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Plantation Forestry and Economic Development in the Tiwi Islands

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Abstract

The maritime borders of Australia include over 8,000 islands. The second largest of these – Melville Island 5,786 km² together with the fourth largest – Bathurst Island 1,693 km² (and a number of tiny outlier islands) comprise the Tiwi Island group within the Northern Territory. Since 1960 seven investment groups have attempted to develop forestry plantations on Melville Island. The Tiwi landowners and the investors have sought sustainable outcomes from plantation forestry. Fifty years experience has provided a range of data and understanding that informs the Tiwi Plantations corporate model developed by landowners. Three substantial independent financial appraisals of the Tiwi islands forestry project have been undertaken by Poyry Forest Industry Pty Ltd in 2010, 2012 and 2014. All analyses were for a single rotation of *A. mangium*, and they provide useful guidance about the economic merit, from a private investment viewpoint, of establishing, growing and harvesting this species over a series of ten year cycles of forest plantation on Melville Island.

In this paper, a social benefit cost framework is used to appraise the potential contribution to Tiwi Islanders of plantation forestry on the Melville Island. Analysis of the priced benefits and costs of investment of a ten year cycle of *A.mangium* under most likely yields and prices indicates that the investment in *Acacia* plantation forestry has a 35 per cent probability of earning a 4 per cent p.a. or greater real return on capital. To double the odds to two chances in three of earning the annual required return on capital of 4 per cent real return on capital, an additional \$100m of unpriced benefits need to be generated over the forty years life of the plantation rotation. This would require unpriced annual benefits of \$5.1m or \$2550 per Tiwi Islander.

The Tiwi Islanders currently have 30,000 ha of mature *Acacia* to harvest. They have relatively small landowner debt to service, an established port and confirmed buyers. Re-investment of the cash returns from the current harvest into more plantation forestry to secure future community benefit is not a compelling attraction; re-investing these revenues to grow-out *Acacia* over further rotations is unlikely to benefit landowners as much as investing the proceeds in a sovereign wealth fund.

1. Introduction

Bathurst and Melville islands lie 80kms north of Darwin in Australia's Northern Territory. These two large islands with eight smaller outlier islands comprise the Tiwi Island Group containing 800,000 ha of land secured under Statutory Aboriginal Freehold Title enacted in 1978 (Australian Government Gazette 1978). Two thousand Tiwi people are registered as owners (Tiwi Land Council 2014). Following a series of corporate misadventures, the Tiwi Islanders have ended up being owners of the plantation forestry activity that exists on their land.

Plantation forestry was commenced on Melville Island in 1960 and has expanded to 30,000 hectares in 2015 representing 1.5 per cent of the total Australian plantation forestry estate and over 3 per cent of the hardwood species estate (Bureau of Rural Sciences 2014). In 2014-15 the Melville Island Plantations are ready for initial harvest. Since 2012 interested buyers of wood chip from the plantation have informed themselves of density values and other crop qualities. They have also explored infrastructure constraints and operational capacity leading up to harvest. On 10 February 2014 Mitsui

completed a memorandum of understanding (MOU) with Tiwi landowners confirming contractual intentions for five year's purchase and supply of *Acacia* chip valued by the parties in excess of \$220m (Tiwi Plantations Corporation 2014). Sales income will retire all Tiwi plantation debt by 2018, excluding any additional decisions and costs of replanting (Tiwi Plantations Corporation 2014).

The purpose of this paper is to investigate the medium to long term economic merit of *Acacia* plantation forestry^a as an economic activity on land owned by the Tiwi Islanders. This question is viewed from two perspectives. First the investment options from the perspective of private investment risk are assessed using private Benefit Cost Analysis methods. Second the Melville Island estate is viewed as an economic industrial asset, rather than a simple financial asset, using a Social Benefit Cost framework. The merit of re-investing the proceeds from the current plantation in a renewed cycle of *Acacia* is analysed, identifying the expected returns on such an investment and identifying the size of the unpriced social benefits that would be required to make the investment a sound use of the resources involved. This use of resources – renewed plantation forestry with associated social benefits - is then compared with the alternative of establishing a Sovereign Wealth Fund from harvest proceeds of the current plantation, coupled with leasing the land to private investors and obtaining associated social benefits from this source.

2. Background

2.1 Location

The Tiwi Islands Forestry Project is located wholly on Melville Island. It is strategically close to Asian markets (Figure 1).

2.2 Climate and Soils

The Tiwi islands have a tropical monsoon climate with distinct wet summer and dry winter seasons. The islands receive over 2,000 mm towards the northern tip of Bathurst and Melville Island decreasing to 1,200 mm in the east of Melville Island. In excess of 95 per cent of rainfall is received between October and May (Figure 2). On average during the dry season less than 30 mm is received per month. Mean maximum temperatures (30-34 degrees C.) remain relatively constant throughout the year, whilst mean minimum temperatures vary between the wet and dry seasons.

The soils on the Tiwi islands are predominantly derived from sandstones. Van Diemen Mesozoic (Australian Stratigraphic data base 2012) - very fine sandstone, is the main aquifer. It is recharged every year with the abundant wet season rainfall sustaining ample and reliable water throughout the Islands. The soils derived from these geological features are highly weathered and variable in depth. Soils derived from transported material are often deep: soils developed *in situ* are more variable. Texture ranges from sands to light clays, some with gravel. Nutrient status is variable but generally poor. Most soils are acid, high in aluminum and iron, and phosphorus fixation capacity often high. The soils are periodically saturated and root development is naturally limited by density (transported soils) or by rock *in situ* (Hadden 2004).

2.3 Estate and Species

Tiwi plantation forestry commenced in 1960 with 3.6ha of Cypress (*callitris intratropica*) planted (Sprengel 1985). Caribbean Pine (*Pinus caribaea* var. *hondurensis*) was planted in 1973 when the initial Cypress trees did not grow well (Sprengel 1985). By 1978, when the Tiwi landowners secured title to their land, 1600ha of Cypress and 1210ha of Caribbean Pine plantation (Sprengel 1985) had been planted. In July 1986 the plantation managers and developers at the time (the Northern Territory Government) withdrew from Melville forestry (Tiwi Land Council records 1986). At this time the Melville Island plantation estate was 4,000 ha, including 1,200 ha of research plantings, provenance and species trials and ineffective plantation defined as trees incapable of producing ten cubic metres of marketable product per year for a twenty five year rotation (Haines 1986). The initial business model was based on growing saw log timber. This model concluded that a plantation estate of 42,800ha would be required to establish a viable forestry plantation industry on Melville Island (Montefiore 1986).

^a The Melville Island Plantation Estate comprises *Acacia* (*A. mangium*) and is evaluated in this manuscript as the plantation of that species now ready for harvest. Tiwi Plantations Corporation has aged trials and blocks of a more promising species established since 2009. Performance of this species is encouraging.

