, thin boards, and other offcuts, which the project has demonstrated can be painted and carved into artefacts and cultural items and sold into local markets. In addition to the income opportunities for Traditional Owners, production of the various artefacts helps preserve cultural knowledge and skills transfer to next generations. Importantly, a stockpile of sawn timber fall-down generated from a milling campaign can supply timber that is crafted and decorated over time, to provide a medium-long-term supply and income stream for Traditional Owners.

Bark

Bark 'canvases' are a valuable commodity in East Arnhem. The production of bark canvases can be another integrated component of sustainable small-scale Indigenous commercial forestry operations in East Arnhem. The project demonstrated this concept, with local Birany Birany women harvesting large bark pieces from selected sawlog trees, processing them through traditional methods, and selling the resultant bark canvases to the regional Buku-Larrnggay Mulka Art Centre, generating substantial income for community members.

Bark canvases are a unique and lucrative non-timber forest product, and their production is only possible due to the traditional skills and knowledge handed down from many generations of Yolŋu people. The traditional bark processing method originated from the use of bark in shelters and canoes. The bark is processed on-site using heat (fire), before the outer bark is removed and the pieces are weighted, flattened, and allowed to cure over several days. The final product bark canvases can be wholesaled to the Art Centre, or value-added by local artists painting traditional designs on the processed bark before sale. In terms of regional economics, once these large bark canvases are painted by prominent artists, they can inject thousands, or tens of thousands of dollars into the local community.

Bark canvases are a valuable traditional commodity that can be produced as part of integrated (zero-waste) forestry operations. Seasonal harvesting activities could supply the art market with reasonable amounts of large bark canvasses, and help prohibit the indiscriminate taking of smaller, lower-quality barks ('bark hunting') which results in living trees that would otherwise be useful as future sawlogs or roundwood being ringbarked and left as standing dead trees. The project sought to demonstrate and emphasise to the Traditional Owners the importance of the 'integrated' nature of bark and timber harvesting, promoting a more sustainable approach to bark supply.

Ecosystem services

Ecosystem services derived from sustainable forest management (including areas excluded from timber harvesting), including carbon sequestration, biodiversity enhancement and watershed protection, are tradeable non-timber forest products. There is a rapidly developing global Payment for Ecosystem Services (PES) market and an opportunity for East Arnhem commercial forestry to tap into this market as an integrated income stream (complementary to sustainable timber production) for Traditional Owners. The PES opportunity now also includes the concept of 'cultural ecosystem services' generated from Indigenous Cultural Landscapes as a tradeable commodity, with the Forest Stewardship Council (FSC) recently adding this to its list of certifiable ecosystem services. The project has therefore identified cultural ecosystem services as an emerging PES opportunity of high relevance to the East Arnhem context.

Further details of the PES opportunity for East Arnhem community forestry are provided in the '**Opportunities for trading ecosystem services from Indigenous Homelands**' poster and the '**Phase 4 Report – Indigenous community capacity building**' document.

A potential East Arnhem 'hub and spoke' business model

Gumatj Corporation is working to develop a new Indigenous-led forestry business model. Emphasis is on scaling-up of the organisation's current forestry operations to create more jobs and increase revenue for the Gumatj clan. Gumatj's forward planning for the new business strategy has included collaboration with this 'East Arnhem project'.

The new Gumatj forestry business strategy involves vertical integration from its existing milling operations (in place for over 15 years) across the value chain to include: 1) harvesting, 2) expanded milling operations, and 3) product manufacturing. The premise of the new Gumatj forestry business strategy is to maximise the potential social and financial value of harvested timbers, rather than continuous growth in harvest volumes. This is consistent with the findings and recommendations of this 'East Arnhem project'.

One aspect being considered by Gumatj as part of the new forestry business strategy is a broader regional sector strategy that centres on Gumatj's Nhulunbuy sawmill operating as a centralised 'hub' to facilitate forestry activities by other Yolŋu clans on their respective Homelands. This potential 'hub' (Gumatj sawmill) and 'spoke' (Indigenous communities/Homelands) arrangement is consistent with the goals of this 'East Arnhem project' and its proposed East Arnhem community forestry business model, which emphasises small-scale, selective harvest, local use, and niche product development forestry businesses operating at the remote community/Homelands level.

The project has documented considerations for future implementation of the East Arnhem Indigenous forestry 'hub and spoke' model. These are briefly outlined below, with further details provided in the '**Phase 4 Report – Indigenous community capacity building**' document.

Forest management planning The project has developed an FMP template for use by East Arnhem communities to plan for future forestry operations on their Homelands. The template includes Operational Harvest Plan considerations. Using the template to develop an FMP will be a comprehensive business planning exercise for any community considering commercial forestry. The template has been developed to ensure it is compliant with requirements for forest management certification as per the Forest Stewardship Council (FSC) and Responsible Wood (RW) guidelines. Attaining certification would require careful implementation of the FMP and passing an audit conducted by an independent third-part auditor.