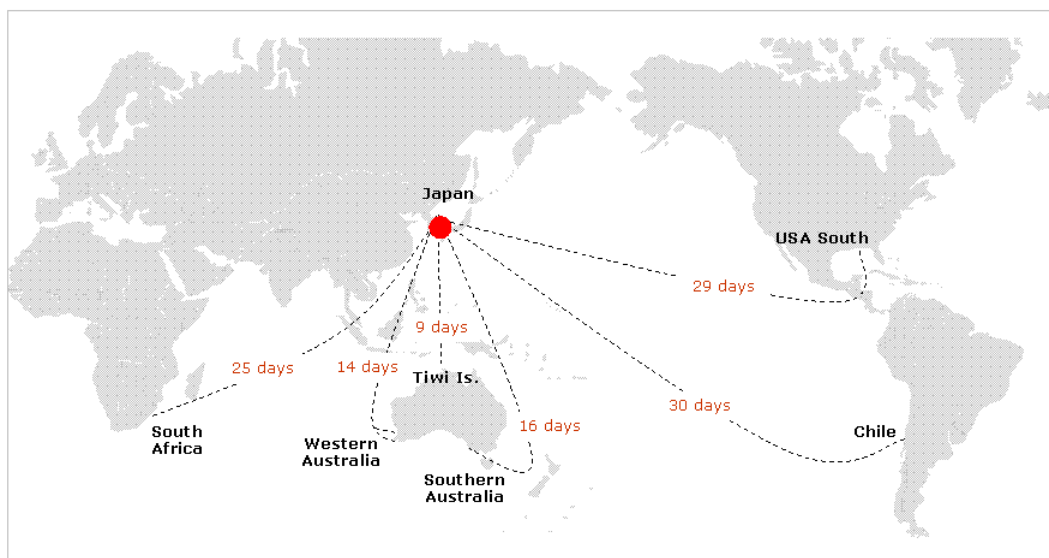


Figure 1. Location within the Region – Shipping days travel

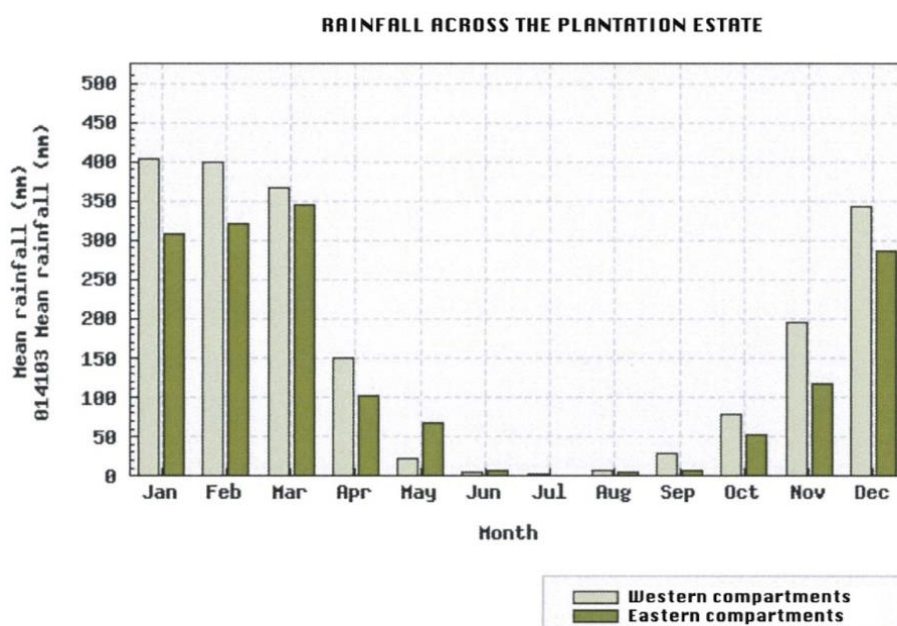


Figure 2. Typical mean annual rainfall recorded at Eastern and Western sites of the Estate (Bureau of Meteorology)

The strategy has changed through the past twenty years, with economic models now favouring wood chip products. A significant majority of the plantation estate comprises *Acacia mangium* (Table 1). *A. mangium* was first planted commercially on Melville Island in 1998 (small pilot plantings occurred in the 1980s and in 1997). The *A. mangium* plantation estate continued to expand to 5,200 ha after the 2004 planting season. At this time (early 2005) Cyclone Ingrid passed over the island damaging most

of the plantation estate over the age of eighteen months. The current *A. mangium* stands were planted between 2003 and 2008 – over 50 per cent of the entire estate in the two years` post cyclone 2005-6. In light of the impacts of Cyclone Ingrid, a strategy of diversifying the plantation estate spatially across the landscape within and among age classes has been employed (Figure 3).

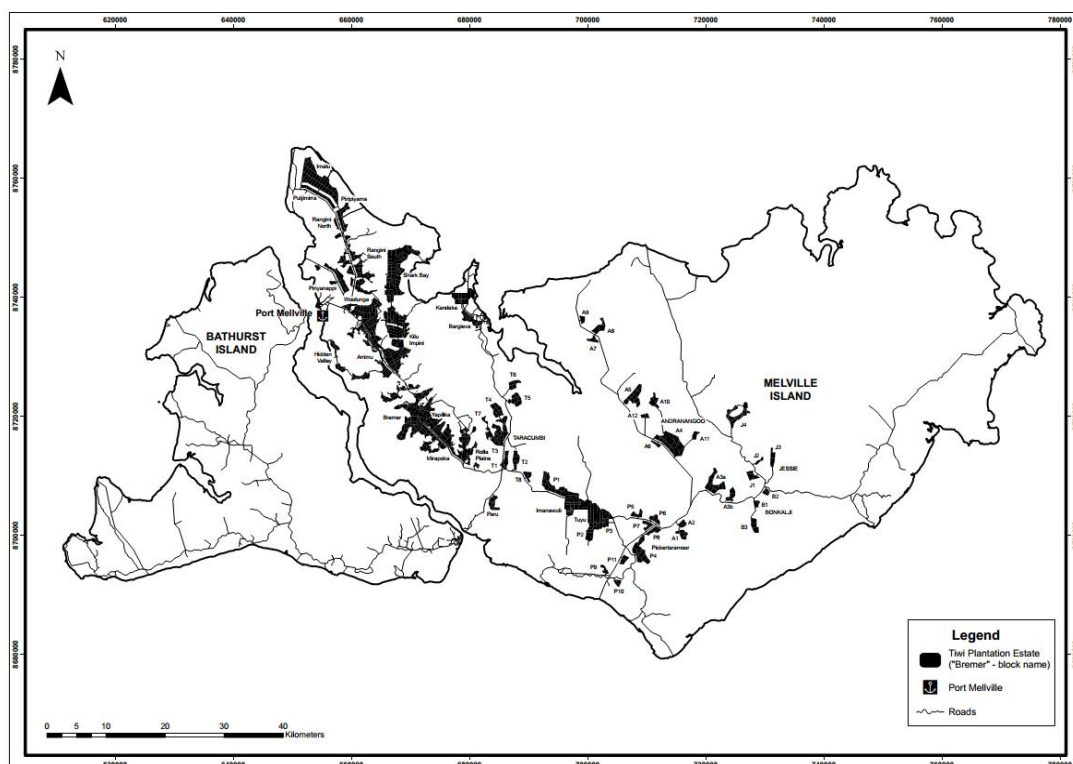


Figure 3. Plantation of scattered compartments – managing cyclone risks.