Supply chain considerations One of the supply chain challenges in East Arnhem is security of supply. Without significant and reliable volume, a steady and secure supply chain is harder to maintain. The roundwood products, such as the bollard products tested as part of this project, could prove to be an antidote to this problem. There are large volumes of 20-30 cm diameter trees in the East Arnhem forests. Up until this point, this resource has not had an application due to it being unsuitable to processing into sawn timber. As part of upgrading the Gumatj timber processing facility at Gunyangara (the proposed 'hub'), one or more spindleless debarking lathes has been budgeted for, to process smaller logs into roundwood products. There is potential for substantial supply for this product, and it should be achievable to store enough raw log to ensure steady production over the wet season.

A semi-transportable spindleless lathe could also be considered, enabling value-adding of the predominant small-diameter logs in the Homeland communities. But many advantages exist in a fixed operation at the Gumatj 'hub' (sawmill). In this scenario, Homelands communities would supply raw logs (cut to size) to the Gumatj sawmill, with finished rounds returned to the Homelands for community applications and/or sold into regional and/or broader markets.

The sawn timber production opportunities could be pursued in both the Homelands and at the Gumatj hub. The project demonstrated the application of a portable sawmill (Lucas Sawmill, purchased through the project) operating in a remote community (i.e., in Birany Birany) to produce sawn timbers (green off-saw boards and boxed-heart posts) for community infrastructure (used in the shelter constructions). Additional portable sawmills are not recommended but the existing Lucas mill, managed by Gumatj, could be moved to harvesting sites (i.e., different Homelands communities) on an as needs basis and scheduled to accommodate seasonal restrictions (i.e., wet season impacts). This supply arrangement would enable broad participation by communities, and for timber products to be quickly available to service local demands thereby helping displace costly timber imports. The remote 'spoke' processing operations could also supply the Gumatj sawmill with unseasoned sawn board feedstock given that value-adding processing options (i.e., profiling and drying for flooring and decking timbers) would be challenging in the remote communities and are therefore better suited to occurring at the Gumatj 'hub' sawmill.

Assembly of the 'Shelter Kits' as a commercial product, utilising both roundwood and sawn timbers sourced from Homelands communities, would also ideally be conducted at the Gumatj 'hub' sawmill.

'Local first' supply principal Communities in Arnhem Land have a connection to timber that has grown and been harvested and milled on their land. The preference of communities who have taken part in this project is to use local wood, locally, before considering commercial export opportunities. In addition, the shortest and most efficient supply chain is to use local timber in the local community, negating the tyranny of distance and long supply chains, as well as avoiding the transport costs of imported materials. There is a significant demand for new housing in remote communities, with an estimated 54% of remote houses suffering from overcrowding (NT Government 2022). The cost of housing in Arnhem Land is also extreme, estimated at $550,000 for the house alone (NT Government 2019), and can go as high as $700,000 for a build in very remote regions. Much of this cost comes from importing and transporting materials. Using local timber supplied from community owned forests provides a direct supply chain for building materials as well as local employment, a low carbon footprint, and community pride in place of importing timber that is grown and processed interstate or even overseas.

The shelter kits that were milled and constructed at Birany Birany as part of this project provide a proof of concept for this local supply chain. While they are not complete housing solutions, the shelters provide additional infrastructure for overflow accommodation and day use spaces for the community, and all the timber used in construction was sourced, milled, dressed, and constructed using the local labour force.

Processing equipment To enable production of the recommended roundwood products (posts and bollards), a spindleless debarking lathe would be required. While a transportable arrangement may be able to be designed, a fixed site installation offers many advantages. Co-locating this equipment at the Gumatj 'hub' sawmill would be more convenient and would offer benefits including shared supporting infrastructure (e.g., secure facility, maintenance equipment, log delivery equipment, product dispatch equipment). This would also allow for the efficient allocation of incoming logs (e.g., smaller logs diverted to roundwood processing and larger logs diverted to the sawmill).

The fixed capital investment for the spindleless lathe equipment would be approximately A$100,000. The equipment produces a consistent commercial-grade product and can be tailored to produce roundwood of varying lengths (up to 3 m) and diameters (up to 30 cm or larger). This presents a good opportunity to manufacture a sustainably sourced Indigenous provenance roundwood product range well suited to various construction and landscaping applications. Operator training requirements are likely to be manageable and are probably comparable in complexity with sawmill operator training. A generalised roundwood processing protocol has been demonstrated by the project through the product development work conducted by partner QDAF. A more detailed costing and investment plan, and Gumatj-specific roundwood processing protocol, could be determined once site options are evaluated and supporting infrastructure availability and target markets for the roundwood were better understood.

The Gumatj sawmill is already well equipped with two sawmilling lines, a timber drying kiln, and two planers (or moulders). This core equipment suite enables the production of both unseasoned sawn timber and value-added milled products (i.e., dried and profiled). The addition of a re-sawing bench would likely add significant capability to the sawmill, especially in re-sizing boards to maximise grade quality. This addition would contribute to an increased product recovery and reduce waste. A sawn timber docking saw would also be advantageous to remove defects within boards and enable 'fixed length' sawn boards to be efficiently and safely produced.

Zero-waste forestry Consistent with Yolŋu ideology, community wishes and sustainability principles, the project was able to demonstrate a truly zero-waste, small-scale forestry operation in the community and Homelands contexts. All sawmill falldown and small dimension timber was used to make cultural artefacts. These wood pieces have limited commercial use in a mainstream application, but make excellent traditional crafts and hunting tools. The project demonstrated that barks can be harvested at high-quality and high-volume from felled sawlog trees. These barks would be a waste product in a western forestry operation but are a valuable commercial resource in the East Arnhem context. Flitches were used for a variety of applications in community including garden beds and outdoor furniture. Second grade timber was put aside

for repairs, non-structural construction and funeral shelters, and was used in construction of a community garden. Very low-grade timber offcuts were delivered to family homes and docked to be used as firewood, the primary fuel source for cooking in Homelands. The sawdust left over from the milling operation was composted and added to the soil in the community garden, along with ashes and charcoal from cooking fires.

Certification of sustainable forest management and provision of ecosystem services is recommended for the proposed East Arnhem Indigenous community forestry business model. The project team have been working with the Birany Birany community, the Forest Stewardship Council (FSC) and Responsible Wood (RW), and corporate investors to demonstrate the application and benefits of forest management + ecosystem services certification in the context of Indigenous commercial forestry. The collaboration is working towards implementing the 'Birany Birany PES Pilot Project' in 2024. This will be a world first project, aiming to support the Birany Birany community attain forest management + ecosystem services certification and then trade in the certified forest products and ecosystem services, providing a sustainable income stream that can support livelihoods of community members and the preservation of local cultural heritage and healthy Country. The project will demonstrate the application of the FSC's recently introduced Continuous Improvement (CI) Certification Procedure, which has been designed specifically for small Indigenous communities engaged in forestry. The CI process is designed to ease the burden (logistical, financial) for small and remote Indigenous communities to attain certification by implementing the Certification Standard through a five-year, step-by-step process.

An additional opportunity for future East Arnhem Indigenous community forestry businesses is 'Supply Nation' registration and certification. This is a scheme that certifies that a business is Indigenous owned. Supply Nation certification can assure purchasers of an Indigenous business's products that they are supporting a genuine Indigenous-owned and -operated business. It can also help the Indigenous business connect with purchasers and investors (including government procurement departments) that are motivated to make meaningful contributions to advancing Indigenous economic development. Further details can be found here https://supplynation.org.au/

Recommendations

Recommendations regarding future needs and further research for development relating to the work undertaken in this project are outlined below, categorised by the key project activities outlined in this report.

Sustainable Native Forestry Demonstration Site

It is recommended that the Birany Birany Demonstration Site be maintained as a 'sustainable native forestry' awareness raising and educational (training) tool. A detailed Forest Management Plan (FMP) should be prepared for the Demonstration Site, using the FMP template developed by this project. Ongoing monitoring of the growth response in the harvested areas is recommended. The monitoring method and data gathered will be important inclusions in the FMP.

Despite the diminished functionality of the Permanent Growth Plots established within the Demonstration Site due to unmanaged site disturbance (bark harvesting and fire), opportunity still exists to repurpose these plots to measure the impact of selective harvest and silvicultural management on local biodiversity and cultural values. The above-noted observational evidence (in July 2023) indicates a high diversity of native species recruitment within the plots, including many culturally important bushfood and medicinal species. It is recommended that baseline data be collected to document species richness, with repeated measures over time to better understand and quantify how the applied selective harvest/silvicultural management could drive improved biodiversity outcomes and therefore support opportunities for PES focused on the maintenance and enhancement of biodiversity and cultural values within the forest ecosystem.

Traditional Owner engagement

Further Traditional Owner engagement is needed to facilitate discussions around remote community interest and capacity to participate in commercial forestry, including operating as 'spokes' in the proposed regional 'hub and spoke' business model. Traditional Owner engagement (and culturally appropriate consultation) is also a prerequisite to undertaking inventory in the forests of any communities with interests and capacity to participate in commercial forestry.

Forest resource assessment

The forest inventory identified a high variability in forest quality and productivity (from a commercial forestry perspective) throughout East Arnhem, and a very patchy distribution of potentially commercial forest resources. The inventory covered only a small sample of the potential commercial resource, hence has only provided a glimpse of the productive potential. Further forest inventory is needed to gain a better understanding of the broader regional spread of commercial forest resource throughout East Arnhem. Through desktop/mapping analysis and anecdotal/observational evidence, the project has identified numerous areas that are considered to have some commercial potential and should therefore be prioritised for further forest inventory. These areas include the community forests of Ramingining, Gapuwiyak, Galiwin'ku, Gan Gan, Wandawuy, and Buymarr.

Workforce training and capacity building should continue to be an integral part of any future inventory work in the identified priority areas to ensure that Traditional Owners will be taught the skills to assess their own forests into the future. This includes a need for Traditional Owners to understand the potential of their forests to supply commercial timber and non-timber forest products, and to understand how to manage forest harvesting operations and value-adding processes for forestry products. This will enable community members to make informed decisions about if/how they want to engage in the proposed East Arnhem 'hub and spoke' forestry business model.