The older *C. intratropica* and *P. caribaea* plantation estates remained largely intact after Cyclone Ingrid although the less viable areas of these plantations have reduced in size as a result of harvesting and replanting to *A. mangium*.

Table 1. Species by planting year

Species	Establishment Year	Area Established (ha)
<i>Acacia crasscarpa</i>	2008	49
<i>Acacia mangium</i>	2003	1,115
	2004	4,090
	2005	7,839
	2006	9,563
	2007	2,732
	2008	3,037
<i>Callitris intratropica</i>	1961-1976	790
<i>Pinus caribaea</i>	1966-1989	998
Total		30,213

A. mangium is a fast growing, nitrogen fixing hardwood which is native to coastal northern Queensland, Papua New Guinea and Indonesia. Where found naturally, *A. mangium* can be a large dominant tree over 30m tall with a straight bole extending well up into the crown, with diameters over 50cm.

A. mangium has been widely planted in the tropics, particularly Indonesia, Malaysia, Vietnam and Laos for the production of wood fibre and for the manufacture of pulp and paper products. There are over two million hectares of *Acacia* grown in plantations in South-East Asian tropical regions (CSIRO 2011) with *A. mangium* most dominant. *A. mangium* is ideally suited for plantation pulpwood production in the tropics due to its fast growth (potential volume increments over 30 m³ ha⁻¹ yr⁻¹); tolerance for low nutrient and acid soils; relative resilience to weed competition (i.e., grasses and broadleaves); relative pest and disease resilience; and wood properties making it suitable for a range of uses (Turnbull, Crompton and Pinyopusarerk 1998). Pulp yields (Kraft sulphate analysis) range from 47-57 per cent with air dry density of 500 - 600 kg m⁻³. *A. mangium* is classed as a light hardwood with low to moderate strength properties. The timber is known to have a close grain, is relatively stable during sawing and drying, and is well suited to cabinetry and joinery.

2.4 Investment for Establishment

Since 1960 expectations of seven investment developers and managers who have established the Melville Island plantations relied upon varying estimates of yield. Table 2 shows the range of yield expectations on which these investors based their decisions. Tiwi land owners supported these investors (Tiwi Land Council 1978-2014) in actively attracting private investment of over \$250m for plantation forestry (Sylvatech and Great Southern 1998-2009). The landowner's historical approach of relying upon investors, developers and managers changed on 30 September 2009 when the entire plantation estate of 30,000 ha reverted to the Tiwi landowners when the last investor entity, Great Southern Limited, collapsed into receivership.

The analysis of the economics of sustainable *Acacia* plantation development discussed in the rest of this paper draws on past information, and upon evidence accumulated by Tiwi ownership and operation of the plantations by the Tiwi Plantations Corporation (TPC) since 2009 (see Appendix A). Tiwi Plantations Corporation is a wholly owned landowner beneficial trust^b employing skilled forestry management.

Table 2. Period of involvement and range of mean annual increment (M³ ha⁻¹ y⁻¹) expectations of the various forestry operators on Melville Island.

<i>Party</i>	Federal Government	NT Government	Melville Forest Products	Forbio Limited	Sylvatech Limited	Great Southern Limited	Tiwi Plantations Corporation
Years	1960-1978	1978-1986	1987- 1995	1995- 1996	1997- 2005	2005- 2009	2009-
MAI Range [M³ ha⁻¹ y⁻¹]	14-22	10-19	19-26	25-40+	27-43	15-22	10-15

Note: MAI – Mean Annual Increment.

^b Tiwi Plantations Corporation Trust, a charitable trust whose principal purpose is in respect to the 2000 landowners registered, and includes - the advancement of education; the relief of poverty, sickness, suffering, disease, distress, misfortune, disability and helplessness; the advancement of religion; and any other beneficial and charitable purpose.

3. Analysis



3.1 Investment for Acacia Plantation Forestry – economic activity and risk perspective

The analysis is based on a potential future in which 30,000 ha of land is planted to *Acacia* plantation forestry on Melville Island, in a series of repeated ten year rotations, with one fifth of the 30,000 ha of land (6,000 ha) planted in each of the first five years. The entire planning period is 40 years, in which each 6,000 ha block matures – (four times ten year rotations). This analysis does not include rehabilitation of the land at the end of the production cycle, nor costs of controlling post-harvest *A.mangium* wildings.

Investment in *Acacia* plantation forestry was analysed using risk analysis in which the range of possible yields and exchange rates and the associated prices are incorporated in a 30 year investment budget which is run 10,000 times with yields and prices randomly chosen in each run of the model. The distributions of yields and prices used are shown in Table 3. Mean yields expected are 115 total recoverable volume – (TRV m³/ha) with a triangular distribution demonstrating an expected possible variability of yield being plus or minus 33 per cent of the mean. This distribution was chosen on the basis of expert judgement combined with empirical evidence of yields achieved in plantation forestry on the Tiwi Islands in the past. The required rate of return on the capital invested is 4 per cent real return. The justification for this opportunity cost is that 4 per cent real return is a rate of return used by Australian State and Federal governments for the use of public funds, as well as being a reasonable approximation of public rates of time preference as indicated by the returns offered by the long term Commonwealth bond rate. If the resources involved in the potential investment in Tiwi plantation forestry had no other use, a case for zero discount rate could be made. However, in this case, the land does have alternative use in private hands, and the capital has an alternative use such as being placed in a sovereign wealth fund.

Prices received for timber produced by this project will be determined by international settings. The prices received for Tiwi Island timber is strongly affected by the \$A exchange rate. Thus in this analysis the distribution of timber prices was based on the range of prices derived from the range of exchange rates that have occurred for the \$A to the \$US since 1970. The timber price on offer for Tiwi plantation timber in recent times has been \$US144.50/t and \$A155 per bone dry metric tonne (BDMT) when the \$A/\$US exchange rate was \$0.93. The timber price on offer at this exchange rate reflects current demand and supply conditions. This price at this exchange rate was used to estimate a range of prices that could apply under the range of \$A to \$US that have applied over the past 40 years. This range is from \$US 1.30 to \$US 0.47. Implicit in using the resulting distribution of timber prices derived from the range of exchange rates is that the international conditions of supply and demand for the type of timber that would be produced from the potential investment is a sound guide to the conditions of timber supply and demand in 30 years' time when the timber from this project would be harvested.

Table 3. Distribution of prices and yields.

[AUD USD-1]	Cash Flow	D5		Risk Pert(0.47,0.7,1.3,RiskStatic(0.47))	0.47	0.76	1.30
[TRV m3 ha-1]	Cash Flow	E16		Risk Triang (0.67,1,1.33,RiskStatic(1))	0.67	1	1.33

The results are shown in Figure 4 and Tables 4 and 5. In Figure 4 is the distribution of possible NPVs at 4 per cent discount rate from investing in the 30,000 hectares of Tiwi plantation forestry. In Table 4 is the cumulative distribution function (CDF) of NPVs from this investment. These results indicate that a renewed investment in *Acacia* plantation forestry would have a 35 per cent probability of earning 4 per cent or more return on capital required. That is, there is a roughly 67 per cent chance that the investment will *not* earn 4 per cent return required by landowners. Global assessments of forestry returns on capital in 2011-12 were 3.6 per cent (Price Waterhouse Cooper 2012). To improve the odds of earning the required 4 per cent return on capital from 33 per cent to 67 per cent, an additional \$100m of unpriced benefits would be needed. This means *additional unpriced benefits* would be required to generate the required rate of return on capital. This would need to be an annuity of \$5.1m or \$2550 per Tiwi Islander, each year, for the 39 years of the plantation rotation.

Figure 4. Net Present Value comparisons with probability range.

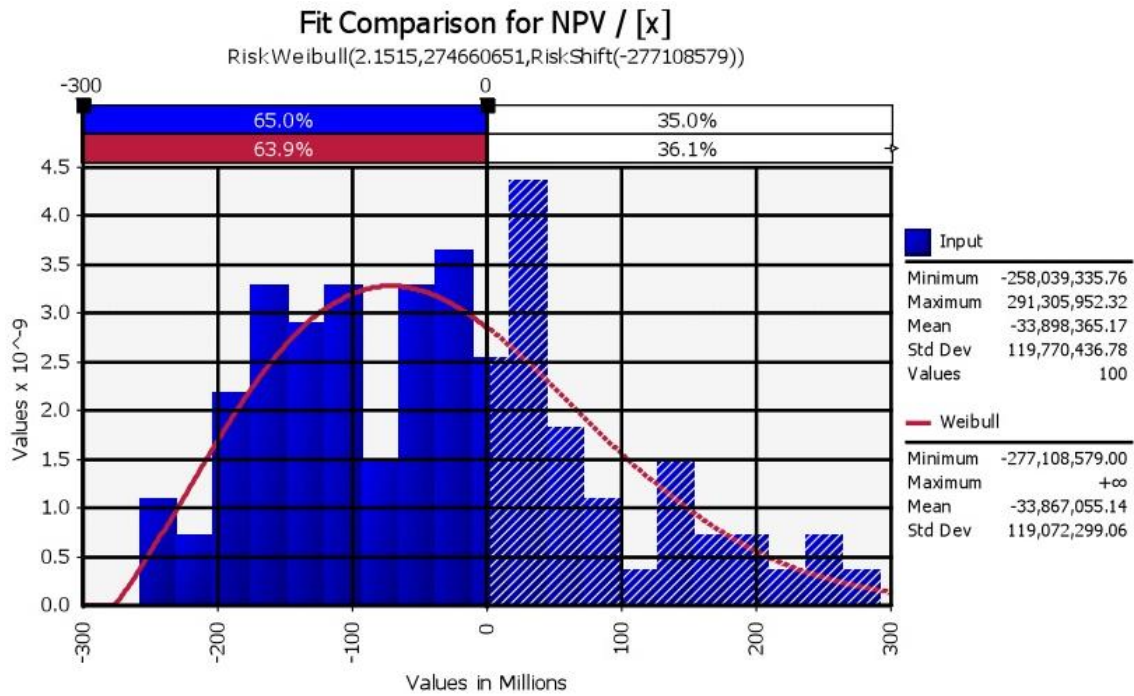


Table 4. Cumulative Distribution Function of Net Present Value

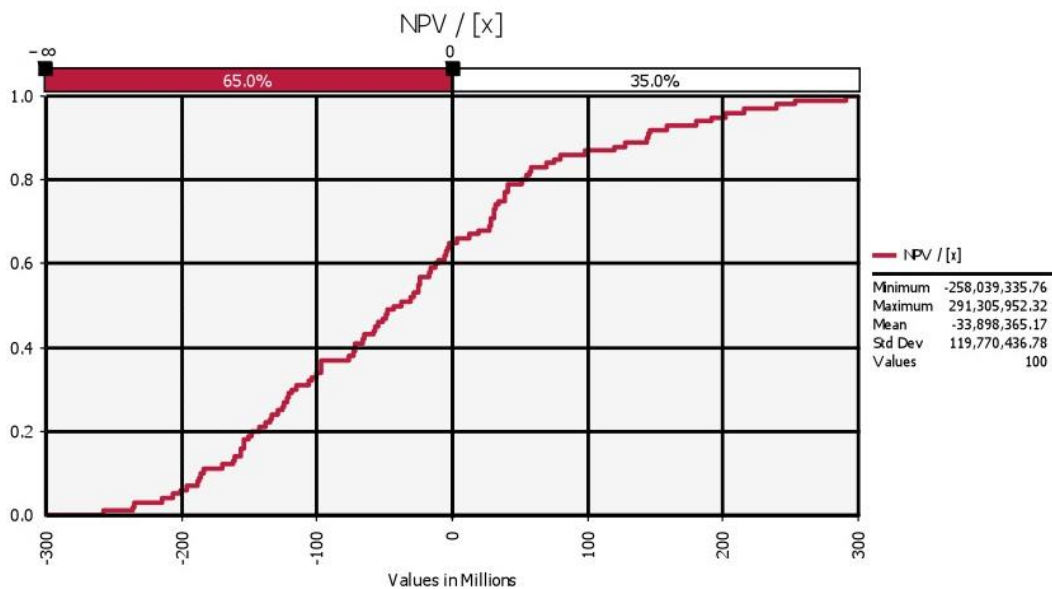
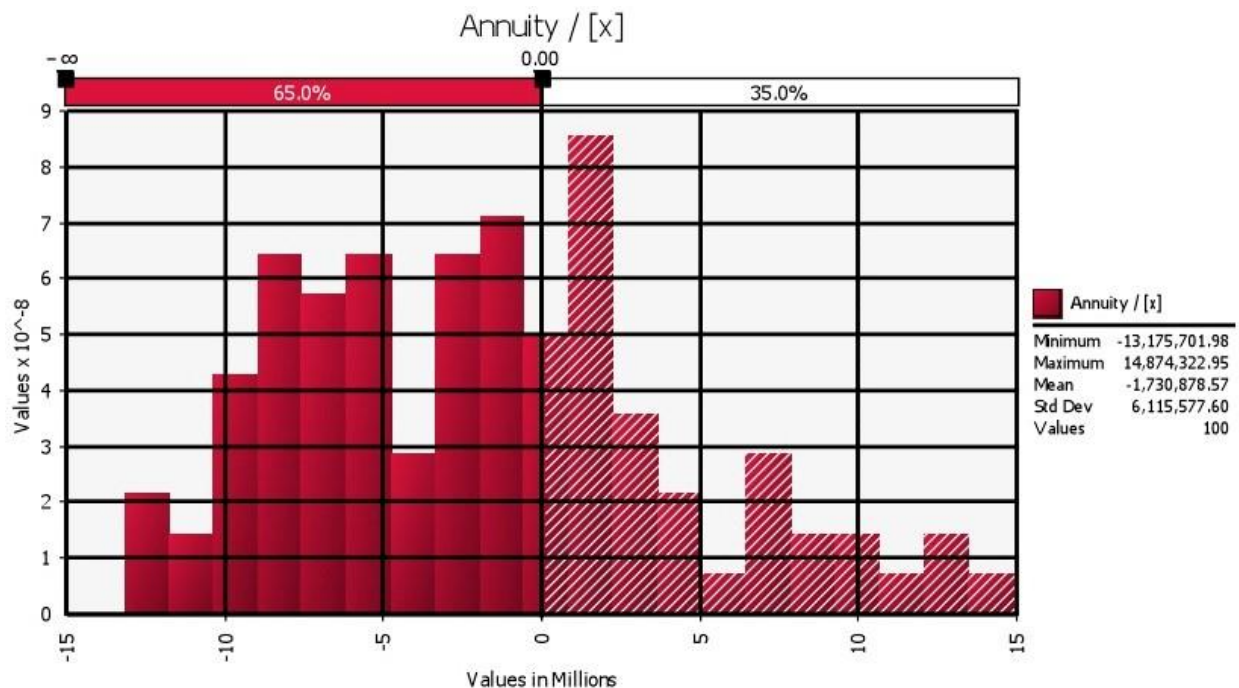