Timber product development

Focusing on the identified roundwood production opportunity (posts and bollards up to 3 m lengths), the processing, drying, and coating systems trialled by QDAF could all be easily applied in other timber processing settings. This confirms the high potential for solid roundwood production in the East Arnhem

Indigenous community forestry context using the spindleless debarking lathe technology. However, processing protocols are inherently site- and business-specific, dependent upon factors including the log supply, target end-product, and market requirements. It is therefore recommended that a Gumatj-specific roundwood processing protocol, alongside a more detailed commercial roundwood processing costing and investment plan (including skills analysis), be developed. A prerequisite to this is greater understanding of the available supporting infrastructure and target markets for the roundwood.

Market survey

The market assessment was a preliminary investigation of the commercial viability of the Darwin stringybark bollards – seeking to gain a greater understanding of potential purchasers' perceptions of and experiences with the bollard product. While this investigation uncovered strong interest in the product, and other insights into consumer expectations and concerns about the product, more market research is needed, particularly to focus on specific customer requirements in terms of demand for roundwood product sizes (lengths, diameters), quantities, continuity of supply, and the prices they are willing to pay. This information is essential to inform future production rates and processing protocols.

Further market assessment should also focus on the 'Shelter Kit' product, which the preliminary investigation has shown there is strong interest in among regional stakeholders. These potential purchasers should be surveyed to better understand the quantities, continuity of supply, and the prices they are willing to pay for the 'Shelter Kit'. Also, it is recommended to provide some Shelter Kits to some prospective purchasers for construction to gather customer feedback on the construction process, and the quality of the Shelter Kit Building Manual as a user-friendly construction guide.

Another opportunity identified by the project and currently being integrated into the Gumatj business model is leveraging a higher price point for bespoke, Indigenous provenance, sustainable sawn timber, including targeting of the architectural market. Further development of this market is a key next step, and this will require additional market survey work and supply chain analysis.

Opportunities and mechanisms for accessing the PES market also require further research. Beyond the carbon market, the 'Nature Repair' market is currently in development to enable biodiversity credits to be traded in a similar manner to carbon credits. Corporate, government or philanthropic sponsorship models could be a more suitable source of funding for PES for biodiversity credits, and also the cultural values derived from forest ecosystems. 'Cultural ecosystem services' are an emerging market opportunity for integration into Indigenous commercial forestry. This is due to the inherent presence (maintenance and enhancement) of cultural values in the type of small-scale, low-impact Indigenous community forestry that this project has worked to support (i.e., an approach that integrates traditional cultural values and knowledge with western science forest management/silviculture), and due to the increasing desire within corporate and government entities to attain social license in addition to supporting positive environmental and cultural outcomes as we transition to a carbon neutral future.

Indigenous workforce development

A functional training program is key to developing (attracting, training, and retaining) an effective Indigenous community forestry workforce in East Arnhem. Learnings from the current project demonstrate that this will only be achieved through industry taking ownership and driving a locally designed and delivered training and development program. The proposed Gumatj Indigenous-led Forestry Training and Development Manager will be an important key to a functional regional training program, alongside adequate and consistent funding to support the role into the long-term.

Project findings, reflected in recommendations in the '*Increasing First Nations participation in Northern Australia's forestry sector*' proposal, suggest that Aboriginal modalities of learning should form the core of training and workforce development – learning through storytelling/sharing, utilising symbols, imagery, and metaphor, connecting community and Country. More specifically, the training and skills building for an East Arnhem Indigenous forestry workforce should be done on Country (place-based) and in local language, be

contextualised within practical, hands-on (on-the-job/action-based) activities, be flexible, involve repetitive activities, and include legitimate employment pathways alongside support and mentoring by 'local champions' with good LLND skills.

Contextualised training emphasises targeting of specific skillsets, then building on these with subsequent skillsets over time. As the trainees' skills and competencies grow, English literacy and numeracy can be scaffolded to suit their LLND levels.

Flexible training emphasises culturally appropriate design and delivery (incorporating local traditional forest management knowledge) and developing skillset-based programs drawing on relevant units of competency from accredited courses and adapting these to the roles needed in the East Arnhem sustainable native forestry and forest livelihoods context.

With the Community Development Program (CDP) being recently replaced with the 'New Jobs Program Trial', and with project partner Arnhem Land Progress Association (ALPA) administering the new program in East Arnhem, ongoing collaboration with ALPA and other regional forestry and training stakeholders is recommended to facilitate participation of East Arnhem Indigenous forestry trainees in the 'New Jobs Program Trial'.

Indigenous business development

The project recommends implementation of the proposed East Arnhem community forestry 'hub and spoke' business model whereby Gumatj operates as the regional processing and marketing 'hub', and remote Indigenous communities/Homelands operate as 'spokes' of forestry operations to support community infrastructure and/or the sustainable supply of raw and/or processed timbers to the Gumatj hub.