Table 5. Annuity Range



3.2 Unpriced social net benefit perspective

The investment analysis above invites the question - how attractive is *A.mangium* plantation forestry as an economic activity from the viewpoint of net social welfare? The social net benefits of investment of publicly-owned resources include all benefits and costs - including priced and unpriced, primary and secondary. The historical medium term government real bond rate, and the real opportunity cost of public capital, means 4 per cent real discount rate is a credible approximation of real social rates of time preference and opportunity costs.

A social benefit cost framework set out by Sinden and Thampapillai (1995) is used (Tables 6 and 7) to identify primary and secondary, and priced and unpriced benefits and costs of current plantation species forestry land use on Melville Island. A consolidation of available 2011 Tiwi census data was undertaken by the Tiwi Land Council (Atkin and Harari 2013). Demographics, education, employment and income detail provide the context for assessing benefits and contributions attributable to subsequent development impacts (see Appendix B).

The investment analysis raises the issue of unpriced benefits and costs. Elders and current landowners have consistently affirmed plantation forestry benefits (almost exclusively) as social benefits. This is the assessment undertaken by Tiwi landowners themselves. Their *gut feeling* about plantation forestry is recorded continuously from the 1960s (Tiwi Land Council 1978-2014). 'Forestry is to supply jobs for our kids upon our land,' and a 'Purpose for the kids at Tiwi College' (Kalippa 1978, 2014). Further, any major or sole industry in remote aboriginal Australia impacts extensively on general community well-being. Identifying the financial implications alone of investments of capital in projects in these regions also isolates the magnitude of the *other* outcomes necessary to assess such use of capital.

In managing the limitations of cost-benefit analysis a framework which uses a lexicon of primary (Table 6) and secondary benefits (Table 7) is adopted to illustrate the contributions an investment such as plantation forestry *in-situ* may make to the support of community sustainability.

The qualitative detail provided poses questions of economic and community sustainability for landowners. Are the unpriced primary and secondary benefits listed likely to amount to \$100m over the next 30 years and thereby justify the investment? That is, would the non-priced benefits amount to \$5.1m per year, or \$2550 for every Tiwi Islander?

Table 6. Primary Benefits - Priced and Unpriced Benefits of a future investment in 10 year cycles of plantation forestry growing *A.mangium* from 2015 to 2055

ABLE TO BE PRICED	Sale price of timber Timber chip price/demand range \$130-\$200/t
POTENTIAL BENEFITS UNABLE TO BE PRICED	Increasing skills – technical and managerial
	Development of negotiating skills
	Broadening work experience – stimulates conceptual tools
	Budgeting and financial concepts and skill development
	More and varied options – stronger personal resilience
	Healthier lives
	Child learns working ethics and routine structures from employed parents.
	Participation with a language of numbers opens considerations of probability and capacity to plan a future.
	Sophisticated plant and equipment → operator's status and pride → expansion of skills and status in industry impacts on parenting → increased enthusiasm for schooling
	Identified work purposes → develops personal ambitions → goals and outcomes → self-harm declines.

3.3 Another Option – A Sovereign Wealth Fund (SWF)

The potential investment analysis above assumes re-investment of the proceeds of harvesting the current plantation in a further cycle of the same plantation investment, and considers both pecuniary and social benefits and costs. What if another option existed? What if the proceeds of harvesting the current plantation could be invested in a sovereign wealth fund (SWF), and the land currently under plantation forest leased to another investor?

Meetings and consultations with landowners from 2010 confirm their rights and expectations that plantation harvest net benefits will provide (among other interests) education, infrastructure, cultural and recreation support for the entire Tiwi community (Tiwi Land Council records 1978-2014). The definition provided below^c (Clark, Dixon and Monk 2013) satisfies Tiwi landowner expectations and rights as owners and beneficiaries of the plantation estate. Most SWF are linked to resource-related non-renewable revenues (Australian Treasury 2012). In this case the source of the fund is harvesting the plantation forest that prior investors were unable to sustain or bring to harvest. Continuing rotations, calculating the costs of replanting, together with management and cropping risks, determine it is very unlikely that revenues to be received from harvest of the current plantations be a worthwhile application for this purpose.

Total plantation tonnage of 3.45m tonnes is anticipated, requiring harvest rates of 492,857 tonnes a year to achieve a seven year take-off. The anticipation of Tiwi Plantations Corporation is a six week requirement to stack 30,000 tonnes at the Port utilizing one harvesting unit comprising a skidder, feller-buncher and chipper plus associated chip trucks. Other limitations on harvest rates are a 35 week weather-related working year, and shipping availability. To achieve total harvest within seven years, additional harvesting units would be required. Table 8 shows the harvest units required to take-

^c "Sovereign Wealth Funds are government-owned and controlled (directly or indirectly) investment funds that have no outside beneficiaries or liabilities (beyond the government or citizenry in abstract) and invest their assets, either in the short or long term, according to the interests and objectives of the sovereign sponsor."

off the crop over seven years and the anticipated revenue to provide for the establishment of a SWF generating the required annual revenues.

Table 7. Secondary Benefits - Priced and Unpriced Benefits of a future investment in 10 year cycles of plantation forestry growing *A.mangium* from 2015 to 2055.

<p>EMPLOYMENT</p> <p><i>NOTE: ABS data Appendix B for impact on regional economy</i></p> <p>EMPLOYMENT</p> <p>INFLUENCE ON REGIONAL ECONOMY</p> <p>EXTENDED USE OF PORT</p>	ABLE TO BE PRICED	Direct Forestry jobs increase median weekly income – all sectors from \$253 to \$365 per week
	POTENTIAL BENEFITS UNABLE TO BE PRICED	Jobs relieve Government's burden (Federal and NT) expenditure (In 2011/12 = \$67,761 per head of NT indigenous peoples across 86 categories.22)
		Individual assumes risk burdens → insurance, superannuation and other money management industries stimulated
		Personal contributions to schooling, health and other needs. Fewer health issues → social costs change
		Structured work → planning skills develop → lifestyle changes. Self-identity strengthened. Personal risks and goals identified through personal planning
		Employed group influences behaviour → fewer drop outs; drug free safety through elite belonging. Self-worth outstrips money's worth
		Individual security → nuclear families multiply → extended family demands lessen
	ABLE TO BE PRICED	Multiplier influences - skills and mobility through other sectors to 2020 add 131 jobs → Maritime 35. Catering 10. Hospitality 12. Transport 6. Tourism 26. Mining 8. Contracting 15. Food production 16. Laundry services 3.
		Infrastructure expansion. Better roads → affordable private cars → increased intra island connections and trade → broadens social and economic experiences → elevated and expanded outcomes
		Expanded mobility and infrastructure expands secondary enterprise → Food-drink takeaway. Motel contracting Petrol Stations; R&M. Hardware outlets. Entertainment/Leisure. Payroll and financial. Security and bio-security.
	POTENTIAL BENEFITS UNABLE TO BE PRICED	Own asset identification stimulates savings → self-driven ambitions expand e.g. Do-it-yourself R&M; enterprise; home ownership.
		Access to capital improves through elevated standards of ethics and governance required of workers.
		Plantation Forestry unique among 57 investment interests over 35 years. Known foundations, depth of managerial excellence is normal
	ABLE TO BE PRICED	"Trade to support both Darwin and Melville Ports." → Rig tenders increase from 500 to 1000+ from 2015. See WP23. Rents and Levies agreed with landowners - \$1.5m per annum over 10 years increasing over 50 year term of lease.
	POTENTIAL BENEFITS UNABLE TO BE PRICED	Port use other than timber: Fuel and water (30m litre tanks installed 2014) Maersk empty containers. Defence force use. Cyclone moorings – rates \$20/70,000 per day. 1m tonnes known rutile. Fish processing Timor Sea Transshipment hub to PNG, Eastern Australia and central Pacific. International and domestic connections as exporters stimulates world view and Tiwi identity in it. Establishment of own post-traditional land-use economy asserts land management as the continuing cultural foundation. Growing mainstream independence from patronage and Government funded care.

Table 8. A Sovereign Wealth Fund 2015-2021 scenario established by focused harvesting

YEAR	HARVEST UNITS	TONNAGE HARVESTED	TONNAGE REMAINING TO HARVEST	INCOME RECEIVED AUD\$	CONTRIBUTION TO SWF
2015	One	150,000	3.3m	\$15.768m	\$4m
2016	Two	300,000	3.0m	\$31.536m	\$10m
2017	Three	450,000	2.55m	\$47.304m	\$25m
2018	Four	600,000	1.95m	\$63.072m	\$31m
2019	Five	750,000	1.2m	\$78.840m	\$38m
2020	Four	600,000	0.6m	\$63.072m	\$33m
2021	Four	600,000	-	\$63.072m	\$30m

The range and distribution of prices and yields at Table 3 are reinforced by other opinions and authority. At February 2015 the exchange rate was 0.77c when the Reserve Bank observed that, 'Most estimates suggest the Australian dollar remains above its fundamental value' (Reserve Bank of Australia 2015). A study by the Western Australian Government records that linear averages of the exchange rate over the long run are the most reliable predication (accurate in 55 of 86 years) (Department of Treasury and Finance 2009). The Australian dollar has averaged 0.77c from 1993 to 2015. It was 0.77c in February 2015 (Trading Economic 2015). An exchange rate of 0.75c has been used in Table 8. Price studies for hardwood chip record price increase of 9.9 per cent in twelve months to April 2014 to \$173.53 FOB per BDMT (ForestConnect 2014). A forecast of annual prices for hardwood chip for 2015-18 suggests an average high of \$US 190 and a low range of \$US 162.50 (Macquarie Forestry Services 2013). A conversion factor of 54 per cent from green to bone dry, has been used. With sample tested harvest volumes of 115 tonne per ha we predict a harvest volume of 1,863,000 BDMT off 30,000ha. Applying an exchange rate of 0.75c to an average \$US 146 BDMT sale price suggests a total income of \$A 363m over the entire plantation harvest.

Significant costs applied include total harvest and handling at \$48.51 per GMT totaling \$167m over the entire harvest. Total administration and management costs of \$4.7m a year reducing after three years to average \$2.7m per annum in years four to seven suggest, if the SWF option was acceptable, a total of \$25m over the harvest years. Other associated costs of rehabilitation would be assisted by successful forestry and/or agri-business investor lessees converting harvested blocks.

Analysis of expected net revenues from harvesting the current crop suggests that a range of \$150-\$200m could be available from harvesting the current crop of timber for a Sovereign Wealth Fund. This sum is derived from total income of \$363m, less costs of \$192m, providing a corpus of \$171m. Given the uncertainties, the potential is for a SWF of the order of \$150m-\$200m accumulating by 2022. At 4 per cent real return, this would earn \$6m-\$8m per year in current dollars.

A mid-range \$171m invested by a transparent and ethically managed SWF at 4 per cent real return would provide low risk annual net revenues of \$6.84m, exceeding both the expectations of owners and the most optimistic modelling of continuing plantation harvests.

Further, re-investment in plantation timber on the land on which the current plantation stands could be an option for new investors, or the growing of different crops.