Recommendations specific to operation of the Gumatj 'hub' include:

- Employment of professional forestry staff and the Forestry Training and Development Manager.
- Employment of Yolŋu 'local champions' to act as peer mentors for new Indigenous staff, and to engage with/conduct consultation with Homelands 'spokes' to support their efficient and sustainable local forestry operations.
- Ensure engagements/business arrangements with communities operating as 'spokes' follow community defined FPIC principles to determine interests, needs and desires.
- Develop a hub-specific roundwood processing protocol, alongside a more detailed commercial roundwood processing costing and investment plan (including skills analysis).
- Attain sustainability certification (FSC and RW) for timber products processed at the Gumatj 'hub' that will be traded in external/export markets.
- Further develop/promote the 'Gumatj brand' to help attain more value from timber that is exported. This should emphasise the sustainability certification coupled with the Indigenous provenance of the processed timbers, and utilise the Gumatj brand 'hot stamp' on the timber products.
- Collaborate with ALPA to facilitate prospective new forestry employees and/or forestry training opportunities in the 'New Jobs Program Trial'.

Recommendations specific to operation of remote Indigenous community/Homelands 'spokes' include:

- Communities should select individuals who can act as the 'local champion' to facilitate information, knowledge and skills transfer from the Gumatj hub forestry employees to the Homeland community members involved in forestry activities and forest-based livelihoods through timber and non-timber forest products trade, including PES.
- Develop comprehensive Forest Management Plans for the community forest, in accordance with the FMP template developed by this project. Developing these FMPs will ensure community members are deciding the who/what/where of forestry activities in their community forest, and ensure that traditional forest management practices, knowledge and values are integrated into the local forestry system.

- Develop a core local Traditional Owner workforce, being individuals who will consistently be involved in forestry activities over time, to ensure continuity of roles, activities, and continued learning and building on foundational skills over time.
- If supplying timber to the Gumatj 'hub', seek sustainable forest management certification (through FSC and/or RW), and consider ES certification as a tool to support participation in the global PES market (Note that the project team is working with the Birany Birany community to pilot the certification and PES trading opportunity – further details below).

Conclusions

The '*Indigenous Commercial Forestry Opportunities: East Arnhem, northern Australia*' research and development (R&D) project investigated the potential for Indigenous-led commercial forestry in the East Arnhem Land region of the Northern Territory. The project has achieved its core goal of providing preliminary R&D support to underpin the development of a commercially viable Indigenous-led community forestry industry in East Arnhem.

The project's activities and outputs are key steps towards development of an East Arnhem Indigenous community forestry industry. The project has highlighted the need for long consultation timeframes, and space for community decision-making. But once communities have decided on a direction, it is important to keep that momentum, and provide continuous support. Indigenous communities in East Arnhem have unfortunately had a long history of well-meaning organisations and individuals coming into Homelands, beginning projects and programs, and then losing momentum, support, and funding. This project has successfully raised regional stakeholders' awareness of and created expanded interest in sustainable native forestry, and its potential to support Indigenous livelihoods and regional development, and there is significant momentum generated by the project to further advance Indigenous community forestry development in East Arnhem. The project team is grasping the momentum and is continuing to work with the Birany Birany community, Gumatj Corporation, and other collaborative partners to develop a new follow-on project to further test the commercial viability of Indigenous community forestry in East Arnhem.

Working with Birany Birany as a pilot community, and Gumatj as a regional timber processing and marketing organisation, the 'next step' project will implement an integrated forest product and service business model involving the production and trade of certified sustainable sawn wood, roundwood, shelter kits, artefacts, bark, and ecosystem services. It will demonstrate the practicalities of a remote East Arnhem community operating as a viable forestry 'spoke' in the proposed East Arnhem Indigenous-led forestry 'hub and spoke' business model. Replacing imported construction timbers, and on-the-job training and skills building, will continue to be core elements of project implementation. The project will also continue the collaboration with Gumatj to support its operation as the regional 'hub', including in the development and marketing of new value-added Indigenous-provenance products.

The 'next step' project's mixed activities and income streams has the potential to create and sustain long-term forest livelihoods for all community members (elders, women, men), while also promoting culture, language, and integrational knowledge transfer. This new project is intended to be a model for Indigenous community native forestry capacity building and regional development that could be refined for application in other East Arnhem communities and other areas of northern Australia.

References

ALC (Anindilyakwa Land Council), 2018. Mill opens doors for timber industry, In: Ayakwa Newsletter (Feb-March 2018), p.7, ALC, Groote Eylandt, NT.

Annandale, M & Feary, S. 2009. Consulting with Aboriginal and Torres Strait Islander Communities – agroforestry in north Queensland, RIRDC Publication No. 08/168, Rural Industries Research & Development Corporation, Kingston, ACT.

Annandale, M & Taylor, D. 2007. Forest Futures: Indigenous timber and forestry enterprises on Cape York, In: Feary, S (Ed), Forestry for Indigenous Peoples: Learning from experiences with forestry industries, Papers from Technical Session 130, XXII IUFRO World Congress, August 2005, Brisbane, Australia, pp.49-59, ANU College of Science.