Concluding Discussion

The option of re-investment in plantation forestry, even allowing for both financial and social benefits looks a poor bet against the SWF coupled with the possibility of leasing the land to other forest or agri-business investors, with this option providing some of the benefits such as employment that the current stand of forest provides to the community. Most of the extra unpriced net benefit required to make re-investment by Tiwi Islanders in another cycle of *Acacia* plantation forestry a sound investment from a social net benefit perspective depends on the value placed on skills and cultural changes that may manifest as a result of forestry activity. Given this, the comparison of the options available to landowners has to include consideration of how the proceeds from a SWF, and possible leasing of the forest plantation land might also provide social benefits that would otherwise be supplied by the re-investment option.

For re-investment in forestry plantations to be attractive, it requires \$5m per year in unpriced extra benefits for the investment to have a 67 per cent probability of earning the required rate of return. The SWF has a high probability of earning annual monetary net benefits \$6m-8m per year for use by Tiwi Islanders. Deposit of harvest revenues into a SWF secures what continuing with plantation forestry cannot – a reliable, low risk annual net income stream that would be considerably superior to the much more uncertain and notably lower monetary net benefits attainable from a 30,000 ha plantation. Additionally with a SWF there remains the possibility of leasing the current plantation land to other users for other uses, with the potential of generating some of the unpriced benefits currently attributed to plantation forestry. Tiwi plantation workers and supervisors have developed skills and interests readily transferable to other land use projects. A number have already transferred to maritime, township farms, vegetable cropping, and other maintenance and heavy equipment operations. Training and satisfactions acquired through forestry have been a continuing labour source for public and private Tiwi industry established in the past five decades.

Superior SWF returns should not compromise the primary and secondary unpriced benefits from plantations that can also be obtained from external forestry or agri-business lease-hold investment. Recent initiatives have already attracted interest from a variety of investors for these investment purposes. The secured buyers of first rotation chip have also stated an investment interest in continuing plantation forestry on Melville Island (Takahashi 2014). Options of crops on the land are beginning to attract investment interest with detailed land use capability studies completed over the past twelve months by the Northern Territory Government. These have informed a Tiwi Islands Investment Prospectus and attracted some international agri-business interest from a number of Asian and South-East Asian investors. Landowners and Tiwi Plantations Corporation have also successfully grown and trialed an alternate species, a eucalypt, over the past decade which appears to provide superior yields and buyer attractions. Whether this species of forest could overcome the shortfall of return on capital of the dimensions that we have outlined from growing *Acacia* is not known.

Return on capital has not motivated Tiwi landowners in the past (Hicks et al. 2012). Plantation forestry benefits have been sought as a source of other benefits (Tables 6 and 7) and secured through lease of land rather than their own direct management and use. Attracting lease-hold investment at investor's risk has been a strategy employed by landowners since the 1980s (Tiwi Land Council records 1978-2014), that has had some success. Ten private Tiwi trust corporations have been established and resourced by lease agreements and revenues over 30 years. These have contributed in excess of \$5m to establish and operate the Tiwi College; \$4m for clinics and medical services; \$4-5m for construction of community stores and other community facilities; \$2-3m for sporting activity and Tiwi Bombers football; \$3-4m for roads, airstrips and infrastructure; \$80,000 annually for cultural, funeral and ceremony; \$70,000 annually for books, newsletters, CD's and information pamphlets, in addition to subsidizing group projects, schooling and scholarships (Tiwi Corporate records 1986-2014).

Existing plantations were developed during more traditional times and the option of creating a SWF may be attractive in respect to those traditional developments and the general Tiwi expectations that they inspired. Land development projects, once unanimously initiated by all Tiwi elders of all land groups as a whole, are now fracturing to assert single group interests. These single group attractions will increase with cleared and more fertile land becoming available post-harvest for individual group decisions and for their own group investor relationships in future.

Establishing a SWF prevents alternative uses of these funds. Standards of governance, transparency and ethical management are genuine risks of SWFs and need to be managed with rigour. Rather than a risk that invites discussion in mature economies, a SWF is suggested as a potential means of transition from a traditional Tiwi economy. The SWF approach contains the elements of sustainability inherent in those traditions. It derives from a past land use that, while including external investment benefits, has been fundamental to the evolution of a unique Tiwi culture. Further, a SWF provides the promise of annual reliable income, without those post-traditional land use cropping risks that landowners have no developed capacity to manage within the foreseeable future. Their adopted strategy of lease-hold investment at investor's risk substantiates Tiwi recognition of these limitations and keeps open the possibility of supplying valuable social benefits.

This analysis clarifies that current harvest revenues from the *Acacia* plantation have a low probability of being repeatable and earning a competitive return to landowners from the same activity. Landholders will have to evaluate for themselves the full costs and benefits of the security of returns from an established SWF and associated land leasing to other users for other uses with associated

social benefits. The analysis completed and evidence summarized here serve to inform these considerations.

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Appendix A

Tiwi plantations corporation financial model

1.0 General					
CPI	[%]	2.70%			
WACC	[%]	5.0%			
Price	[USD BDMt ⁻¹]	132.50	NPV	Plantation	Rehab
Currency Exchange	[AUD USD ⁻¹]	0.93		(1,915)	(8,591)
Price	[AUD BDMt ⁻¹]	142.47			
Price Growth	[%]	3.00%	LEV	(1,596)	
Management Cost	[\$ Ha ⁻¹]	99.38			
Camp Cost	[\$ Ha ⁻¹]	57.98			
Total Administration Cost	[\$ Ha ⁻¹]	157.36			
Ezion Wharfage Fee	[% Gross Revenue]	5.0%			
Landholder Stumpage	[% Gross Revenue]	5.0%			
2.0 Growth Site Factors					
Harvest Age	[y]	10			
Productivity	[TRV m ³ ha ⁻¹]	115			
Haul Distance	[km]	45.41			
3.0 Conversion Factors					
Basic Density	[BDMt m ⁻³]	0.50			
Moisture Content	[w/w]	46%			
Dry Fibre Content	[w/w]	54%			
Conversion Factor	[GMt m ⁻³]	0.93			
Stockpile Losses	[w/w]	3.0%			
4.0 Supply Chain					
Harvest Cost	[\$ GMt ⁻¹]	33.27			
Haulage Cost	[\$ GMt ⁻¹]	10.35			
Roading Cost	[\$ GMt ⁻¹]	1.10			
Port Handling Costs	[\$ GMt ⁻¹]	3.79			

Note: The TPC Financial model is extensive. A general outline only is provided above for the purposes of both space and commercial in confidence. The model includes charts, cash flows nominal and real; stumpage, volumes; CAI v MAI charts; yield, harvest and haul analysis; OPEX profile; establishment; maintenance; basic density; rehabilitation; MAI; Estate model real and employment.

Appendix B

Census data

Demographics.