Anonymous, 2005. The National Indigenous Forestry Strategy, Australian Government, Canberra.

BDO Consulting, 2004. Opportunities and Barriers for Greater Indigenous Involvement in Australia's Forest Industry: A scoping report addressing Indigenous involvement in the forestry and associated sectors for the National Indigenous Forestry Strategy Steering Committee. BDO Consulting (SA) for the Australian Government Department of Agriculture, Fisheries & Forestry (DAFF) and the Aboriginal and Torres Strait Islander Commission (ATSIC), Canberra.

Davey, S & Dunn, G. 2014. Australian native forest commerciality, ABARES technical report 14.3, Canberra.

Donovan, J, Stoian, D, Macqueen, D & Grouwels, S. 2006. The business side of sustainable forest management: Small and medium forest enterprise development for poverty reduction, Natural Resource Perspectives, 104, Overseas Development Institute, London.

Feary, S. 2008. Social justice in the forest: Aboriginal engagement with Australia's forest industries, *Transforming Cultures eJournal*, 3(1):265-290.

Feary, S, Kanowski, P, Altman, J & Baker, R. 2010. Managing forest country: Aboriginal Australians and the forest sector, *Australian Forestry*, 73(2):126-134.

Halkett, J, Turner, J, Penfold, S & Dickinson, G. 2012. Future Directions for Forestry and a Forest Products Industry in Northern Australia, RIRDC Publication No. 12/081, Rural Industries Research & Development Corporation, Kingston, ACT.

Hogdon, B & Sandoval, C. 2015. Developing Indigenous community forestry enterprises: Where tradition meets the market. A case study of Moskibitana (Muskita, Honduras), Rainforest Alliance.

Hopewell, G. 2001. Characteristics, Utilisation and Potential Markets for Cape York Peninsula Timbers, QLD Department of Primary Industries Forestry, Brisbane.

Koenig, J, Altman, J, Griffiths, A. 2011a. Artists as Harvesters: Natural Resource Use by Indigenous Woodcarvers in Central Arnhem Land, Australia, *Human Ecology*, Vol.39, pp.407-419.

Loxton, E, Schirmer, J & Kanowski, P. 2012. Employment of Indigenous Australians in the forestry sector: A case study from northern Queensland, *Australian Forestry*, 75(2):73-81.

Marley, G. 2017. Tigercat takes on far north Queensland. Australian Forests & Timber News, December 2017, www.timberbiz.com.au

Matthews, K. undated. *Log Volume Tables*, Private Forestry Southern Queensland, Gympie, QLD.

Mausel, D, Waupochik, A, and Percore, M. 2017. Menominee Forestry: Past, present, future. *Journal of Forestry*, 115(5):366-369.

Meadows, J., Annandale, M., Bristow, M., Jacobson, R., Ota, L. & Read, S. 2020. Developing Indigenous commercial forestry in northern Australia, *Australian Forestry*, 83(2), 1-16.

MIG & NFISC (Montreal Process Implementation Group for Australia & National Forest Inventory Steering Committee), 2018. Australia's State of the Forests Report 2018, ABARES, Canberra.

Pearson, C & Helms, K. 2010. Releasing indigenous entrepreneurial capacity: A case-study of the Yolngu clan in a remote region of northern Australia, *Global Business and Economics Review*, 12(1/2):72-84.

Pearson, C & Helms, K. 2012. A chronicle of the East Arnhem Land timber industry, In: Solagberu Adisa, R (Ed), Rural Development – contemporary issues and practices, Chapter 19, pp.393-408, Intechopen, Australia.

Sessions, J, Gordon, J, Rigdon, P, Motanic, D, Corrao V. 2017. Indian Forests and Forestry: Can They Play a Larger Role in Sustainable Forest Management? *Journal of Forestry*, 111(5):364-365.

Smyth, J. 2007. Building Capacity, Economic Development Opportunities and Partnerships: Canada's First Nations Forestry Program. In: Feary, S (Ed), Forestry for Indigenous Peoples: Learning from experiences with forest industries, Papers from Technical Session 130, XXII IUFRO World Congress, August 2005, Brisbane, Australia, pp.23-31, ANU College of Science.

Stephens, M, Woods, T, Brandt, C, Bristow, M & Annandale, M. 2020. Northern forestry and forest products industry situation analysis, Cooperative Research Centre for Northern Australia (CRCNA), Townsville, QLD.

Stevenson M & Perraeult, P. 2008. Capacity for what? Capacity for whom? Aboriginal capacity and Canada's forest sector, Sustainable Forest Management Network, Edmonton, Alberta.

West, P.W., 2015. *Tree and forest measurement*. Springer.

Whitehead, P. 2012. Indigenous Livelihoods: Background paper. North Australian Indigenous Land and Sea Management Alliance (NAILSMA) Knowledge Series, Issue 011/2012, Charles Darwin University, Northern Territory.

Wyatt S, Fortier J, Natcher DC, Smith MA, and Hébert M (2013). Collaboration between aboriginal peoples and the Canadian forest sector: a typology of arrangements for establishing control and determining benefits of forestlands. *Journal of Environmental Management*, 115:21–31.

Acknowledgements

Forest and Wood Products Australia (FWPA) for providing the core funding for this project, and allowing this work to take place for the benefit of Traditional Owners in East Arnhem Land.

Traditional Owners and community members of Birany Birany Homelands, and other members of the Gumatj clan for their hard work and dedication to a future in forestry and patience in teaching the research team about Yolŋu culture, language, and world views.

University of the Sunshine Coast (UniSC) and Northern Territory Government (Department of Industry, Tourism & Trade – DITT, and the NT Department of the Chief Minister & Cabinet [CM&C) for providing critical cash and in-kind support for the project. Renee Stensholm at UniSC (Finance Research) for her project accounting and financial reporting expertise that was critical to all Milestone reporting and general project budgeting.

Mark Annandale (Annandale Consulting) for his many years laying the groundwork for the project, ongoing support as a UniSC Adjunct Associate Professor, and many hours of voluntary time put into this project.

Mila Bristow for her work during the foundational stages of the project, for rebuilding the Forestry Group at the NT Gov. DITT, and her continued support as the current Chair of the Project Steering Committee.

Gumatj Corporation for supporting the project, including via logistics and human resource management administration of wages for Traditional Owners working on the project.

Project Steering Committee members, and notably the 3 Chairpersons over the course of the project – Jordy Bowman (DEAL), Sean Ryan (PFSQ) and Mila Bristow (Hort Innovation, formerly Plant Health Australia and NT Government).

Gulkula Mining and Ken Kahler for his support with logistics and insights into working side by side with Yolŋu.

The Northern Land Council (NLC), particularly Craig Bonney, for supporting the project, including for providing access to the NT Stimulus Package Homeland Community Grant, which facilitated the purchase of the mobile Lucas sawmill, construction tools, and trailer, and funded external milling and construction expertise, materials and a portion of the wages paid to community members for their work on the project.

Australian Government, Department of Agriculture Fisheries and Forestry (DAFF) for provision of funding for a dedicated Indigenous Forestry Officer (Michael Brand).

Nadyezhda Pozzana (Nawa Nawa Consulting) for providing interpreting services, but also guidance, support, and insight into the complex social and cultural landscapes of East Arnhem Land.

Sean Ryan and David Menzies from Private Forestry Service Queensland (PFSQ) and PFSQ contractor Sandon Kulinskis for their work on forest inventory, forest productivity and management insights, and the sawmilling and construction work for the shelters in Birany Birany. Sean was instrumental in developing the solid roundwood product concept, and potential applications in community infrastructure including shelters.

The Arnhem Land Progress Aboriginal Corporation (ALPA) and Harrison Lill for supporting the project and Birany Birany TOs when the research team was not able to be on site, and Paul Wardle for his continued support of the Forest Garden at Birany Birany.

Thanks Alice Doyle and Alicia Boyle from Charles Darwin University (CDU) for discussions and knowledge sharing on Indigenous training and workforce development.

The National Indigenous Australians Agency (NIAA) for supporting the project.

Developing East Arnhem Limited (DEAL) for supporting the project and coordinating funding and in-kind contributions from the NT DITT and CM&C, Gumatj Corporation, NLC, ALPA, and NIAA.

Appendix – List of Project Outputs

Milestone Reports

- Milestone 1 Report (submitted December 2020).
- Milestone 2 Report (submitted August 2021).
- Milestone 3 Report (submitted February 2022).
- Milestone 4 Report (submitted September 2022).
- Milestone 5 Report (submitted December 2022).
- Milestone 6 Report (submitted August 2023).
- Milestone 7 Short Report (submitted November 2023).

Fieldwork Reports

- May 2021 Birany Birany Fieldwork Overview + Photos (submitted with Milestone 2 Report).
- September 2021 Fieldwork Report.

Project Partner & Consultants Reports

- 'Preliminary Forest Assessment Report' October 2020. Private Forestry Service QLD (PFSQ).
- 'Phase 2 (Traditional Owner engagement) MS3 Progress Report, 1 August 2021 – 28 February 2022'. Developing East Arnhem Limited (DEAL), February 2022.
- 'Darwin Stringybark Processing Study Progress Report' (PowerPoint presentation). QLD Department of Agriculture & Fisheries (QDAF). December 2021 (submitted with Milestone 3 Report).
- 'Indigenous Commercial Forestry Opportunities Project Report'. Private Forestry Service QLD (PFSQ). February 2022 (submitted with Milestone 3 Report).
- 'Roundwood & Veneer Processing Investigations Report'. QLD Department of Agriculture & Fisheries (QDAF). September 2022 (submitted with Milestone 4 Report).