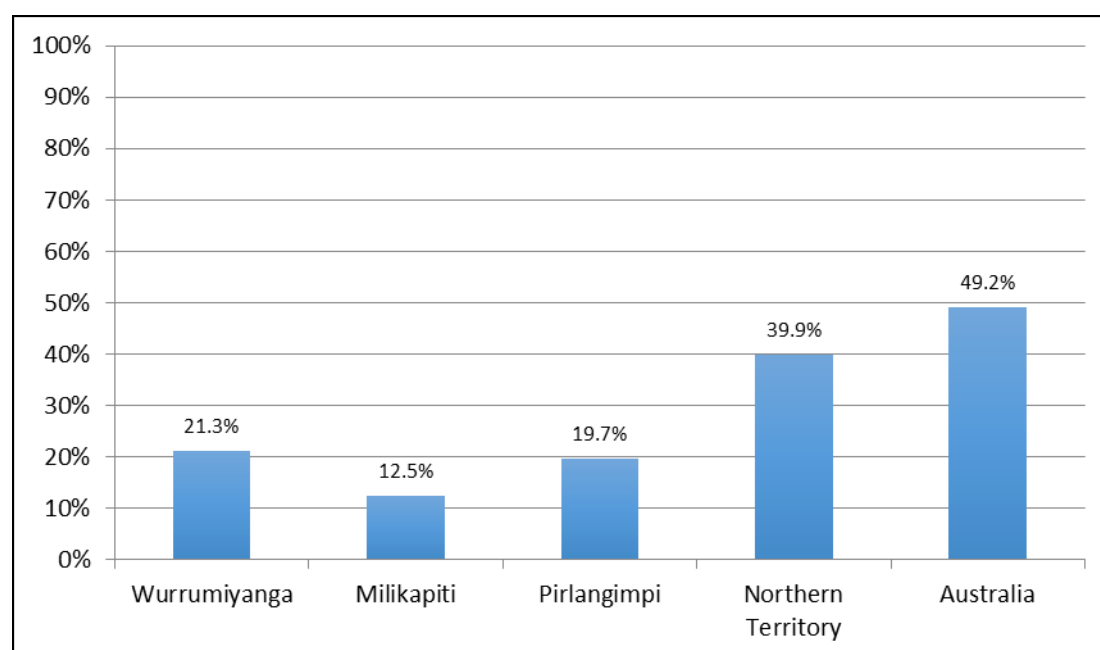
The total population of the three major communities on the Tiwi Islands is 2,347. Less than 100 live elsewhere on the Islands. 2000 are landowners. The number of persons under 15 years of age is 658 or 28.0% of the population.

The number of people between 15 and 64 years of age on the Tiwi Islands is 1,618 or 68.9% of the population.

The median age of Tiwi landowners is 28 contrasted with an Australian median age of 37. Tiwi life expectancy has risen from 47 years at 1990 to 67 years today. (Hoy, W. 2012. Kidney Disease in Aboriginal Australians. University of Queensland. Brisbane.)

Education.

Approximately 780 children on the Tiwi Islands are attending an educational institution. Rates of attendance at school differ among communities and range from 60% to over 80% at Tiwi College. Completion rates by staying at school through to year 12 are less than half the Australian average as reflected below.



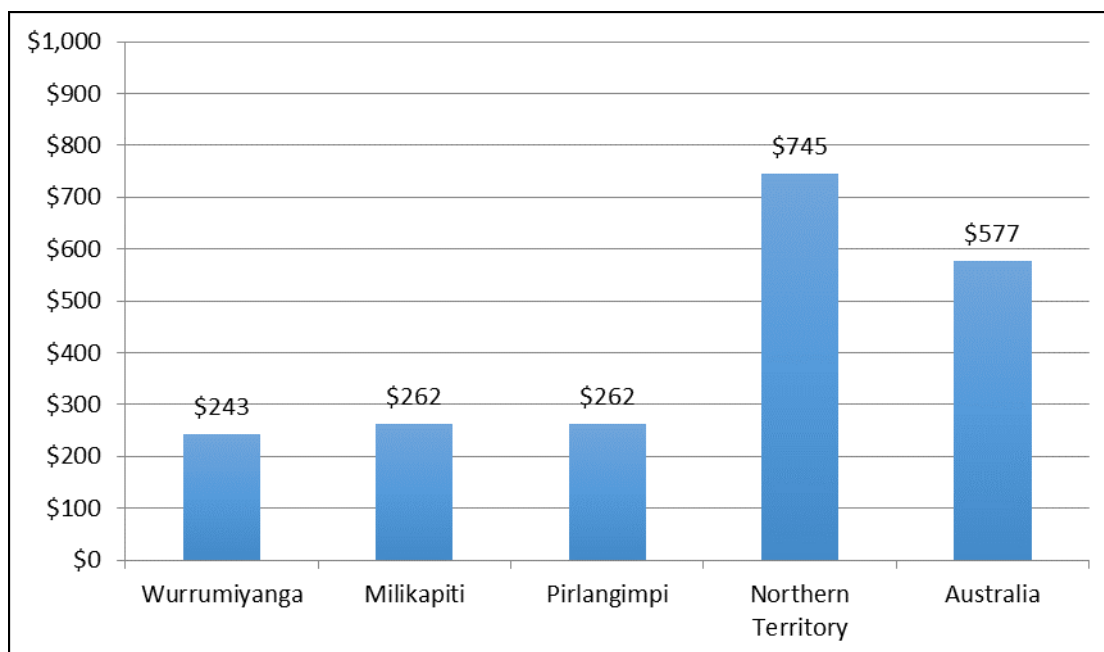
Students from the three Tiwi communities staying at School until Year 12, compared to those elsewhere.

Employment.

The labour force on the Tiwi Islands totals 589 and consists of persons over 15 years. The remaining 1029 over 15 year olds are not looking for work. 250 of them are at school. 71 are over 65. 708 unemployed Tiwi are considered employable. Of the workforce itself 80% are in the over 25 year cohort. Less than 6% of 15 to 24 year olds are at work.

Median Income.

Weekly personal income is illustrated below. Wurrumiyanga is the township on Bathurst Island. The other Townships named are on Melville Island – central to plantations and to the Tiwi private economy. Median weekly family income averages \$602. Landowners identify within approximately 100 traditionally structured families. Census expands family composition to 521 nuclear Tiwi families.

**Median personal incomes from the three Tiwi communities, compared to those elsewhere.**

The basic 2012 Centrelink payments for the Newstart allowance are \$244.85 per week for a single person with no children, plus \$64.90 per week for a single person with dependent children and \$221 per week for each partnered person. This amount varies depending on individual circumstances. (Department of Human Services 2012. Canberra. *Newstart Allowance*. <http://www.human-services.gov.au/customer/services/centrelink/newstart-allowance>, accessed 31 August 2012.)