Other Reports & Documents

- 'East Arnhem Indigenous Forestry: Community Forest Gardens'. December 2020 (submitted with Milestone 2 Report).
- 'East Arnhem Forest Inventory – Summary Report'. August 2023 (final version – submitted with Milestone 6 Report).
- 'East Arnhem Forest Product Market Assessment Report'. June 2023 (submitted with Milestone 6 Report).
- 'Workshop 1 Report 2022'. September 2022 (submitted with Milestone 6 Report).
- 'Workshop 2 Report 2023'. July 2023 (submitted with Milestone 6 Report).
- 'East Arnhem Indigenous Forestry: Community Forest Garden Report'. August 2023 (submitted with Milestone 6 Report).
- 'Phase 4 Report – Indigenous Community Capacity Building'. October 2023 (submitted to the Project Steering Committee in October 2023).
- 'Stringybark Shelter Kit Building Manual'. July 2023 (submitted with Milestone 6 Report).
- Forest Management Plan (FMP) template.
- East Arnhem Landowner Prospectus Overview. December 2019 (prepared by Developing East Arnhem Limited- DEAL).

Posters (an 'East Arnhem Community Forestry' poster series presented at the 2023 ANZIF Conference)

- Opportunities for Commercial Timber Production & Ecosystem Services from Indigenous Homelands
- Opportunities for Commercial Roundwood Production from Indigenous Homelands
- Timber Shelters & Shelter Kits
- Opportunities for Trading Ecosystem Services from Indigenous Homelands
- Indigenous Business & Workforce Development
- Community Forestry Workshops
- Birany Birany Community Forest Garden

Factsheets

- 'Timber Bollards – Darwin Stringybark'. October 2022 (submitted with Milestone 5 Report).
- 'Darwin Stringybark – Natural Termite Resistance'. May 2023 (submitted with Milestone 6 Report).

Mapping

- A compilation of East Arnhem regional mapping, highlighting (prepared by Developing East Arnhem Limited - DEAL).
- Birany Birany Harvest Area Map_May 2021 (submitted with Milestone 2 Report).
- Map of all forest inventory locations up to May 2021 (submitted with Milestone 2 Report).
- Normalised Difference Vegetation Index (NDVI) in East Arnhem (map included in the Forest Inventory Summary Report).

Media

- Initial FWPA WoodChat Podcast https://soundcloud.com/woodchat/episode-18-supporting-indigenous-communities-in-the-nt-to-create-a-sustainable-forestry-industry NOTE: this podcase will be updated, based on an interview/discussion between Sam Watson at Pesel & Carr with the project team on Tuesday 28th November 2023.
- Article entitled 'Indigenous Commercial Forestry Opportunities: East Arnhem, northern Australia' published in the March 2023 edition of Forestry Australia's quarterly magazine 'The Forester' (see pp.44-46).
- Articles summarising the project activities and achievements have been prepared (in collaboration with FWPA and their communications contractor Pesel & Carr) for publication in future editions (early 2024) of the FWPA ForWood Newsletter and the FWPA R&DWorks Newsletter. A summary of the project will also be included in the FWPA 2023 Annual Report.
- NT Government's Agriculture & Biosecurity eNewsletter article – 'Gumatj Traditional Owners at ANZIF conference: Forests, livelihoods and the future of native forestry'. November 2023.
- An organised Photo Gallery (photographic record of the project) collating and categorising project photos.

Presentations & Videos

- 'Forestry and forest products_Prospectus consultation materials' – a Powerpoint presentation prepared by Developing East Arnhem Limited (DEAL) to support the organisation's Phase 2 activities.
- A video of the project fieldwork at Birany Birany in May 2021 (approved for distribution by Birany Birany Traditional Owners in July 2021).
- A project video entitled 'Eight Steps to Community Forestry (in the East Arnhem context)'.
- A recording of the project's Panel Session presentation/discussion at the October 2023 ANZIF Conference. Panel.
- A presentation given by Dr Camila Ribeiro on Wednesday November 15 2023 about the project (including the above-noted project video) as part of the 2023 Gottstein Trust Wood Science Course (28 industry participants). The session was an 'Insight Session' entitled 'Native timber in Indigenous culture and commercial forestry opportunities'.

Student Research Projects – Undergraduate Research (UGR) Fellowship program participation and Special Research Project (SRP) enrolments.

Fien Van den Steen

Topic: Indigenous Peoples' Free, Prior & Informed Consent: A forest livelihoods case-study in East Arnhem Land, northern Australia.

Activities and Outputs: field-based support for the 2023 Birany Birany Workshops, attendance at the ANZIF Conference, preparation of an SRP Report and an SRP poster (summarising the report), and presentations of the work (at the Australasian Council of Undergraduate Research [ACUR] Conference [Melbourne] and at UniSC for the SRP final assessment item, both in November 2023).

Moana Krause

Topic: 'Indigenous women, bush medicines and cultural ecosystem services: A forest livelihoods case-study in East Arnhem Land, northern Australia.'

Activities and Outputs: field-based support for the 2023 Birany Birany Workshops, attendance at the ANZIF Conference, preparation of an SRP Report and an SRP poster (summarising the report), and presentations of the work (at the Australasian Council of Undergraduate Research [ACUR] Conference [Melbourne] and at UniSC for the SRP final assessment item, both in November 2023).